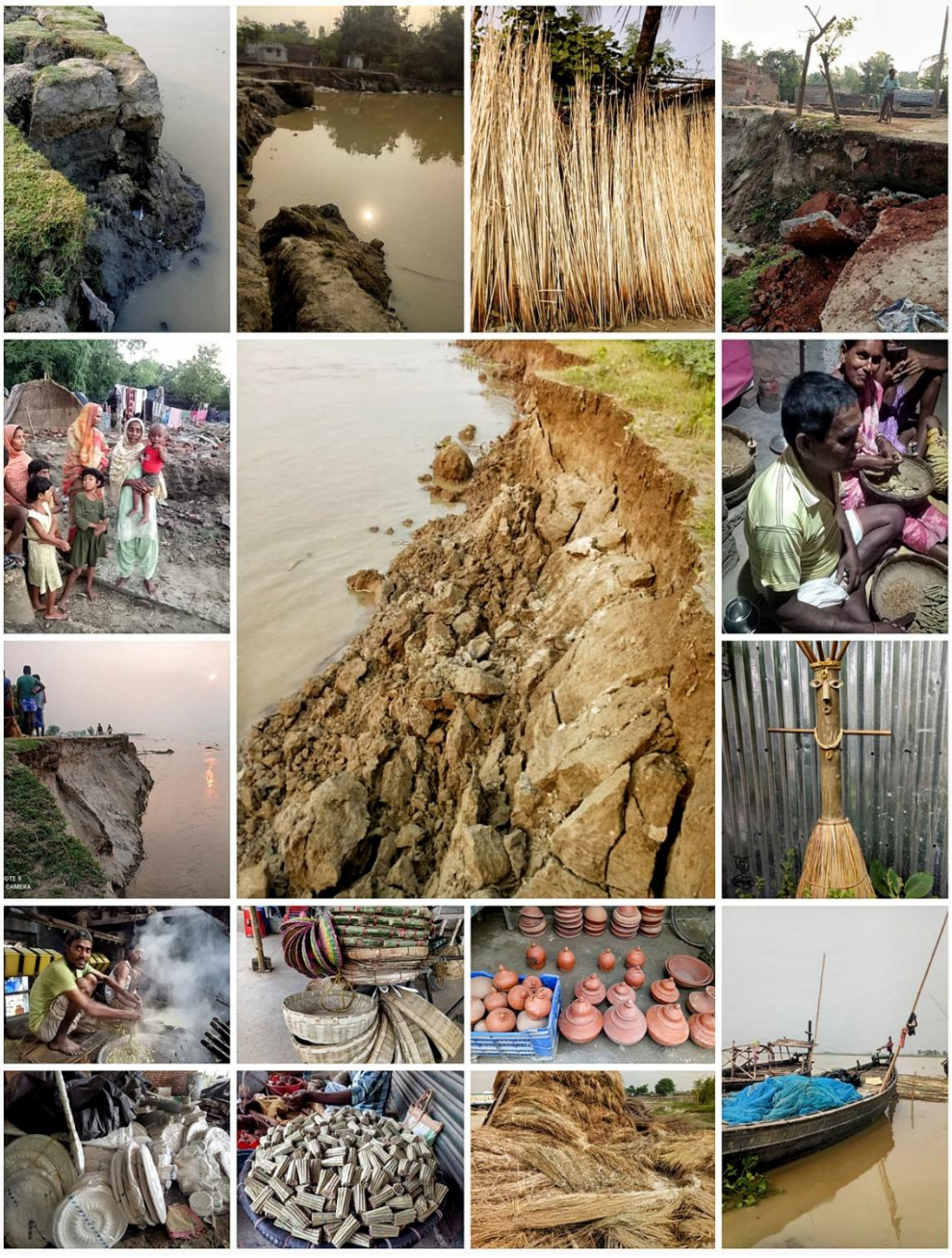
MALDA

DOCUMENTATION OF GANGA FROM GOMUKH TO GANGASAGAR



Report submitted by:

The Natural Heritage Division

GANGA CULTURAL DOCUMENTATION

MALDA DISTRICT

Natural Heritage Documentation

November, 2021

Sponsored by :

National Mission for Clean Ganga

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INTACH

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Chapter 1 : Introduction

1.1 Background of the Project

Namami Gange Programme', is an Integrated Conservation Mission, approved as 'Flagship Programme' by the Union Government in June 2014 with the twin objectives of effective abatement of pollution, conservation and rejuvenation of National River Ganga.

1.1A. Key achievements under Namami Gange programme

a. **Creating Sewerage Treatment Capacity:** 63 sewerage management projects under implementation in the States of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal.12 new sewerage management Projects Launched in these states. Work is under construction for creating Sewerage capacity of 1187.33 (MLD).Hybrid Annuity PPP Model based two projects has been initiated for Jagjeetpur, Haridwar and Ramanna, Varanasi.
b. **Creating River-Front Development:** 28 River-Front Development projects and 33 Entry level Projects for construction, modernization and renovation of 182 Ghats and 118 crematoria have been initiated.
c. **River Surface Cleaning:** River Surface cleaning for collection of floating solid waste from the surface of the Ghats and River and its disposal are afoot and pushed into service at 11 locations.
d. **Bio-Diversity Conservation:** Several Bio-Diversity conservation projects are namely: Biodiversity Conservation and Ganga Rejuvenation, Fish and Fishery Conservation in Ganga River, Ganges River Dolphin Conservation Education Programme has been initiated. 5 Bio-Diversity center's at Dehradun, Narora, Allahabad, Varanasi and Barrackpore has been developed for restoration of identified priority species.
e. **Afforestation:** Forestry interventions for Ganga through Wildlife Institute of India; Central Inland Fisheries Research Institute and Centre for Environment Education has been initiated. Forestry interventions for Ganga have been executed as per the Detailed Project Report prepared by Forest Research Institute, Dehradun for a period of 5 years (2016-2021) at project cost of Rs.2300 Crores. Work has been commenced in 7 districts of Uttarakhand for medicinal plants.
f. **Public Awareness:** A series of activities such as events, workshops, seminars and conferences and numerous IEC activities were organized to make a strong pitch for public outreach and community participation in the programme. Various awareness activities through rallies, campaigns, exhibitions, *shram daan*, cleanliness drives, competitions, plantation drives and development and distribution of resource materials were organized and for wider publicity the mass mediums such as TV/Radio, print media advertisements, advertorials, featured articles and advertorials were published. Gange Theme song was released widely and played on digital media to enhance the visibility of the programme. NMCG ensured presence at Social Media platforms like Facebook, Twitter, YouTube etc.
g. **Industrial Effluent Monitoring:** The number of Grossly Polluting Industries (GPIs) in April, 2019 is 1072. Regulation and enforcement through regular and surprise inspections of

GPIs is carried out for compliance verification against stipulated environmental norms. The GPIs are also inspected on annual basis for compliance verification of the pollution norms and process modification, wherever required through third party technical institutes. First round of inspection of GPIs by the third-party technical institutes has been carried out in 2017. Second round of inspection of GPIs has been completed in 2018. Out of 961 GPIs inspected in 2018, 636 are complying, 110 are non-complying and 215 are self-closed. Action has been taken against 110 non-complying GPIs and is issued closure directions under Section 5 of the E(P)Act. Online Continuous Effluent Monitoring Stations (OCEMS) connectivity established to CPCB server in 885 out of 1072 GPIs.

h. **Ganga Gram:** Ministry of Drinking Water and Sanitation (MoDWS) identified 1674 Gram Panchayats situated on the bank of River Ganga in 5 State (Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, West Bengal). Rs. 578 Crores has been released to Ministry of Drinking Water and Sanitation (MoDWS) for construction of toilets in 1674 Gram Panchayats of 5 Ganga Basin States. Out of the targeted 15, 27,105 units, MoDWS has completed construction of 8, 53,397 toilets. Consortium of 7 IITs has been engaged in the preparation of Ganga River basin Plan and 65 villages have been adopted by 13 IITs to develop as model villages. **UNDP** has been engaged as the executing agency for rural sanitation programme and to develop Jharkhand as a model State at an estimated cost of Rs. 127 Crore.

National Mission for Clean Ganga (NMCG) endeavors to deploy best available knowledge and resources across the world for Ganga rejuvenation. Clean Ganga has been a perennial attraction for many international countries that have expertise in river rejuvenation. Countries such as Australia, United Kingdom, Germany, Finland, Israel etc. have shown interest in collaborating with India for Ganga rejuvenation. Memorandums of Understanding (MoUs) were signed with various Central Ministries viz.- Ministry of Human Resource Development, Ministry of Rural Development, Ministry of Railways, Ministry of Shipping, Ministry of Tourism, Ministry of Ayush, Ministry of Petroleum, Ministry of Youth Affairs and Sports, Ministry of Drinking Water & Sanitation and Ministry of Agriculture for synergizing the Government schemes.

1.1B. Why we need "Namami Gange" programmes

a. River Ganga has significant economic, environmental and cultural value in India.
b. Rising in the Himalayas and flowing to the Bay of Bengal, the river traverses a course of more than 2,500 km through the plains of north and eastern India.
c. The Ganga basin - which also extends into parts of Nepal, China and Bangladesh - accounts for 26 per cent of India's landmass.
d. The Ganga also serves as one of India's holiest rivers whose cultural and spiritual significance transcends the boundaries of the basin.

1.1C. Aim & Objective of NMCG

The aims and objectives of NMCG are to accomplish the mandate of National Ganga River Basin Authority (NGRBA) are:

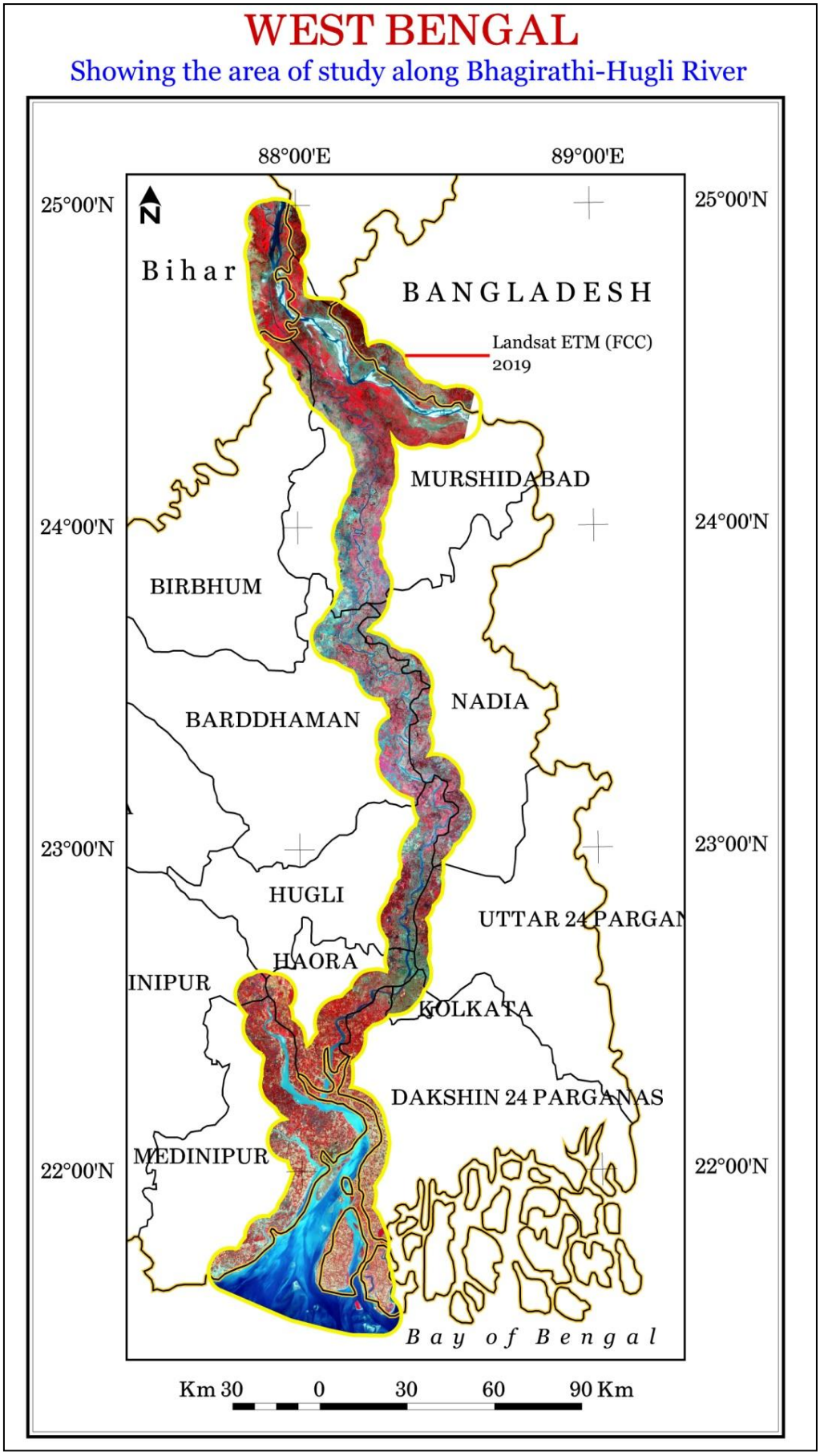
1. To ensure effective abatement of pollution and rejuvenation of the river Ganga by adopting a river basin approach to promote inter-sectoral co-ordination for comprehensive planning and management and
2. To maintain minimum ecological flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development.

1.2. Ganga Cultural Documentation

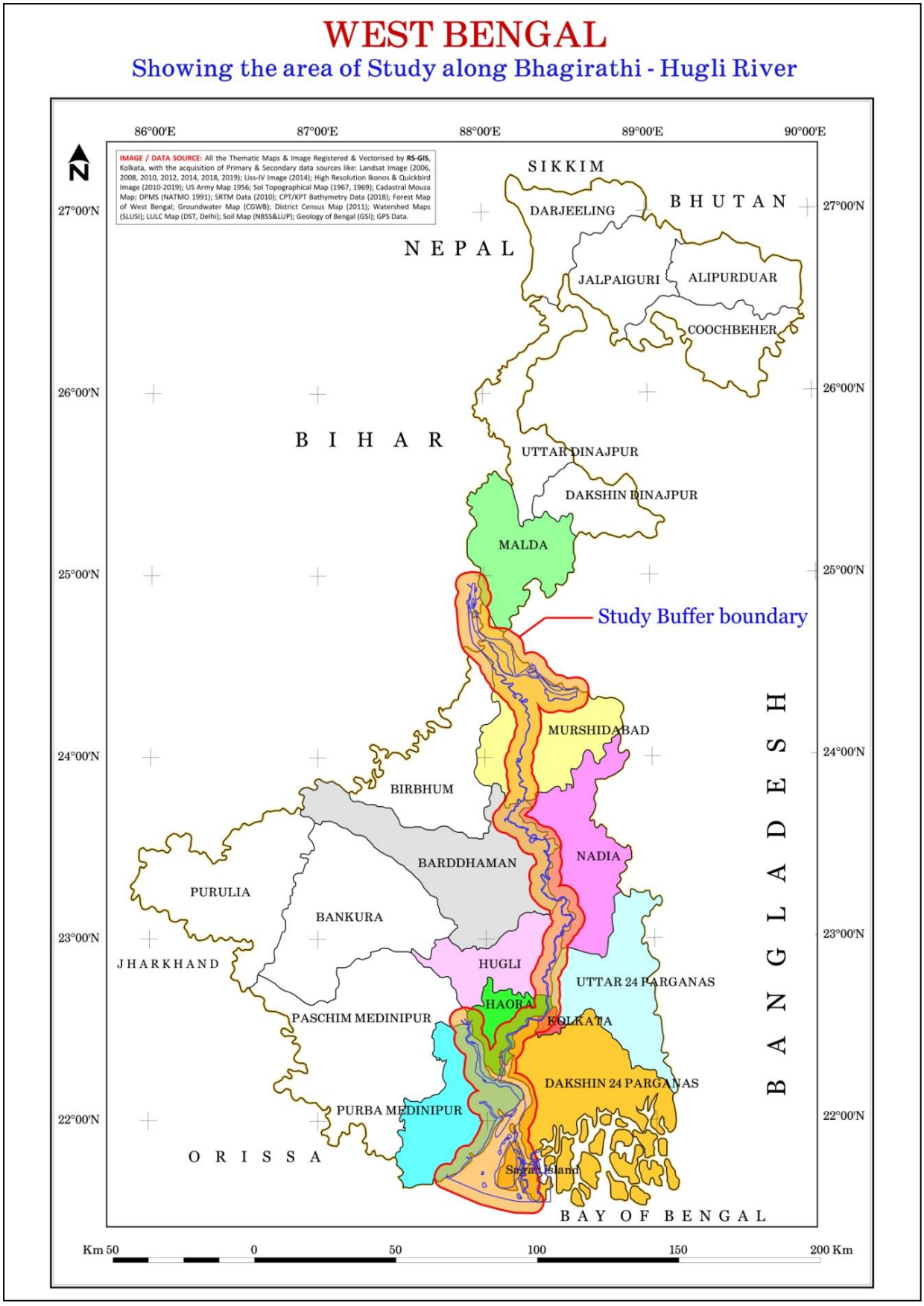
India is endowed with rich water resources with approximately 45,000 km long riverine systems criss-cross the length and breadth of the country. The Ganga river basin is the largest of the basins of India with an area of 8,61,452 Sq.km in India, draining into the 11 states of the country, Uttarakhand, Uttar Pradesh, Haryana, Himachal Pradesh, Delhi, Bihar, Jharkhand, Rajasthan, Madhya Pradesh, Chhattisgarh and West Bengal. The Ganga river has many tributaries, both in the Himalayan region before it enters the plains at Haridwar and further downstream before its confluence with the Bay of Bengal. The basin has a total drainage length of about 624235.73 Sq.km. The Ganga basin lies between east longitudes 73°2' to 89°5' and north latitudes 21°6' to 31°21' having maximum length and width of approx. 1,543 km and 1024 km. The average water resource potential of the basin has been assessed as 525020 Million Cubic Meters (MCM).

Table No 1 : District Details

Sl.	Head Details			Quantitative Information		Remarks
1.	State Name: West Bengal			-	-	
2.	Geographical Extension of Bhagirathi-Hugli			N N	E E	
3.	Areal coverage in 5km Buffer					
4.	Areal coverage in 10km Buffer					
5.	Total Number of Districts coverage			10		
6.	District wise Police Station & Ward coverage		**District**	Number of PS/ Wards	Length of Hugli River	
		A	Malda	04	88 Km	
		B	Murshidabad	13	520 Km	
		C	Nadia	09	112 Km	
		D	Barddhaman	04	138 Km	
		E	Hugli	09	91 Km	
		F	Haora	09	69 Km	
		G	North 24 Parganas	09	42 Km	
		H	South 24 Parganas	09	110 Km	
		I	Kolkata	144 Wards	20Km	
		J	Purba Medinipur	06	92 Km	
7.	Total Length of the Bhagirathi-Hugli River in the Lower Part			1282 Km.		



Map No 1 : Map of West Bengal Showing the Study Area



Map No 2 : Location of Study Buffer Boundary, West Bengal

1.3. Documenting Natural Heritage & Ecological Interdependencies

Natural Heritage would not replicate the work of scientific institutions Biodiversity Conservation is being studied and implemented by Wildlife Institute of India to cover Golden Mahseer, Dolphins, Crocodiles, Turtles and Otters and other fauna under conservation programme. These studies would be referred to.

1.3A. Changes in Flows, Water Levels - The documentation of natural heritage at several sites and banks will look at the changes in flows, earlier course of the river if any and observable changes in water level as revealed in discussions with resource persons and local communities.

1.3B. Floodplains - Crops and natural riparian flora and fauna, ox-bow lakes would be recorded

1.3C. Species-Fauna, Flora, Birds and others - Observations of riparian communities regarding changes in flora and fauna both riparian and in-stream would be recorded

1.3D. Sacred Groves - Landscapes that have both ecological and religious significance, where religion has ensured conservation of natural landscapes shall be noted

1.3E. Sacred Species - Certain species and specific trees are considered sacred because of associated religious beliefs or biological significance. It is because of their presence that several landscapes and sites stand safe. Many of these trees have a close association with the river during performance of some rituals. For instance, Bhojapatra is a birch tree native to the Himalayas, growing at elevations up to 4,500 m. The specific epithet, utilis, refers to the many uses of the different parts of the tree. The white, paper-like bark of the tree was used in ancient times for writing Sanskrit scriptures and texts. It is still used as paper for the writing of sacred mantras, with the bark placed in an amulet and worn for protection. In the sacred forests of Bhojwasa, around Gaumukh, such forests have been protected by pilgrims and resident communities, for eons.

1.3F. Community Understanding of Riparian Rights - Several communities, like the fishermen of the lower delta regions, have been caught in conflict with incumbent authorities in British and Independent India over riparian rights. The project aims to develop an understanding of what constitutes community riparian rights and whether communities are in conflict with authorities over the same.

1.3G. Confluence Points - The course of the Ganga is dotted with several confluence points of lower order streams which will be marked geospatially to understand the catchment and wider system of this river. The documentation also aims to name the minor tributaries that flow within this system and join it at various places.

1.3H. Review of Scientific Research on the Waters - Many scientific papers have been published on the Ganga and features of its water that keep it free of decay. These papers will be referred to recording what they suggest in terms of keeping the waters pristine.

1.4. Methodology

1.4A. Capacity Building

a. **Training arrangement:** Two phases of training have given to the Field Coordinators, Field survey staff and the Project Resource persons. First phase of training has conducted by the Project Funding Authority i.e. INTACH, Delhi and second phase of training will be conducted by the Project Implementing Agency i.e. RS-GIS, Kolkata.
b. **Development of Project Team:** A Project team has formed according to the need of the objective of the present Project. It is formed headed by the coordinator and the Social Scientist. Other members of the Project team are the GIS-Remote Sensing Expert, Field assistant (Geography background), Local Resource persons, Camera person and Hydrologist, Soil Scientist, Botanist, Zoologist & Agriculture scientist.
c. **Acquisition/Procurement/Purchase of Gadgets/Equipments/Analysis:** Following Gadgets/Equipments have been purchased for the implementation of the Project work: GPS machine, Satellite Image (Two seasons, Recent Data), Soft/hard copy Cadastral maps, Soil/Water storage Kit, Measuring Tape/Compass/Dumpy level, Topographical/DPMS, Laboratory Test/Analysis, procurement of other secondary Data/Information/Maps from Census, Irrigation, Ground water, Soil, Agriculture, Forest etc. Purchase of Books, Reproduction of Survey formats & Stationeries etc.

1.4B. Pre-Field Survey

a. **Literature review:** Library work, Study of published and unpublished reports, News paper articles, Journals and Research papers.
b. **Collection of Secondary Data/ Information (Maps) from Govt. Departments:** GSI, NATMO, CGWB, NBSS & LUP, IMD, SWID, PHED, KMC Office, Survey of India (SoI), KOPT, West Bengal Fisheries Corporation, Irrigation & Waterways GoWB, West Bengal Forest Deptt. PWD, Census of India, AISLUS etc.
c. **Satellite Data Acquisition (Real-time):** NRSA Hyderabad, University of Calcutta (Deptt. of Geography), USGS Earth Explorer.
d. **Base-Map Preparation** (for whole Project area)**:** Consulting Topographical maps, Census maps, DPMS & Recent Multi spectral Satellite Image.

1.4C. Field Survey

a. **Data-Information Collection & Measurements:** Collection of detail information with GPS locations, related to Surface Morphology/Relief/Physiography, Geology, Climatic conditions, Bank erosion, Embankment condition, Depth of river Bhagirathi-Hugli, Shifting river course and Paleo-channels, Status of Confluence and Off-take points of rivers, Canals, Flood events and Tide levels, Heritage water structures, Wetlands, Ground water regime, Soil, Water quality, Riparian Flora-Fauna, Sacred trees, Landuse-Land cover types, Impact of Dams/Barrages/Mining, Utilization of Flood plain, Riparian Rights etc.

b. **Photo & Videogrpahy:** Professional photographers having enough experience of Physical, Social, Ecological & Environmental issues will be engaged for Digital documentation of different events related to the Natural phenomenon.

1.4D. Post Field Analysis

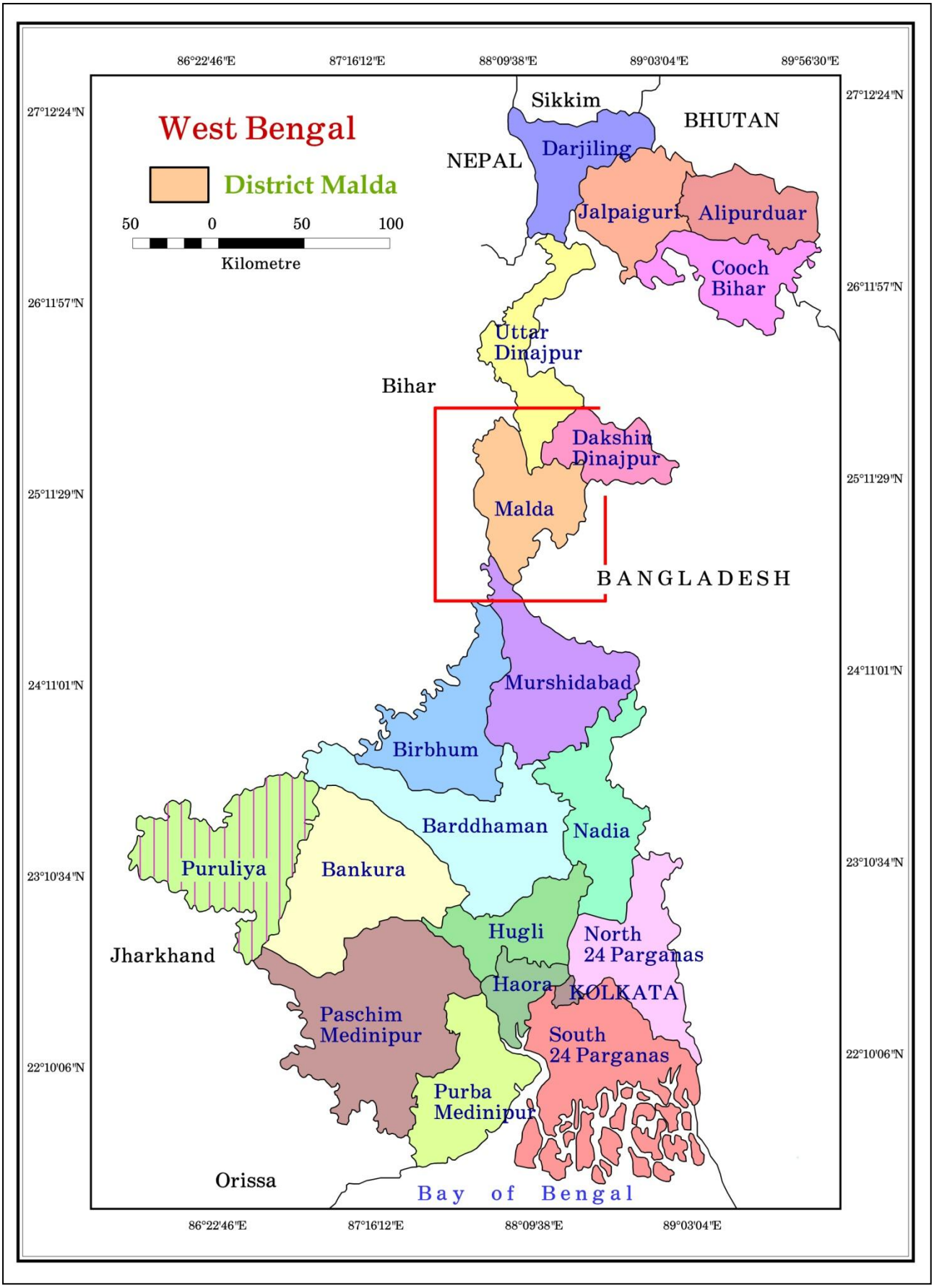
a. **Collection & Scrutinization of Field Data/Survey sheets:** Region/Block/PS/Mouza wise *Proforma for Listing the Natural Heritage* survey sheets will be checked/verified with the concern persons.
b. **GPS Data analysis:** Collecting the Ground Control Points (GCP's) & GPS-Tracks of Land surface & Waterbodies, the database will be processed through Map-Source Software.
c. **Water & Soil Sample data analysis:** Sample will be supplied for analysis in reputed Govt. Departments or Private agencies.
d. **Preparation of Theme Maps:** Location, Administrative, Relief, Geology, Geomorphology, Drainage, Waterbody, Canals, Groundwater, Soil, Rainfall-Temperature, Vegetation, Tidal fluctuations, Landuse-Land cover, Shifting of Rivers, Embankment status, Population growth, Flood condition, Watershed divisions, GPS locations of specific units, Urbanization level etc.

1.4E. Validating Field & Analised Data

a. **Landuse Land cover units:** Physical & Cultural units on land surface to be verified after revisit the area with recent Satellite Image.
b. **GPS locations:** After Overlaying the data on Satellite Image (Google Earth Image) Cross-checking will be done
c. **Water Sample analysis data:** COD, BOD, pH, EC, DO, Turbidity analysis of Water samples.
d. **Flora/Fauna:** Riparian, Sacred Species with their environment.

1.4F. Preparation & Submission of Report

a. **Preparation of Draft Report:** Preliminary Draft Report in Soft & Hard copy mode (1 Colour Printed) of each District will be submitted to INTACH, Kolkata Convener for Verification / Correction
b. **Report Correction:** Any corrections made by the funding authority will be incorporated judiciously into the Final Report.
c. **Final Report Submission:** Final Report in form of Soft Copy will be submitted District wise and Hard copy Report will be submitted after completing the all Districts in three phases.



Map No 3 : Location Map of Malda District in West Bengal

Chapter 2 : Locational Setting

The district of **Malda,** also pronounced as **Maldah** was once the Capital of Gour or *Gauda* Empire. It lies to the Southern fringe of North Bengal. The district of Malda came into existence under the British informally in 1813, obtained the *Diwani* of the Subah of Bengal, Bihar and Orissa from Emperor Shah lmam in 1765. During the intervening period the district had been parceled out between the districts of Dinajpur, Rajshahi (Bangladesh), Murshidabad and Purnea. The newly formed district included in Bhagalpur Division. A treasury was established in 1832 from which the separate existence of the district is usually dated but it was only in 1859 that a Magistrate and collector were placed in charge of the district. The district Malda lies between 25°32'08" North and 24°40'20" North Latitude and in between 88°28'10" East & 87°45'50" East longitude. To the south is Murshidabad district, to the north are Uttar Dinajpur district and Dakshin Dinajpur district, to the east is the international border of 165.5 km. with Bangladesh and to the west is Santhal Paraganas of Jharkhand and Purnea of Bihar. In 1935, the total area of the district was 5146.30 sq.km as per report on the survey and settlement operations. At the time of partition of India it covered 5100 sq. km, but now the area is 3733 sq. km. Its ranking in respect of area is 11th (eleventh) in the state.

It takes its name from the town of **Malda**, which is situated on the left bank of the Mahananda river at its junction with the Kalindri River, and is about 6.5 km north of English Bazar (Engrezabad). A story is current of an old woman buying up the entire stock of mercury of a merchant who had come to the place to trade and who had been unable to dispose of his goods. Her wealth (mal) was such thatshe was able to devote all her purchase to cleaning one tank only, called the Parpukur (mercury tank) to this day, and thus to give the place the name of Malda or the place of wealth. Another fanciful derivation is from *Maladahy* a string of deep pools, a feature of the town being the deep depressions left by old water courses.

The district comprises two subdivisions: Chanchal and Malda Sadar. Chanchal consists of six community development blocks: Chanchal–I, Chanchal–II, Ratua–I, Ratua–II, Harishchandrapur–I and Harishchandrapur–II. Malda Sadar subdivision consists of Old Malda municipality, English Bazar municipality and nine community development blocks: English Bazar, Gazole, Habibpur, and Kaliachak–I, Kaliachak–II, Kaliachak–III, Manickchak, Old Malda and Bamangola. English Bazar is the district headquarters. There are 12 police stations, 15 development blocks, 2 municipalities, 146 gram panchayats and 3,701 villages in this district.

The headquarters of Malda district is in English Bazar, also known as Malda, which was once the capital of Bengal. The district maintains the traditions of the past in culture and education. Old Malda, the town which lies just east of the confluence of the Mahananda and Kalindi Rivers, is part of the English Bazar metropolitan city. The town rose to prominence as the river port of the old capital of Pandua. During the 18th century, it was the seat of prosperous cotton and silk industries. It remains an important distribution centre for rice, jute, and wheat. The area between the historical monument of Jame Masjid (1566) and the landmark of Nimasarai Tower across the river Mahananda, constituted a municipality in 1867. Rice, jute, legumes, and oilseed are the chief crops in the surrounding area. Malda is the largest producer of excellent quality jute in India. Mulberry plantations and

mango orchards also occupy large areas; mango trade and silk manufacture are the main economic activities.

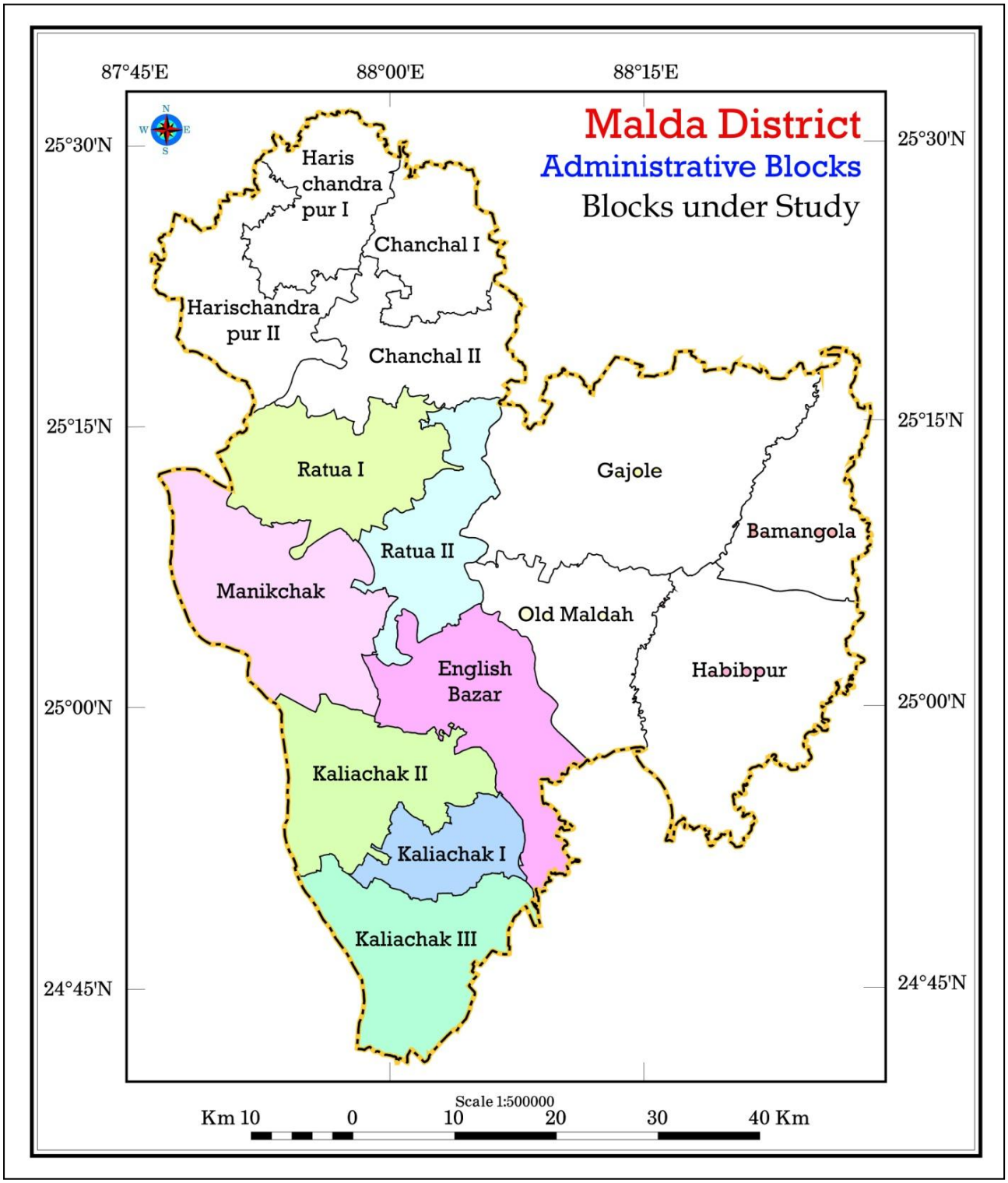
Our Study area is comprised of 4 Blocks lying in between Ganga and Mahananda River. They are – Ratua I & II, Manikchak, English Bazar, Kaliachak I, II & III.

Table No 2 : Blocks Details of Malda District

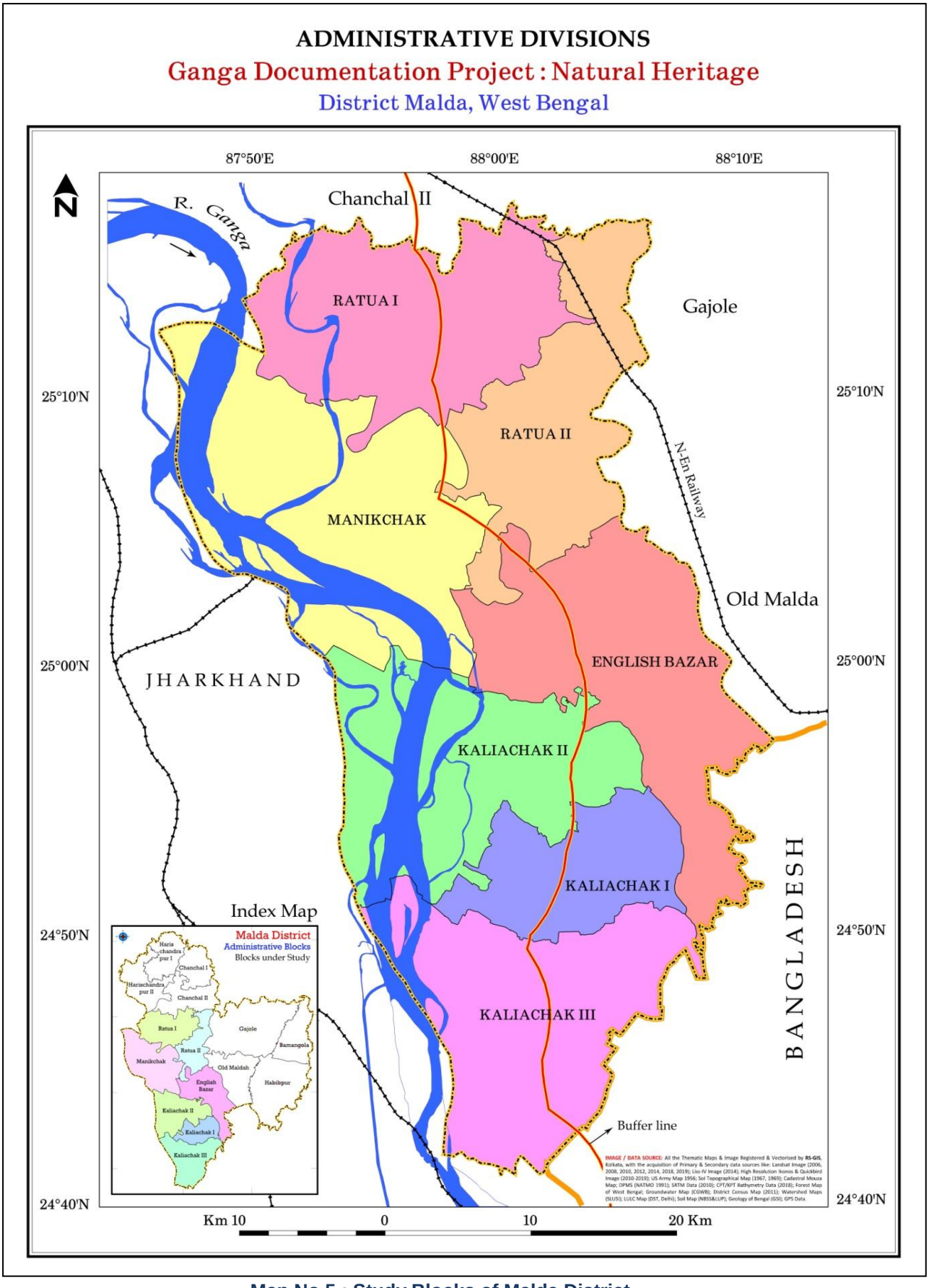
Sl. No	DISTRICTS	BLOCKS		Area in sq.km
	Malda 88 Km	1	Ratua I	225.08
		2	Ratua II	178.47
		3	Manikchak	322.28
		4	English Bazar	250.98
		5	Kaliachak I	109.94
		6	Kaliachak II	230.95
		7	Kaliachak III	240.29
				1557.99

2.1 River Ganges in Malda

The Ganges first touches the district as it sweeps south round the Rajmahal hills. At this point it is connected in the rains by various channels with the Kalindri, though at the present time much Ganges water does not find its way down the Kalindri, the mouths of the connections having silted up considerably as the Ganges has receded to the west. It would seem, however, that in this neighbourhood there has always been a navigable junction between the two rivers in the rains. Doctor Buchanan Hamilton, indeed describes the lower part of the Kalindri, between this point and the town of Malda, as a branch of the Ganges. About 3.2 km below Rajmahal the Ganges sends off a small stream, the Chhota Bhagirathi, which is presumably an old bed of the great river itself and is still revered as at least equal in holiness to any other part of the sacred stream. It runs first to the east and then generally in a southerly direction, bordering for about 13 miles the ruins of the Gaur city of Gaur. A little way further down, the Ganges sends off, also to the east, a larger branch, the Pagla, into which the Chhota Bhagirathi ultimately flows. After their junction they flow past Kansat merging near Tartipur into the Mara Ganga. In the map the main stream of the Ganges is shown as flowing past Tartipur: at the present day, however, the island cut off by the Pagla extends right down to the mouth of the Mahananda, and there are a number of daras or channels which connect the Mara Ganga with the main stream in the rains. During the rains these carry off immense volumes of water to rejoin the Ganges near the mouth of the Mahananda. Somewhere above the point where it finally leaves the district, the Ganges sends off southwards a branch which retains the name of the Bhagirathi, while the great river thenceforth loses the larger part of its sanctity. Boats come from East Bengal to bring Ganges water from Tartipur as being the nearest present point of the sacred stream to East Bengal.

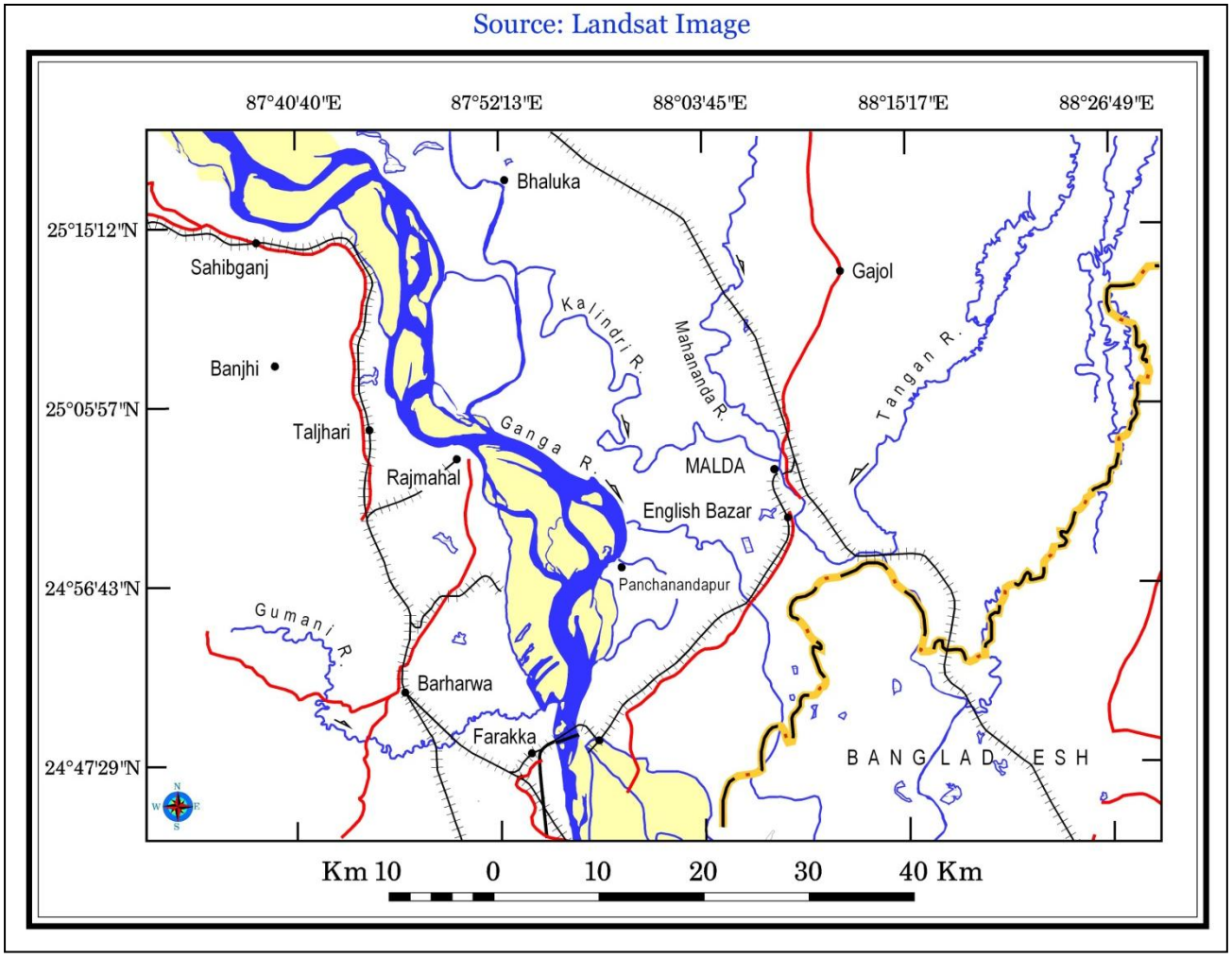


Map No 4 : Administrative Map of Malda, Census Map



Map No 5 : Study Blocks of Malda District

Image No 1 : River Ganga Near Manikchak 25° 3'58.18"N 87°52'20.07"E



Map No 6 : Course of Ganga from Bhaluka to Kaliachak

Image No 2 : Farakka Barrage from Lakshmipur, Kaliachak III 24°48'32.47"N 87°56'39.17"E

Chapter 3 : Physical Setting of the Study area

3.1. Relief

Malda district is a low-lying plain, through which flows a number of rivers. On the basis of topography and drainage pattern, the district can be divided into three regions i.e. **Tal** (north portion above river Kalindri), **Diara** (southern portion below river Kalindri) and **Barind** (eastern part of river Mahananda).

The river Mahananda flowing north and south roughly divides the district into two equal parts, corresponding by local tradition to the old boundary line of the Rarh and Barendra. To this day the country to the east of the Mahananda is called the Barind. Its characteristic feature is the relatively high land of the red clay soil of the old alluvium. West of the Mahananda the country is again divided into two well defined parts by the Kalindri river flowing west and east from the Ganges. North of the Kalindri the distinguishing natural feature is the tal land, the name applied to the land which floods deeply as the nvers rise, and drains by meandering streams into swamps or into the Kalindri. There are extensive tracts of this land covered, where not cultivated, with tall grass in Ratna and Tulsihata thanas. South of the Kalindri lies the most fertile and populous portion of the district. It is seamed throughout by old courses of the Ganges, upon the banks of one of which the city of Gaur once stood. The most striking natural feature is the continuous line of islands and accretions formed in the bed of the Ganges by its ever changing currents and known as the diara - the long open stretches of which contrast with the patchwork-like effect of the miles of small embanked mulberry fields characteristic of the higher lands of this portion of the district. There are no hills in the district, unless a few elevated tracts in the barind may be so described. Parts of these high lands have an elevation of from 50 to 100 feet above the level of the Ganges, and being frequently inter-sected by deep water-channels, stimulate the appearance of small hills. Apart from these undulations the country is a low- scenery lying plain covered with a succession of village sites with their adjacent fields and swampy tracts.

3.1A. Barind Region

The **'Barind'** tracts have the highest elevation of the district measuring 39.7 meters from the M.S.L. The highest lands are present in Gazole P.S. under this tract. Barind areas extend over a wide area in Malda district. The characteristic feature of this tract is wild undulations of successive ridges and depressions seamed with small water courses in the valleys and are practically devoid of shade except for the village sites and small patches of Sal forest here and there in Habibpur P.S. The ground is baked hard as iron; drinking water is scarce during summers. Except in autumn when it becomes green with winter rice, it remains arid. Of the 11 police stations in Malda, 4 P.S. viz. Old Malda, Gazole, Bamangola and Habibpur are within the tract. Adina, which was once the then capital of Bengal for some time during the Muslim rule is located in Gazole P.S. of this tract and the Barind tract comprises of an area of 1,32,761 hectares. In figure 4-4 the area has demarked in the NW side of the block, where the elevation is quiet higher than other side of the block.

3.1B. The Tal

The Tal region is situated to the west of Mahananda River and north of Kalindri River. It is a low-lying area subjected to inundation with the rise of water level in the Ganges, Mahananda and Kalindri. The construction of flood protection measures has however eased the situation to some extent. The Tal area gradually slopes down towards the south and west and gradually merges with the Diara region. Ratua, Chanchal and Harishchandrapur P.S. are within this region. The total area under Tal tract is 1, 14,100 hectares. In figure 4-4 the North side of the block has demarked this Tal area.

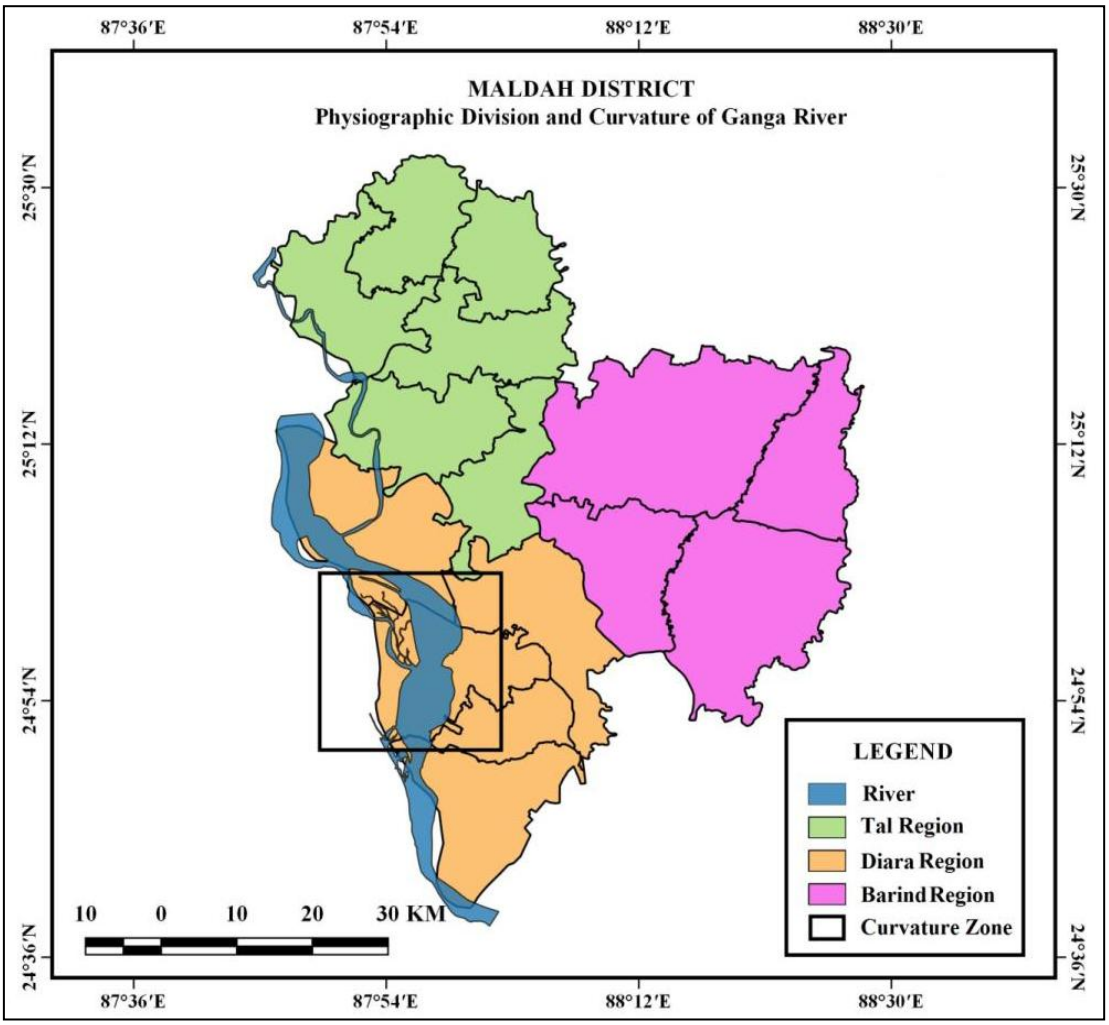
3.1C. The Diara

The 'Diara' consists of a strip roughly 12.87 K.M. in width along the western and southern sides of the district. Its formation is the result of centuries of fluvial action by the Ganges, the old channels of which can still be traced, beginning from the present course of the Bhagirathi River beside Gaur and extending westwards by successive stages. The soil is of light nature with a sandy appearance. English Bazar, Baishnab Nagarar, Kaliachak and Manickchak P.S. are under Diara tract. Total area under this tract is 1, 09,493 hectares. There are no uplands in the district excepting a few elevated tracts in the district above sea level is 39.7 meters and is situated in Gazole Police Station. But the average elevation range of the district is 30 mts above sea level. And the slope direction of the district is generally forming the north to south. The natural division of the district coincides with that of the administrative division boundaries also. The River Kalindri flowing west to east act as a boundary between the Tal region in the north and Diara in the south. Mahananda up to its confluence with that of the Ganga acts as a boundary between the Tal region in the west and Barind in the east. The administrative boundaries particularly of police station in many cases follow the natural alignment of these rivers. So, the Tal region consists of Ratua, Chanchal and Harishchandrapur P.S., the Barind contains of Old Malda, Gazole, Bamangola & Habibpur P.S. and the Diara region comprises of English Bazar, Manickchak, Kaliachak and Baisnabnagar P.S. Therefore obtaining of various secondary data related to population, land use etc., have become easier and directly applicable to the natural region as a whole. This indeed is an advantage for the present research work since the administrative divisions coincides with the natural division as referred above.

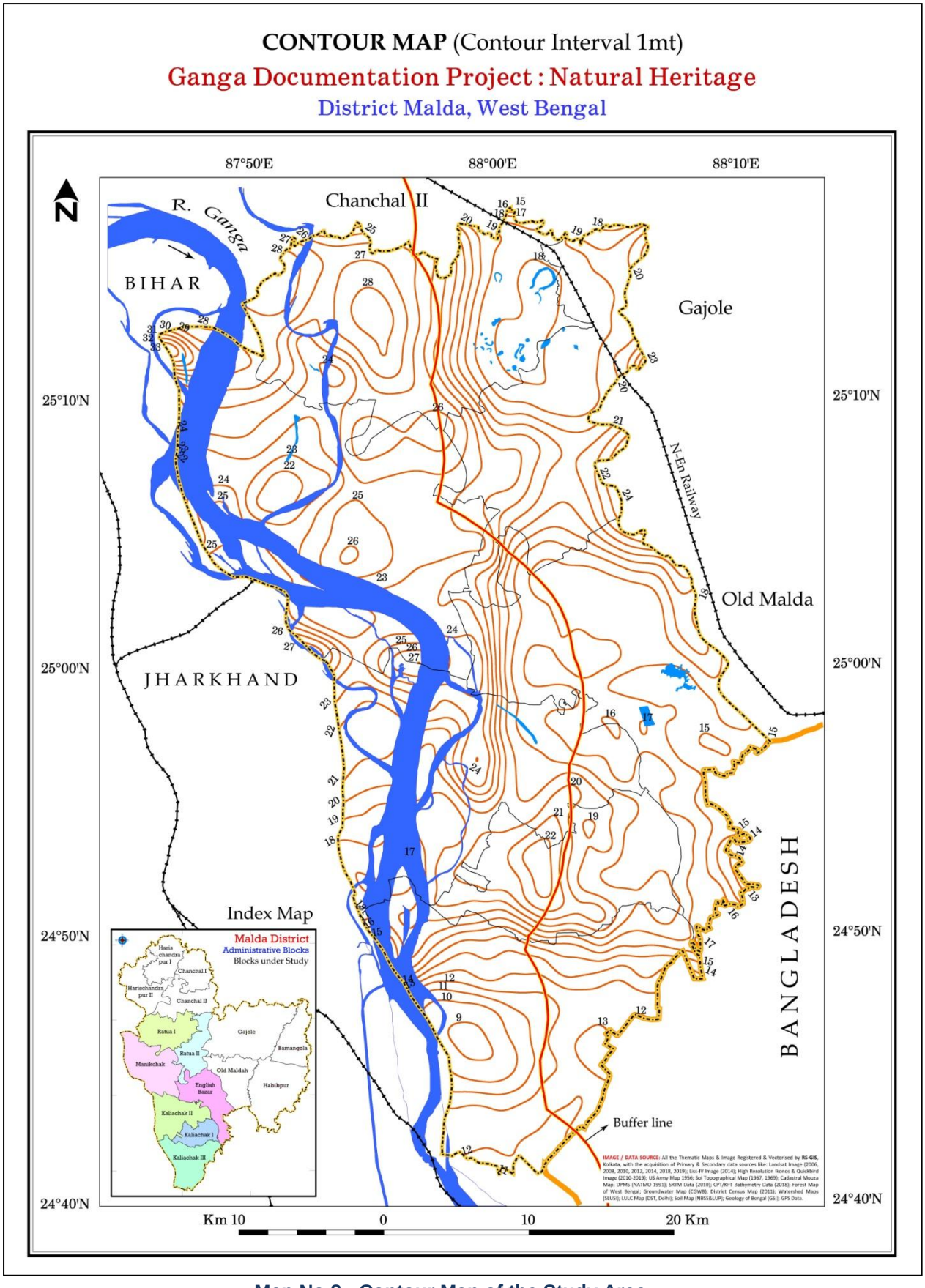
From the brief description of the topographic characteristics of the district of Malda, it is evident that the topographic configuration in association with the river system, soil characteristics and climatic particularly rainfall characteristics do influence innumerable water bodies, their distribution, areal extension and seasonal fluctuation. Given the slightly undulating topographic character present in the Brind area the surface water regions are expected to the less in numbers, more confined in nature and the seasonal fluctuations are expected to be more also. More over the topographic positivity in association with hydrological supportive characteristics the Tal and Diara regions are the more populous area of the district.

3.2. Hydrology

Malda region is located in southern edge of the northern para-delta of Bengal region. By virtue of the fact that Malda region provides the final passage of the Ganga river system with its several tributaries having longitudinal alignments originating from the Himalayas and its foot hills in the north the surface hydrological conditions are prominently active in its true sense. In addition to this, as mentioned earlier, the basin between Rajmahal and Garo hills in the Malda district is situated. This set-up does not offer any structural (Geological) or relief (Geomorphological) obstruction against the free play area stage of surface hydrological features. The hydrological activities are evident from the facts that, first, a number of perennial rivers including the Ganga traverse through the district, Secondly, there is a strong evidence of shifting river channel and Thirdly, almost the entire district floods keep on occurring almost regularly. So, it is quite natural that among the physical indicesses of the district hydrological characteristics, particularly surface hydrology features have created distinctive, prominent and permanent imprints. Beels of the district are one of the products of this active hydrological characteristic of the district. This prominent characteristic in turn has penetrated in some of the explained physical geographical characteristics of the district in one hand and created impression on ethno-socio-cultural mosaic of human life in the district, on the other.



Map No 7 : Regional Division Map of Malda



Map No 8 : Contour Map of the Study Area

3.3. Geology

The Malda district of West Bengal is located at the mouth of Bengal delta within the western half of the Garo-Rajmahal Gap. The district is completely blanketed by Quaternary sediment. Geomorphologically the district is situated at the head of a conjugate fan of the Mahananda & Tista Rivers, which flow respectively to the west and the east of the area and are joint by a number of distributaries. All the Rivers merge into the Ganga- Brahmaputra Delta to the south. The south western part of the district is affected by the Ganga fluvial regime, the deposits of which spread west ward from the southern margin of the Barind uplands up to the present Ganga River. The low land region covered by the flood plain deposits, viz. the Shaugaon - Ganga-Mahananda and Jalpaiguri - Malda formation are devoid of soil cover in contrast to the Baikunthapur flood plain deposits which is characterized by *inceptisol*.

The oldest deposits, the Barind formation is exposed at higher level in the eastern part of the district as brick red clays with a high concentration of nodular ferricret softened by weathering. The Barind formation is also seen in sections at various levels being overlapped by the latter Baikunthapur / Lalgarh formation of the Rarh region of south Bengal. Rill, gully and wind erosion have played a major role in reworking and re-depositing of Barind formation. The Baikunthapur formation consisting of thick clay, sand and silt occurs in the eastern and central part of the district. They also consist of thick clay deposits besides sand and silt horizons. Its oxidized, greenish grey colored capping contains high concentration of calcareous nodules besides a few reworked iron nodules. The presence of calcretised *kankar* classed in the older Baikunthapur formation indicate short annual weight spells followed by long dry spells. The Malda formation of the Mahananda-Tista fluvial regime covers the eastern and central part of the district. It generally overlaps the Baikunthapur formation.

The Shaugaon formation comprising sand, silt and clay deposits is observed to flank the major and minor rivers of the district. It merges with the deposits of the Ganga-Mahananda formation in the Ganga fluvial regime. That has a larger spread in the western and southern part of the district where it overlaps the older deposits.

The present day deposits occur along the course and banks of the presently active channels. They consist of loose, unconsolidated sand, silt and clay. The areas other than the present day flood plain although generally inactive become dynamic in parts during very high floods. Water logging of the ancient back swamps is an increasing hazard of the districts. The instability of the terrain is witnessed by the antecedent nature of the rivers like Tangaon, Chirramati and Atrai and also the slope reversal as indicated by the upland surface which demonstrates northerly tilt of the area. Techtonic upheaval along with an inversion of relief has resulted in the creation of uplands. This area at present remains dry and barren for most of the year and has a low ground water table in contrast to the reach agricultural lands of the low areas adjacent to it.

3.3A. Geological Formations

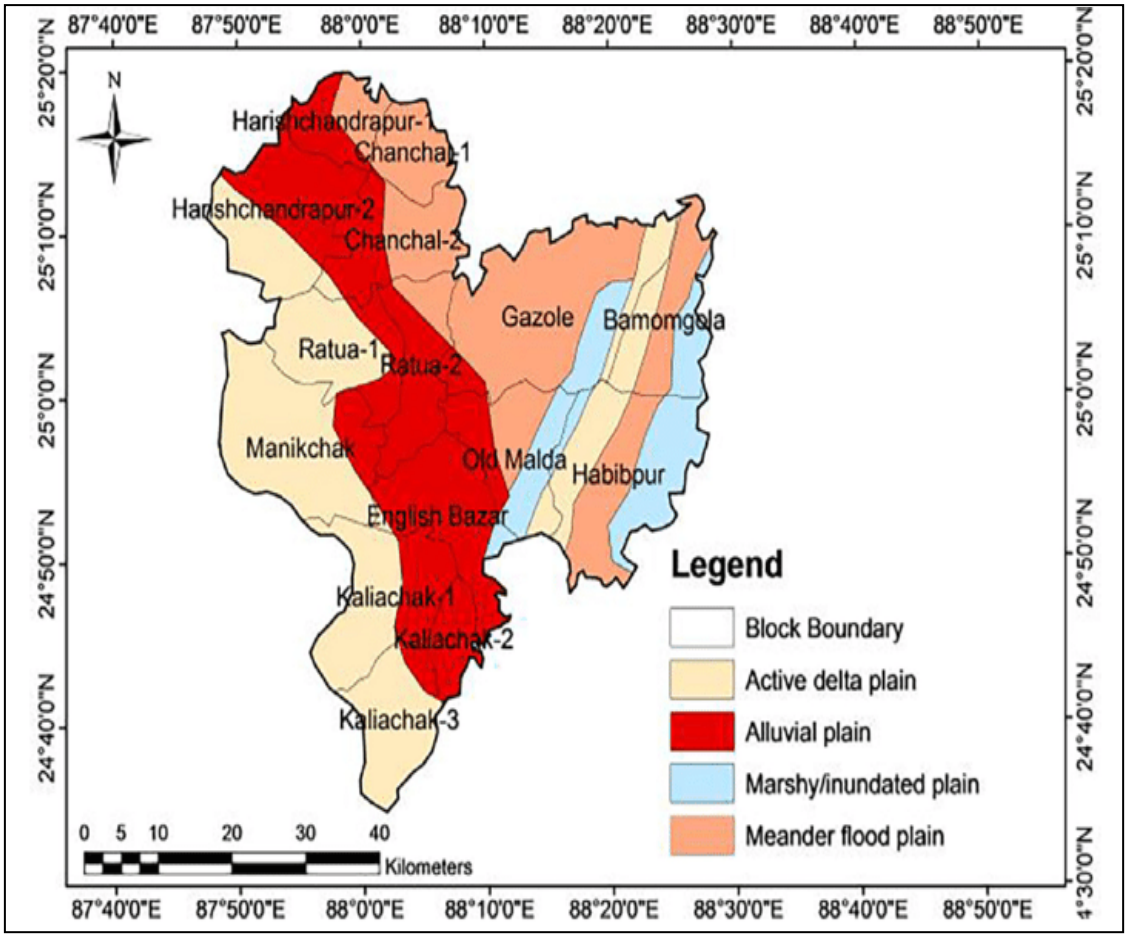
The geological units of the study area were divided by three tentative ages, Holocene period, early Holocene to Pleistocene period and Pleistocene period. The Malda formation, the Shaugaon formation, Ganga Mahananda formation and the present-day deposits were formed

in Holocene period. Baikunthapur formation was formed in early Holocene to Pleistocene period. Barind formation was formed in Pleistocene period. In English-Bazar block vast area was covered by Ganga-Mahananda formation where Manickchak block mainly covered by present day deposit. *Shaugaon* formation was found in Ratua-II block and Old-Malda block very frequently. Baikunthapur formation is found north-western portion of the Old-Malda block and Barind formation is found northeastern portion of the Old-Malda block.

English-Bazar block contains some of the youngest as well as the oldest exposures of Quaternary sediments within the Tista-Mahananda interfluves. To the west the younger deposits inter finger with deposits of the Kosi and the Ganga Rivers while to the east, the older deposits spread laterally into Bangladesh. The older deposits are overlapped by the younger deposits of the Mahananda - Tista regime in the north. The district is completely blanketed by Quaternary sediments. The younger deposits merge with the deltaic sediments of the Bengal basin South wards, while the older deposits terminate abruptly with a relatively higher slope defining a northwest – southeast trending lineament. The spread of the Ganga deposits to the south of the uplands is marked by numerous paleo channels and active channels, viz. the Kalindri, the Bhagirathi.

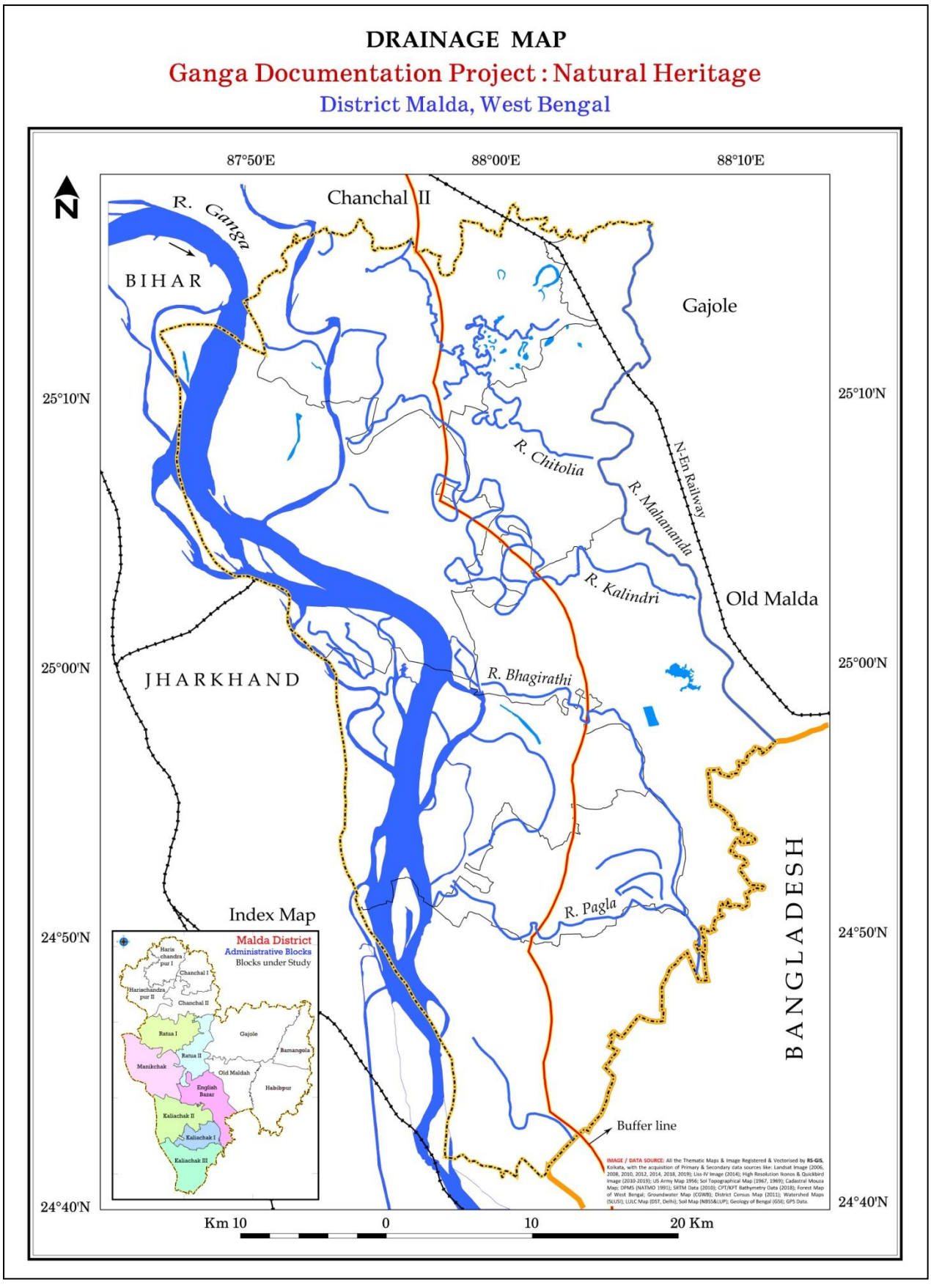
3.4. Geomorphology

Primary geomorphological unit of this area is River flood plain. Based on the deposits of sediments, the flood plain can be divided into – Active Delta Plain, Alluvial Plain, Marshy Inundated Plain, Meander Flood Plain. Our Study area mostly falls under active delta plain.



Map No 9 : Geomorphology Map of Malda.

Image No 3 : Active Flood Plain of Malda, Balugram, Kaliachak II, 24° 2'9.22"N 88°34'2.89"E



Map No 10 : Drainage Map of Study Area, Malda District, Source : Landsat 2019

3.5. Drainage System

Rivers in the district constitute an important feature upon its landscape. The earth surface here is washed by the waves of rivers like the Ganga, Mahananda, Fulahar, Kalindri, Tangaon, Punarbhava, Pagla and Bhagirathi. All main rivers of the district are of the Himalayan or sub-Himalayan origin and flows towards south direction. Due to the devastating flood particularly in the Western side of the district, huge amount of life and property, human establishments and agricultural land goes into the Ganga River each year.

3.5A. The Ganges, or Padma

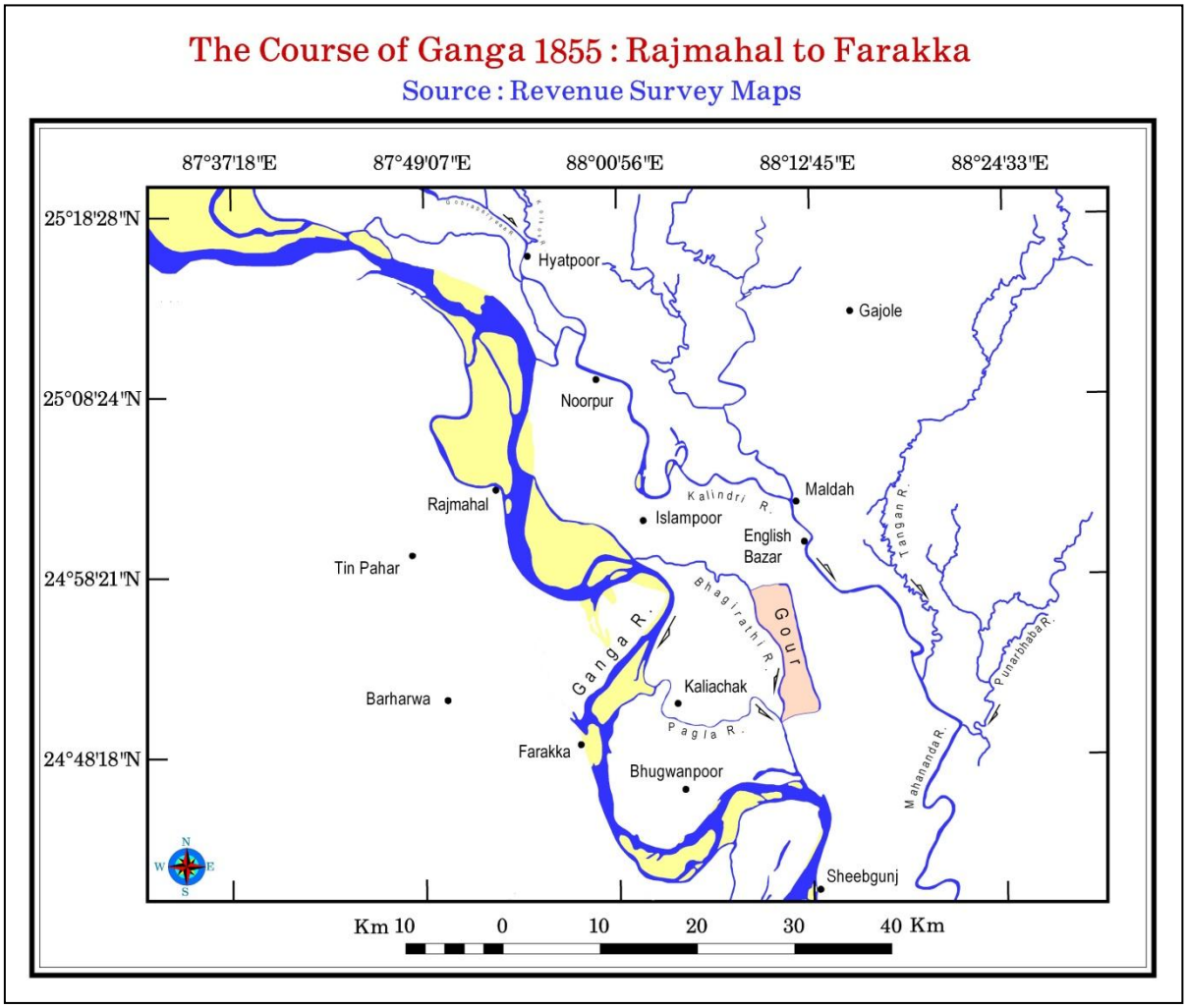
River Ganga flows through the western part of the district and acts as a natural division between Jharkhand and Malda district. The Ganga first touches the district as it sweeps round to the south of the Rajmahal hills from Manikchak Block and leaves the district at Khejuria near Farakka Barrage.

Image No 4 : River Ganga, Manikchak, 25° 3'37.76"N 87°53'33.73"E

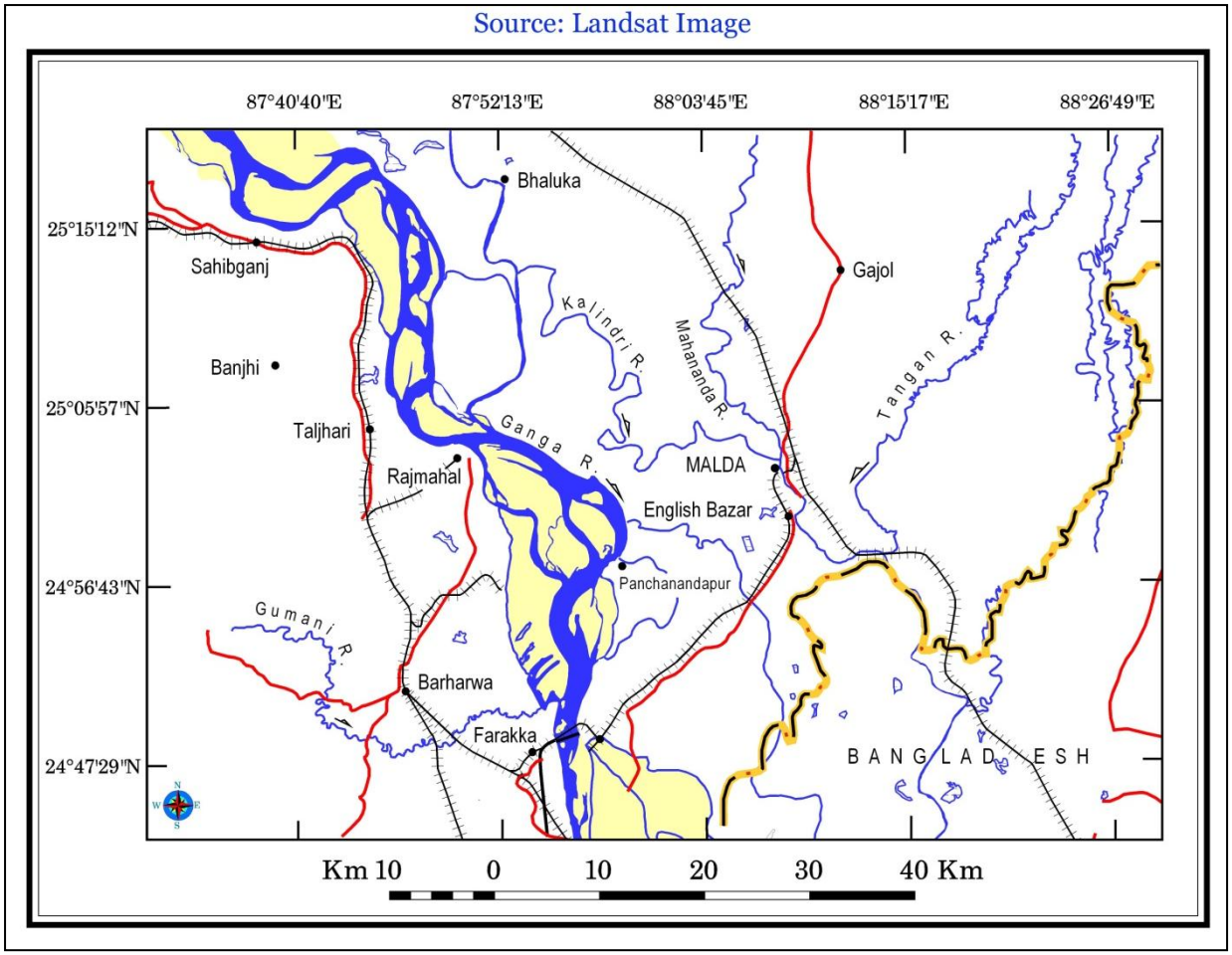
During the last few years, the tendency has been for the river to continue gradually the westward movement. Alluvium and diluvium had occurred constantly as a result of the continual changes in the course of the river. The position of the Ganges was therefore, very similar in Rennell's time (1764- 1773) to what it is today. Buchanan Hamilton noted in 1810 that the general course of the river Ganges was away from plains of Malda. At the time of the revenue survey, Rajmahal was on the bank of the river but in 1870 the river took an eastward move leaving Rajmahal at its west and almost threatened to cut into the river Kalindri, as a result of which a good amount of erosion took place in the Malda Bank. But at present time the river has been flowing through channel.

Doctor Buchanan Hamilton, indeed describes the lower part of the Kalindri, between this point and the town of Malda, as a branch of the Ganges. About two miles below Rajmahal the Ganges sends off a small stream, the Chhota Bhagirathi, which is presumably an old bed of the great river itself and is still revered as at least equal in holiness to any other part of the sacred stream. It runs first to the east and then generally in a southerly direction, bordering for about 13 miles the ruins of the Gaur city of Gaur. A little way further down, the Ganges

sends off, also to the east, a larger branch, the Pagla, into which the Chhota Bhagirathi ultimately flows. After their junction they flow past Kansat merging near Tartipur into the Mara Ganga. In the map the main stream of the Ganges is shown as flowing past Tartipur: at the present day, however, the island cut off by the Pagla extends right down to the mouth of the Mahananda, and there are a number of daras or channels which connect the Mara Ganga with the mainstream in the rains. During the rains these carry off immense volumes of water to rejoin the Ganges near the mouth of the Mahananda. Somewhere above the point where it finally leaves the district, the Ganges sends off southwards a branch which retains the name of the Bhagirathi, while the great river thenceforth loses the larger part of its sanctity. Boats come from East Bengal to bring Ganges water from Tartipur as being the nearest present point of the sacred stream to East Bengal. Alluvion and diluvion are perpetually taking place on the Malda bank, which is throughout of sand, offering little resistance to the changes of the current. An ordinary incident in the life of a riverain dweller is the hasty removal of his lightly built houses to a new site and the complete disappearance of his lands, which reform as sandy chars miles away. An historical instance of wider destruction is the complete obliteration of the town of Tanra, an important city of Mahomedan times situated near Gaur. The Ganges is navigable throughout the year by steamers and country boats, and is nowhere fordable.



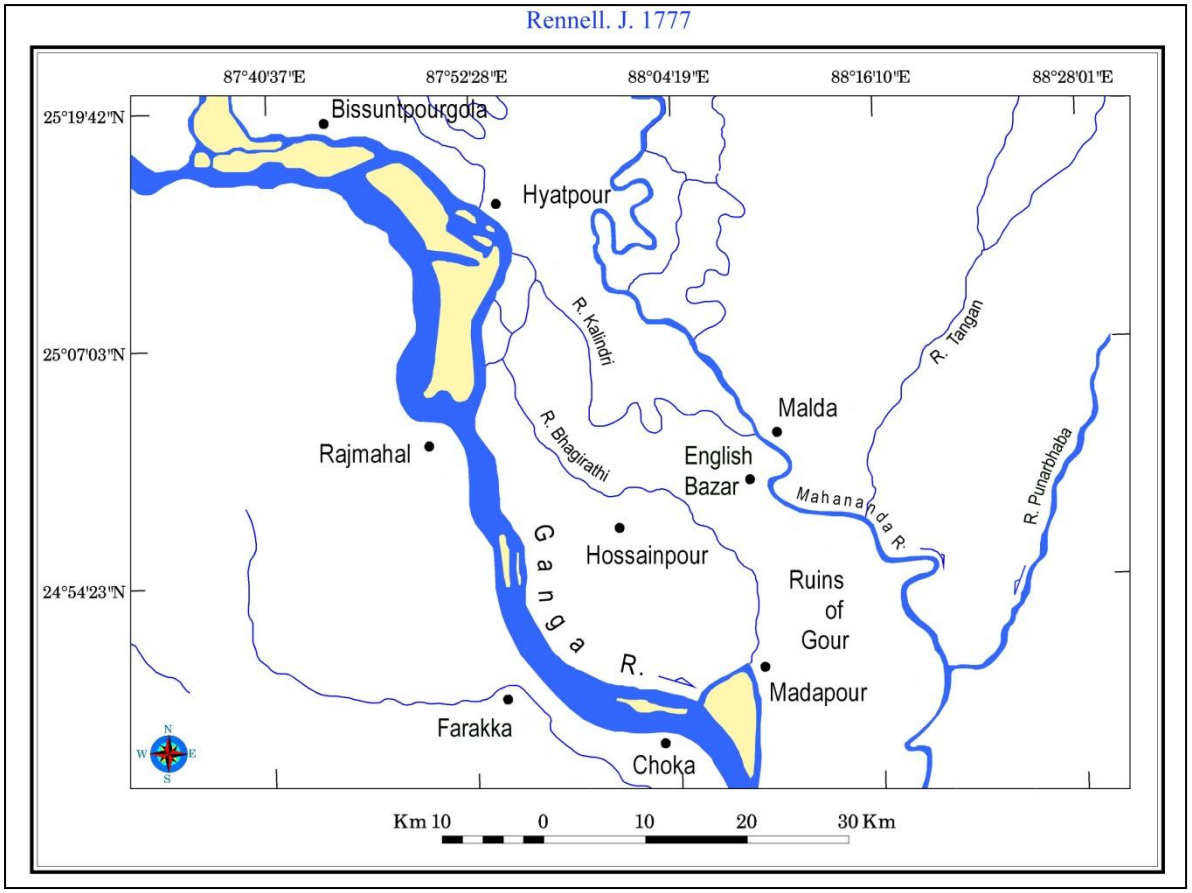
Map No 11 : The Course of Ganga, Revenue Survey Maps, 1855: Rajmahal to Farakka
Source : River Atlas of Bengal, Dr. Kalyan Rudra



Map No 12 : Course of Ganga, 2010 Landsat Image ***Source : River Atlas of Bengal , Dr. Kalyan Rudra***

3.5B. Mahananda

River Mahananda first touches the district at its extreme north point near the tri-junction point of the P.S. of Chanchal, Ratua and Gajol and leaves the district at the southernmost point and falls into the river Ganges. The main channel of river Mahananda in Malda district is fairly deep and alluvium & diluvium processes are going on gradually. River Mahananda runs for about 88.6 km in this district and divided the district into two nearly equal portions. During the last century few changes have been taken place in its course. But in between the dates of Rennell's map and revenue survey a very great change took place. In Renells time, the river ran from Swarupganj down to what is now the channel known as the Mora Mahananda along the western boundary of Kharba P.S., instead of along the eastern boundary as at present. At one time it formed a most important channel of through communication between Lower Bengal and the sub-Himalayan districts, but the construction of railways has diminished its importance in this respect, and at the present time the traffic on it is mainly in local exports and imports. Up to Malda its average width is from 50 to 100 yards, the waterway at the railway bridge at Bargachi being 220 feet; the banks of sand and clay are steep and of about the same height, and cultivation is general. Below Malda, where it receives the water of the Kalindri, it widens out to an average of 200 to 600 yards: its banks are alternately sheer and sloping: the cultivation is more intense and population denser.



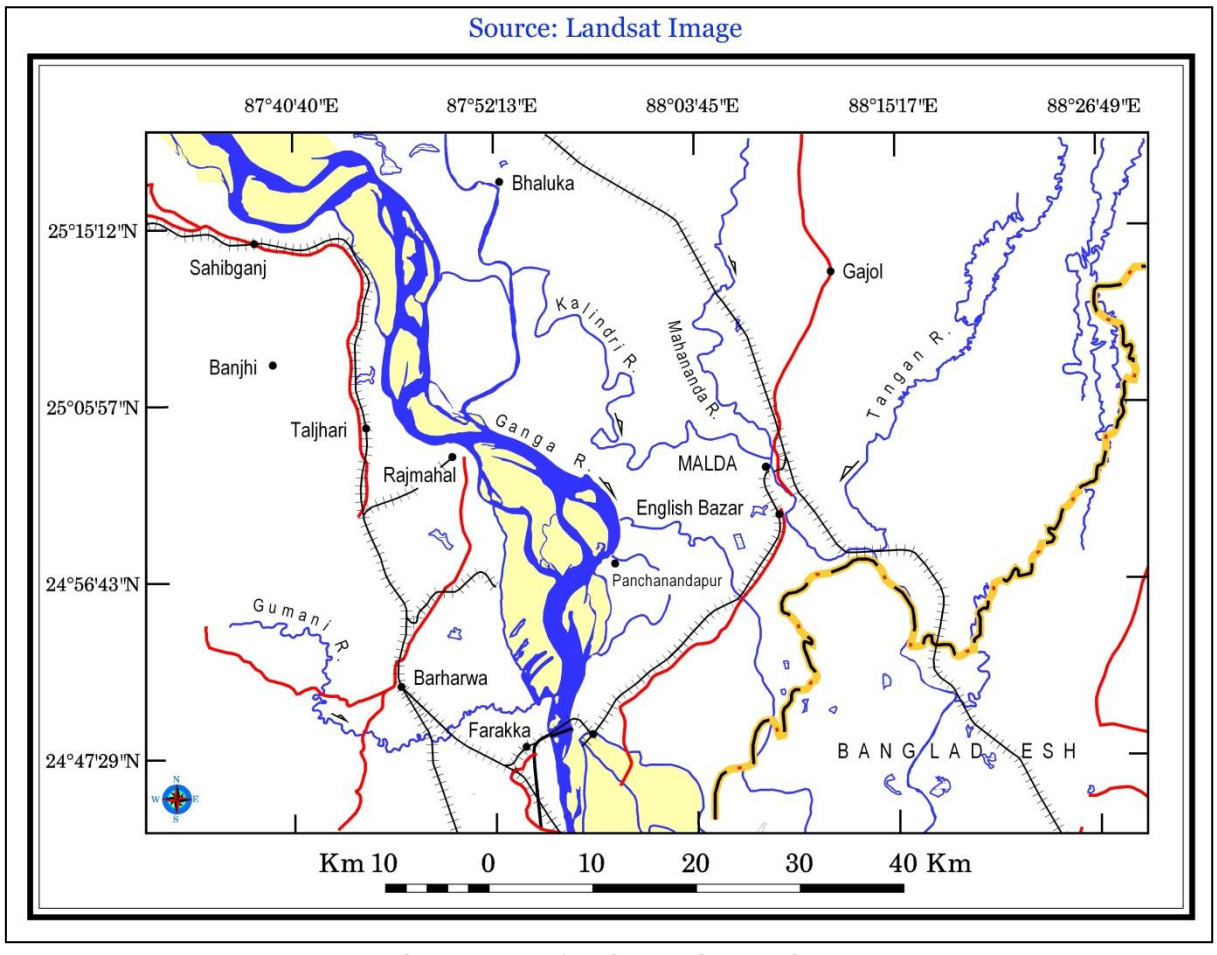
Map No 13 : Course of Mahananda River & Chota Bhagirathi, Rennell's Map

Image No 5 : River Mahananda Near Bakhrabad, Malda 25° 2'10.08"N 88° 7'57.98"E

Throughout the channel is generally deep, but the silting up of the Kalindri connections with the Ganges has diminished the volume of water it carries, so that in the dry season it becomes fordable in several places even as far down as Nawabganj. In the rains, when the snows melt, the river rises 20 to 30 feet and even more in years of high flood. Occasionally

the river straightens itself across a loop, as at Gumaslapur in 1867 and at Churamon in 1909, but in general the diluvion and alluvion which goes on is more gradual.

Map No 14 : Latest Image Showing the Course of Mahananda River, 25° 3'17.01"N 88° 7'57.59"E.



Map No 15 : The Course of Mahananda, Landsat Image 2019

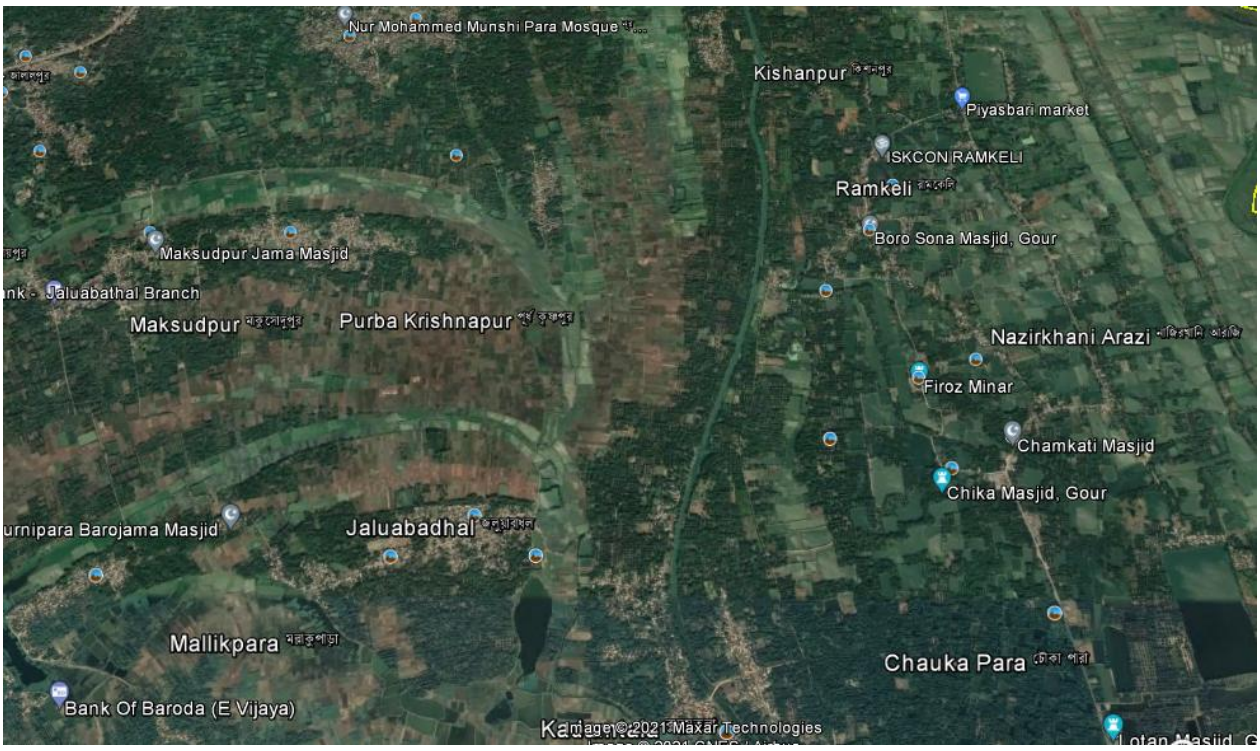
Image No 6 : Mahananda River Near Old Malda, 25° 1'57.17"N 88° 7'58.52"E

Image No 7 : River Kalindri Joining With River Mahananda at Old Malda 25° 2'25.10"N 88° 7'55.54"E

3.5C. River Chota Bhagirathi

It is one of the historical river of Malda. Luknowty/Gaur was the capital of Bengal for atleast 300 years. *'The Ganga formerly ran close to it, and its departure is easily accounted for, the soil to the westward being light and sandy, through which the river runs, continually shifts, filling up the place it has left with new land. The present distance from Gaur to the Ganga is nine or ten miles, but in one direction it has within the last five years (preceding 1801) approached three or four miles nearer, causing the natives, whose lands are cut away, to resort to the wastes of Gaur itself, who have brought some parts of it into cultivation; but it is unhealthy where they attempt to settle upon it. Rajmahal, Malda, and Murshidabad, for centuries have been supplied from hence with materials for building; and bricks and stones are continually carried away to other parts of the country on carts, bullock, and in boats, by the natives, for the purpose of modern edifices.' (Creighton 1817: 5). In 1505, a very powerful earthquake, which may have exceeded Richter 8.2 (Bilham, 2004), struck a wide swathe of the Himalayan front. There was considerable damage throughout north India. This earthquake is implicated by Hirst in the desertion of Gaur: 'In the 16th century Gaur was deserted. There was a severe earthquake in 1505 A.D., and shortly after it, the Ganga left its old course past Gaur and retreated southwards. The cause of this great change is not known, but it may have been due to earth movements between the old alluvium of Malda and the Chota-Nagpur outliers.' (Hirst, 1916: 41)*

At present we can find a small stream from Ganga Gobindapur (24°59'21.10"N 87°59'16.56"E) from the main stream of Ganga to move eastward through Sattara to meet with River Pagla (Garmahali, 24°50'46.03"N, 88° 7'26.54"E). The ruins of Gaur can be found this river.



Map No 16 : Present Course of Chota Bhagirathi

Image No 8 : River Chota Bhagirathi Near Sattari, Malda 24°59'7.73"N 88° 2'18.60"E

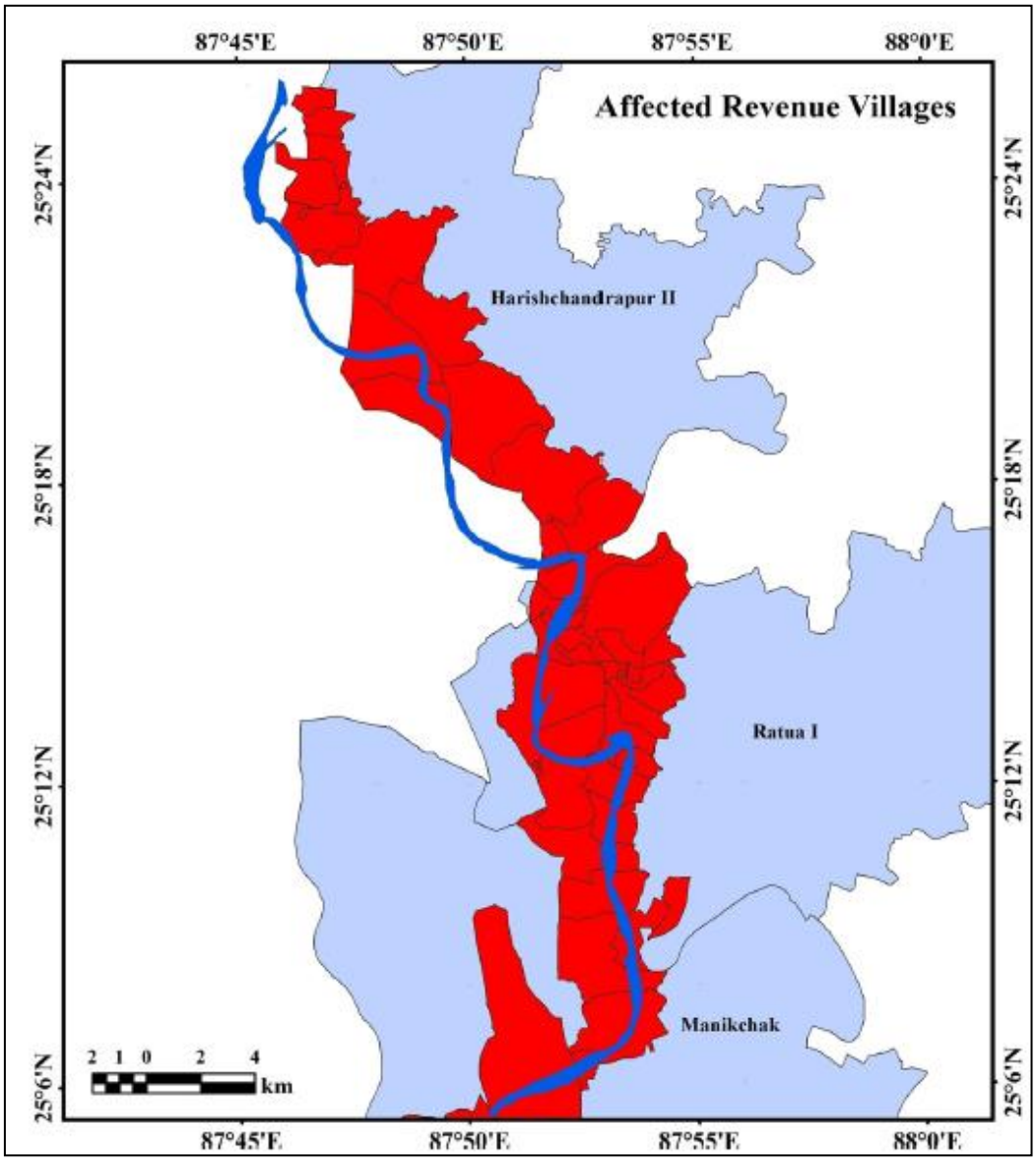
Image No 9 : River Chota Bhagirathi, Nayabad, Englishbazaar Malda 24°57'31.04"N 88°5'20.00"E

3.5D. The Fulahar River

The Fulahar is an important river of Malda extends about 60 km. It is a main flow of the river Mahananda. The river flows through Bihar and enter in the district near Mihaghat of Harishchandrapur-II (25320 N and 87370 E) and merges with Ganga at Manikchak (25080 N and 87480 E). The Mahananda river divided into two channels in Barsoi of Bihar district. Out of its two branches the western branch flows through the Bihar and Malda district of West Bengal by the name of Phulhar or Fulohar or Fulhar or Fulahar (Rudra 2010). The river Fulahar discharge into the Ganga river at Manikchak block in Malda district . Mostly the Tal and Diara region with alluvium of two different ages (e.g. Pleistocene and Tertiary). This region consists of layers of clay and sand. It originated in the age of Ramayana, the great Hindu epic, and takes off from old Mahananda or Mara Mahananda near Bagjob and entered into the district (Saha 2012). Buchanan Hamilton (1810) considered that Fulahar river lying over the Tal region within the district which was merely a branch of the Ganga. During the Nababi period (in the seventeenth century), it is known as Kalindri, after this century it renamed as Fulahar (field survey by the local people). As per the census of India 2011, the total population of the study area (Manikchak, Harishchandrapur-II and Ratua-I) is 796,546 persons. At present, the Fulahar meet the Ganga at West Narayanpur of Manikchak block. The main tributaries of this river system are Kankhar, Katiganj, Kalkos, Kankhor, Maria-kankhar, Kalikosi and Chitolia etc. For contributing the massive turbulence into the river, not only the Ganga herself rather the Fulahar individually acts as one of the causative factors of dynamic bank erosion in Malda district. Nowadays, the river Fulahar does not show a successive change in its course. The river move laterally in its channel bed. Occasionally, it moves two or three km towards the right bank side and at times moves towards the left bank side. During the summer month, the river water gets reduced; however, in monsoon the water level increases. The river experiences a prolonged flood in July, August and September every year. The western part of the Malda district receives floodwater from the neighbouring country of Nepal and the state of Bihar through a vast network of the river.

Image No 10 : Immersion of Lakshmi Idol in Fulahar River, 25° 6'44.45"N 87°53'4.82"E

The Fulahar river enter Mihaghat of Harishchandrapur-II C.D. block, it flows towards southern direction and meet the Ganga river in Paschim Narayanpur of Manikchak C.D. block of Malda district. The river runs through North western and western part of the district mainly Harishchandrapur-II, Ratua-I and Manikchak C.D. blocks. Due to the Fulahar River, these three blocks are affected by the erosion and deposition of its left and right bank during several years. The shifting characteristics of the river is escalating in every year and affecting more than 160 sq. km areas under the villages of HarishchandrapurII, Ratua-I and Manikchak blocks. Within these blocks, the percentage of affected area to total area is high in Harishchandrapur-II block. In the block, 29.79 sq. km areas are affected in respect of total area(21.49 sq. km in Ratua-I and 18.26 sq. km in Manikchak respectively). Among the affected blocks, 35 revenue villages are severe affected while 3 revenue villages are uninhabited . Most of the population of Harishchandrapur-II block (25.19 percentage of population in respect of total population of the block) are affecting by the Fulahar river bank erosion and flooding in every year. 14 revenue villages of Islampur, Daulat Nagar and Bhaluka gram panchayets of Harishchandrapur-II block are severely affected by the natural or man-made hazards .



Map No 17 : Showing the Affected Villages along Fulahar River

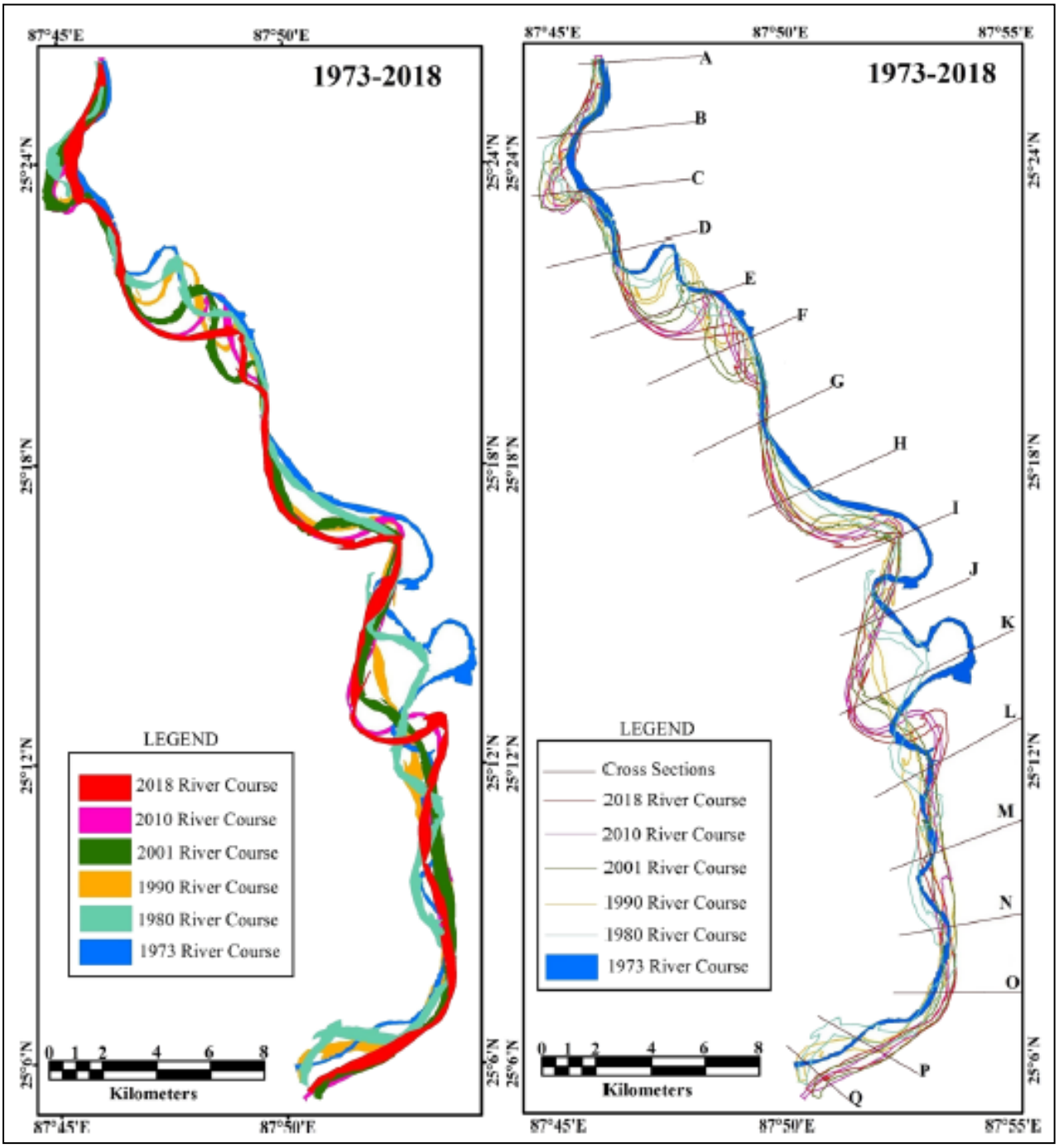
In every year, Mahanandatola and Belaimari gram panchayets of Ratua-I block one more affected than its other affected gram panchayets of Debipur and Kahala. On the other hand, Dakshin Chandipur gram panchayet of Manikchak block is more affected remaining other gram panchayets such as Narayanpur, Uttar Chandipur and Nazirpur . The river bank erosion and flooding are most hazardous phenomena in the study area. During 1998 and 1999, there as a massive flood in the Malda district. In 1998, 198 villages and 200,000 persons were affected in Ratua-I C.D. block, 99 villages and 140,000 persons were affected in Manikchak block, and 74 villages and 75,000 persons were affected in Harishchandrapur-II C.D block. Again in 1999, 218 villages and 90,000 persons in Harishchandrapur-II C.D block, 413 villages and 128,135 persons were affected in Manikchak C.D block, and 81 villages and 80,000 persons in Ratua-I were affected due to flood (DHDR 2007). So, most of the parts were devastated due to back to back floods in the study area. After that, no heavy flood occurred, but due to continuous increase in the water level of the Fulahar river most villages suffer from the flood every year.

Table No 3 : Measurement of Spatio-Temporal

Cross-sections	River width in metres					
	1973	1980	1990	2001	2010	2018
A	250.12	241.93	172.28	245.74	159.17	186.89
B	230.27	197.95	317.5	595.01	212.91	557.83
C	393.96	448.77	198.4	445.91	342.45	440.56
D	287.27	242.17	144.97	313.52	131.85	166.74
E	238.45	219.53	345.76	194.98	202.09	185.88
F	146.43	254.94	154.02	342.21	179.53	133.69
G	157.96	292.32	240.56	268.61	289.54	302.72
H	148.1	259.9	150.85	371.54	341.32	279.58
I	201.63	323.97	217.3	480	306.76	411.08
J	264.7	372.89	408.48	710.54	204.72	132.51
K	181.97	465.59	216.86	419.21	108.32	129.82
L	224.69	441.18	785.71	401.06	370.98	494.83
M	137.87	553.87	548.63	499.17	480.65	189.77
N	116.1	440.07	326.19	479.13	228.13	198.43
O	266.15	363.2	479.57	353.67	168.44	221.21
P	149.29	1327.04	1068.41	461.91	306.22	598.89
Q	195.86	435.57	305.82	351.1	379.49	202.27

The northern and middle part of the mainstream reflects its frequent shifting pattern than other parts . The shifting pattern and flooding cause several damage along with the riverine villages of these blocks . Due to the shifting nature of the river, the agricultural lands along both the bank areas (right and left) have become a barren land for excess siltation of sand. Primary economic activities, cultivation, fishing, agricultural practice and cropping pattern of agricultural land have been changed at an extreme rate. Sometimes the agricultural land becomes a barren land due to the siltation of sand by flooding. The villagers loss their

homeland, local rural infrastructure and services and also struggle for their survivals with the selected natural hazards.



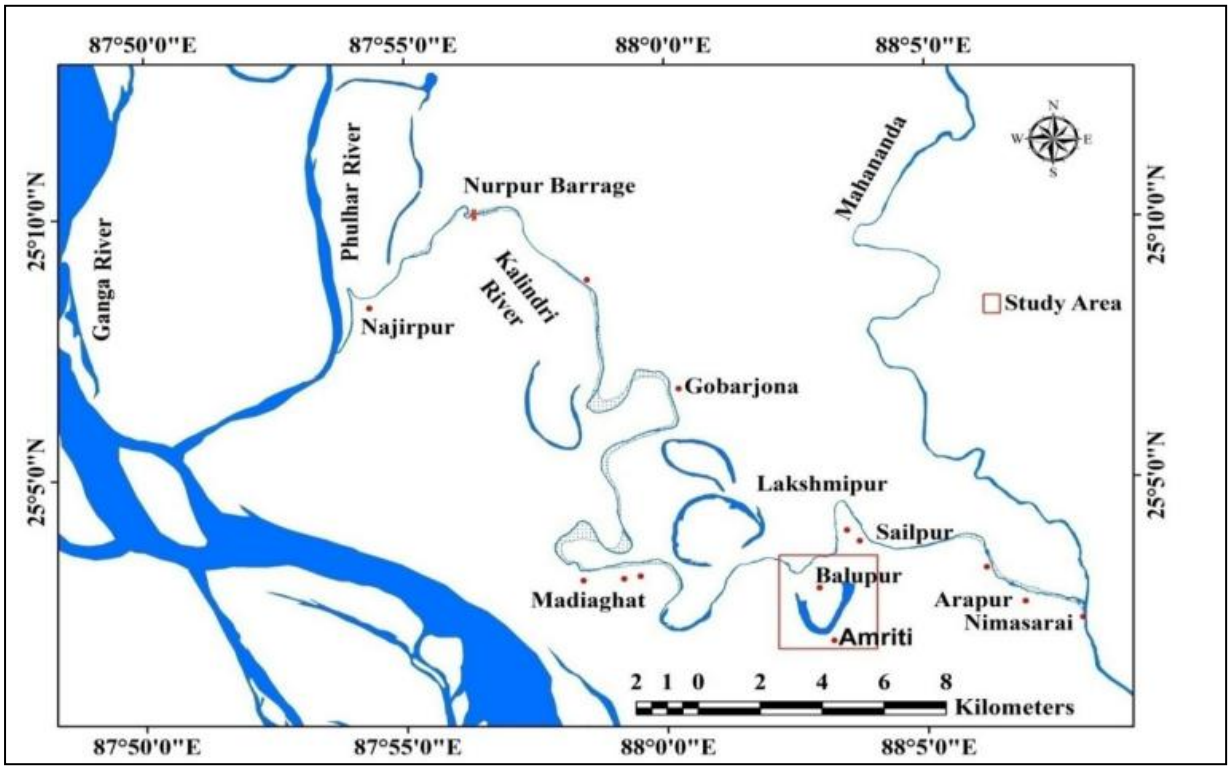
Map No 18 : Spatio-Temporal Shifting of Fulahar River, 1973-2018,

Source : Morphological analysis and channel shifting of the Fulahar River, Rubia Biswas.

3.5E. River Kalindri

The River Kalindri is taken as an off-shoot of eastern branch of the Ganges. It enters into the district near Miaghat of Harishchandrapur-II. The main body of its waters are Kalindri brought down from the mountains of Nepal by the Panar, which assumes the name of Kalindri shortly before its entrance into the district. In the Tal region, the river Kalindri receives four

tributaries, namely **Kalkos, Kankar, Kos and Baromasia.** These four small tributaries of Kalindri drain the excess water of Tal region and meet river Kalindri. After then, the river Kalindri is flowing mainly in south- eastern direction and meets river Mahananda near Nimasarai (25° 2'21.29"N, 88° 7'55.52"E). The alteration in the course of river Kalindri is still now going on. The present bed has being in places at some distance from the position of the river at the time of revenue survey.



Map No 19 : Course of Kalindri River

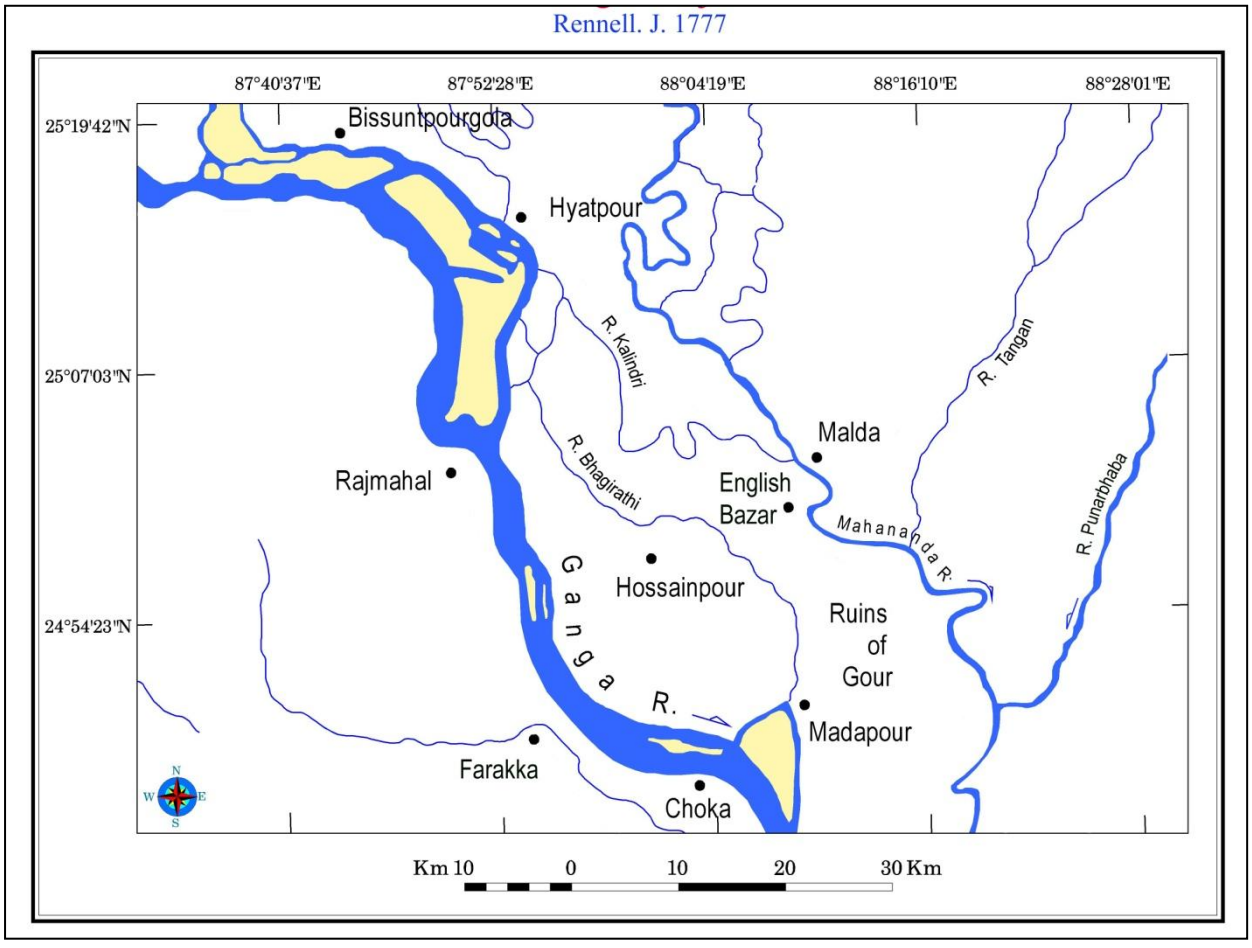
Image No 11 : Confluence of Kalindri River and Mahananda River

3.5F. Tangon & Punarbhaba

These two are very similar river systems. Both are narrow system, muddy and tortuous courses. Both are also the tributaries of the river Mahananda. The Tangaon forms the boundary between Gazole and Bamangola Block. The Tangaon appears to have shifted its course at various periods. Due to shifting of course, a branch of named Mara Tangaon, flows several kilometers through the police station of Gazole and join the mother course in Bamangola. These rivers Tangan flow from Dinajpur into the north-eastern comer of the district, where there are connections between them. At this point the country is low (duba) and of later alluvium. This low land continues into the district by the two broad valleys of the Tangan and Pumabhaba, which are divided by a triangular stretch of barind country, the base of the triangle being a line roughly parallel to the Mahananda and a few miles from it, whilst its general direction runs north and south. The northernmost of these valleys, that of the Tangan, has on Us west the barind which touches the Mahananda at Malda: its length is about 30 miles and in places it extends to several miles in width. The river (Tangan) winds circuitously through the valley and meets the Mahananda at Muchia Aiho, at which point the waterway of the railway bridge is 200 feet : in 1807, when Dr. Buhchanan Hamilton completed his manuscript, the point of junction was at Ahorganj, seven miles further south. The position of the remains of an embanked road and stone bridge at Raniganj, a hunting seat of the kings of Gour, shows also that there have been variations in the course of the river at that place. A small stream joins the river near Bamongola from the west: higher up at Nalagola the channel has been canalised in places and a navigable connection established with the Purnabhaba.

Image No 12 : River Kalindri, Milki, English Bazar, 25° 1'53.38"N 88° 0'4.51"E

Image No 13 : Kalindri, Old Malda 25° 2'34.64"N 88° 7'22.09"E

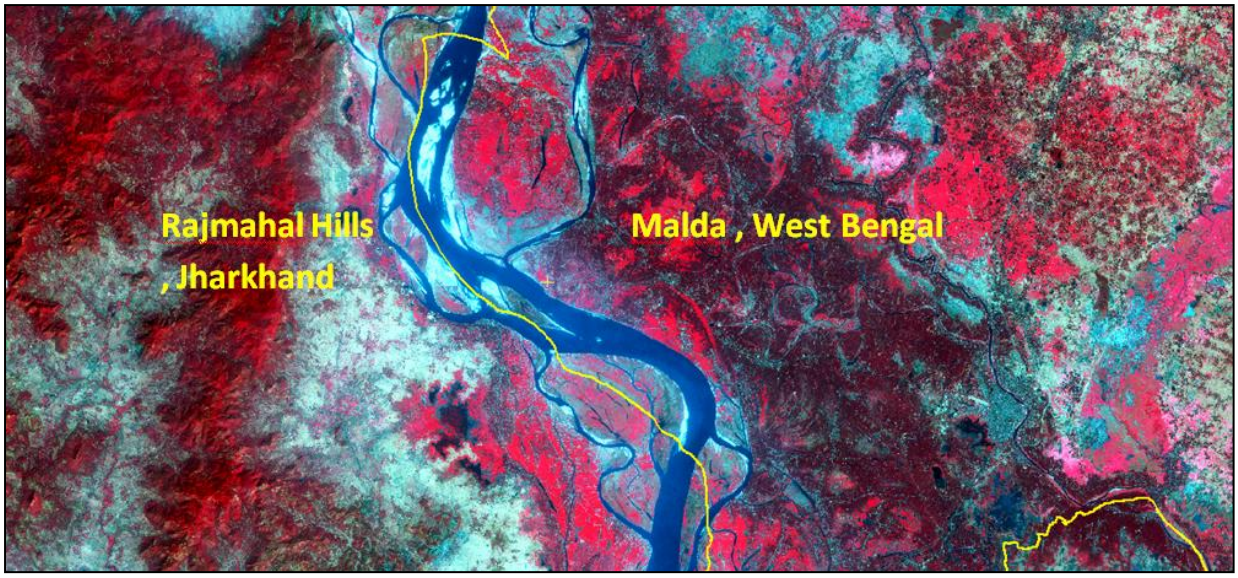


Map No 20 : River Tangon and River Punarbhaba Source : River Atlas, Dr. Kalyan Rudra

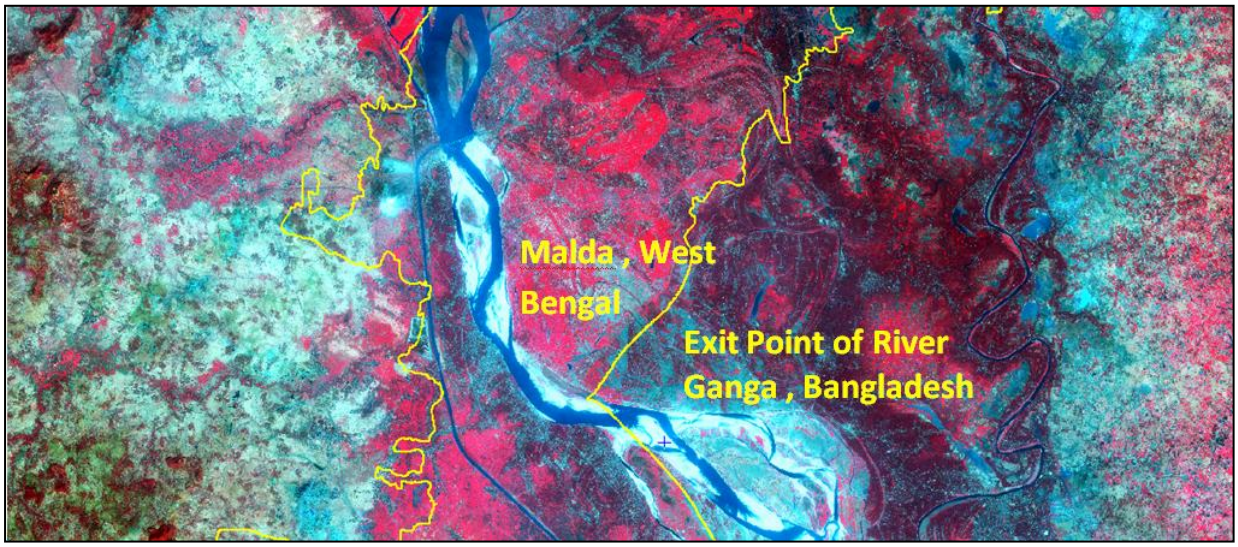
Table No 4 : Place of Origin of Important Rivers and Streams

Name of the River or Stream	Place of origin	Total Length in the District (in Km)	Entry Point to the District	Runs through C.D. Blocks	Branches	End Point
Ganga	Gangotri Glacier, Gaumukh	***60.98***	Kesarpur of Bhutni Char of Manickchak C.D. Block 25°11'36.79"N 87°48'36.93"E	Manickchak English Bazar Kaliachak1 Kaliachak-II Kaliachak-III	Fulahar, Bhagirathi Pagla, Kalindri Punarbhaba,	Dakshin Baidyanathpur at Kaliachak-III 24°39'19.25 N 88° 1'16.00"E
Chota Bhagirathi	Ganga Gobindapur	***29***	Ganga Gobindapur, English Bazaar 24°59'21.02"N 87°59'15.28"E	English Bazaar KaliachakI Kaliachak II Kaliachak III	-	Joins with Pagla River Mahadipur 24°50'48.28" N 88° 7'26.32"E
Kalindri	Tributary of Mahananda	***56.97***	Nazirpur, Manikchak Block 25° 8'29.95"N 87°53'46.85"E	Manikchak English Bazar,, Ratua-I	Fulahar	Mahananda River at Bachamari, Old Malda 25°2'24.69"N 88° 7'54.91"E
Mahananda	Paglajhora Falls on Mahaldiram Hill near Chimli, east of Kurseong in Darjeeling district	***71.39***	Junction of Chanchal-I, Ratua-II and Gazole C.D. Blocks	English Bazar, Old Malda, Habibpur, Gazole	Kalindri Pagla	Rishipur at Habibpur 24°52'44.60"N 88°15'35.54"E
Punarbhaba	Tributary of Ganga	***36.53***	North-East portion of Bamangola C.D. Block	Bamangola Habibpur	.-	Srirampur, Habibpur 24°52'14.84"N 88°19'54.76"E
Tangon	Jalpaiguri	***71.05***	Junction of Bamangola and Gazole C.D. Blocks	Bamangola, Old Malda, Habibpur Gazole	Chunakhali Khal	Aiho Habibpur E Mahananda River 24°57'32.58"N 88°13'43.99"
Nagri	Tributary of Mahananda	***30.02***	**-**	**-**	-	**-**

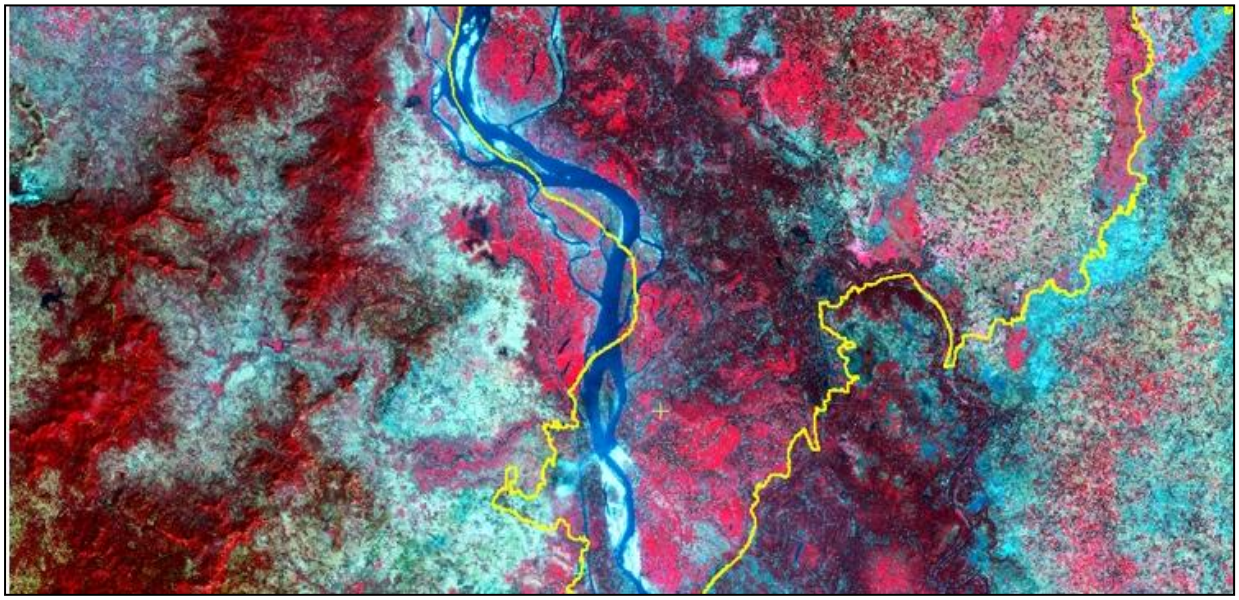
Source: Landsat Image 2020, District Census Hand Book Malda, Census of India, 2011



Map No 21 : Showing the Entry Point of River Ganga, From Rajmahal Hills, Jharkhand.



Map No 22 : Exit Point of River Ganga, Rajshahi, Bangladesh.



Map No 23 : Entire Course of Ganga in Malda District.

3.6. Climate

The Climatic characteristic of the district can be considered as one of the explanatory factors for the nature and type of surface water bodies essentially the 'bils' in the district. Reduction in the water quantities during summer months and recharging of water during monsoon and post monsoon months depend to a great extent on the temperature, humidity and precipitation. Rainfall naturally carries slightly more weight age in determining the recharge quantity and quality of water in the bils. The district with its notorious flooding background provides the recharging quantity and quality factors of the "bils" of the district.

3.6A. A brief description of the climatic parameters of the district is given below

The Malda district is significantly under hot and humid monsoonal climate. An oppressive summer season, plentiful rain and humid atmosphere all through the year are the main characteristics of the climate of Malda district. On the basis of temperature variation, rainfall, humidity and winds, the year of the district can be divided into four well defined seasons; namely

1) Hot- Summer Season- March to May,
2) Monsoon Season – June to September,
3) Retreating Monsoon-October to November and
4) Winter Season- December to February

1. The Hot Summer Season starts from March and ends in the 1st week of June. This season characterized by a rise in temperature, increases in the amount and frequent rainfall with the advance of the season, decreases in diurnal range of temperature. The total average temperature of this season is around 30°c, average diurnal range of about 6°c and average rainfall is 308.7m.m.
2. The Monsoon Season starts from June and extends up to September. The seasonal characteristic includes weak surface winds, cloudy sky, high humidity and sultry weather. The average rainfall during the season is recorded at 250 cm. Maximum amount of rainfall of the year takes place during this period.
3. In Retreating Monsoon through there prevails a homogeneous climate in plain nevertheless; a little heterogeneity in climatic conditions within and between different parts of the district in terms of variation in rainfall and range of temperature etc prevails.
4. The Winter Season starts from December and ends in February. The main characteristic phenomena of this season is cool weather, frequent morning fog, average monthly temperature above 10°c and a little amount of rainfall.

3.6B. The Different parameters of Climate

a. Rainfall and Humidity - The average annual rainfall is 1326.08 mm from year 2014 – 2018. The maximum rainfall in the area as per IMD data was recorded in the month of June and July followed by August and September (Refer table no. 3-2 and Figure 3-3). The rainfall in winter season is very low in amount.

Table No 5 : Rainfall Yearly Distribution

Months	2014	2015	2016	2017	2018	Av. Rainfall
JAN	mm	0.3	18.8	16.9	0.9	0
FEB	mm	54.4	1.6	0	0	7.6
MAR	mm	1.4	43.4	2.1	12.4	22.9
APR	mm	4.2	103.7	21.6	94.8	112
MAY	mm	152.1	154.2	85.4	110.6	153.6
JUN	mm	263.3	257.3	157.4	76.5	85.3
JUL	mm	315.1	419.1	407.3	352.6	230.2
AUG	mm	226.2	330	152.1	580.5	148.9
SEPT	mm	267.3	193.6	337.9	200.1	133.4
OCT	mm	19.1	17.2	72	143.9	51.2
NOV	mm	0	0	0	0	0
DEC	mm	0	0	0	5.7	12.3

Source : ***Source: India Meteorological Department, Ministry of Earth Sciences***

b. **Temperature** - This district lies in near Himalayan foothills. So, the climate is not too much hot. The minimum temperature of the district lies within the range of 10.7° and 26.1° Celsius in the month of January and August respectively and maximum temperature lies within 24.2° and 36.1° in the month of January and April respectively. Below table 3-3; mentioned the temperature variation throughout the year;

Table No 6 : Monthly Average Temperature Distribution of Malda District

Months	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Temperature (°C)	17.4	19.7	25	29.1	30.1	29.7	28.9	28.8	28.8	26.9	21.8	18.7
Min. Temperature (°C)	10.7	12.7	17.3	22.1	24.7	25.8	26.1	26.1	25.8	22.8	15.8	12.2
Max. Temperature (°C)	24.2	26.8	32.7	36.1	35.6	33.6	31.8	31.6	31.8	31	27.9	25.2

c. **Relative Humidity, Wind speed & Wind direction** - The entire District experiences a high relative humidity that is spread uniformly. Generally, the humidity ranging from 59 - 91%

during the monsoons and the relative humidity generally decreases in drier months of March and April are less humid with the relative humidity ranging between 31% - 55%.

The winds over the district are high during Monsoon, the average wind speed in monsoon seasons varies from 11.5 mph to 16.5 mph, and occasionally this wind speed goes over the 20-mph due to depression and local storm. The wind direction in the monsoon season is South- West wind.

3.7. Soil

The pedological characteristics of the district do not have a very strong explanatory characteristic so far as the thematic spreads of the present research work. However, the bils or water body areas partly act as depositional areas as follow up of surface runoff and resultant structural change over of soil horizon. Broadly speaking except that of Barind region the entire district possesses a strong active alluvial characteristic and the beels areas are no exception. But since the bils' areas contain some kind of static hydrological condition the scope of depositional activities leading to creation of specific soil characteristic that take place. The overlying introduction of newer soil ingredients as product of the surface runoff is expected to create a pedological composition that becomes a part of the abotic components in the bils ecosystem. The district having different physical and physiographical characteristics is covered by alluvium of two different ages. Older alluvium dominates the Barind region while newer alluvial dominate both Tal and Diara regions. So, the soils of the district are locally classified as below;

3.7A. Soils of Barind Area

Barind Soils are usually made up of massive argillaceous beds of a pale reddish brown colour. It is composed of stiff clay, containing iron and lime and become extremely hard in the cold weather.

3.7B. Soils of Tal Area

The Soils of Tal region are clay loam to sandy loam in texture. These soils are light loam called 'Do-ash'. It is a later alluvial formation and consists of an admixture of clay and sand.

3.7C. Soils of Diara Area

The Soils of Diara region are relatively new one and most fertile. These soils are admixture of sand and clay.

But according to the National Bureau of Soil Survey and Land use Planning (WBSS & LUP) map of soil occurrences in West Bengal, the District of Malda possesses 14 categories of soil. These occurrences are shown in the Fig. 5-2. In the following table 5-1 the number codes of the soils of Malda area given with their respective brief description highlighting soil depth, texture, drainage, slope, erosion, salinity etc. of the dominant and associated subdominant mapped soils.

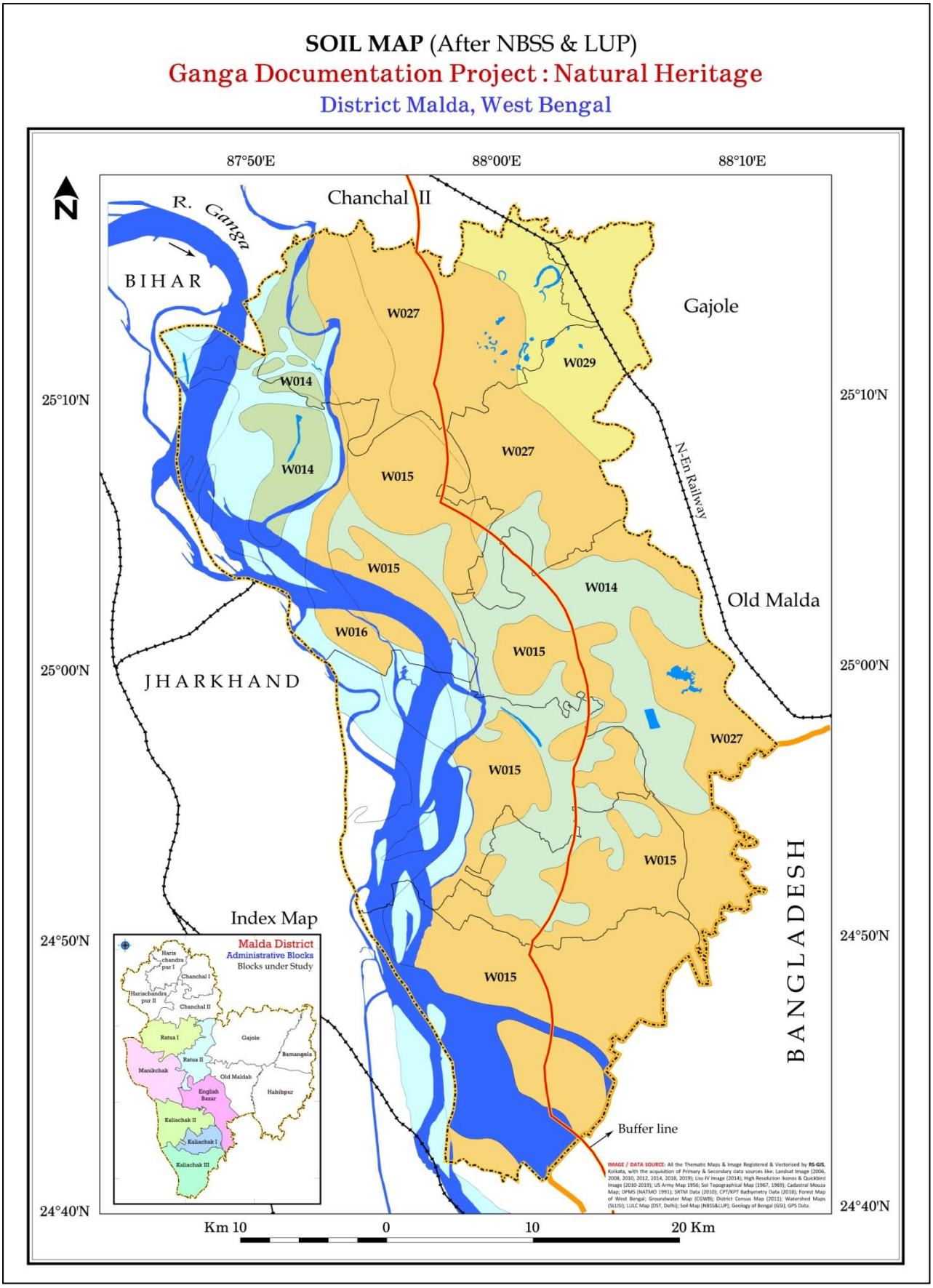
Table No 7: Soil Detail Descriptions

Sl.no	Soils Symbols	Geomorphological Unit	Description
1	W011	**ACTIVE ALLUVIAL PLAIN (AaA) (Flood plain soil)**	Very deep, moderately well drained, fine loamy soils occurring on level to nearly level active alluvial plain with loamy surface and moderate flooding associated with very deep, imperfectly drained, fine soils
2	W014		Very deep, imperfectly drained, fine soils occurring on level to nearly level active alluvial plain with loamy surface and moderate flooding associated with very deep, moderately well drained, fine loamy soils
3	W015		Very deep, moderately well drained, coarse loamy soils occurring on very gently sloping active alluvial plain with loamy surface associated with very deep, imperfectly drained, fine loamy soils
4	W016		Very deep, moderately well drained, fine silty soils occurring on very gently sloping active alluvial plain with loamy surface and moderate erosion associated with very deep, moderately well drained, fine loamy soils
5	W017	**RECENT ALLUVIAL PLAIN (AaB) (Most recent soil)**	Very deep, well drained, coarse loamy soils occurring on level to nearly level recent alluvial plain with loamy surface associated with very deep, imperfectly drained, fine loamy soils
6	W019		Very deep, imperfectly drained, fine loamy soils occurring on level to nearly level recent alluvial plain with loamy surface and moderate flooding associated with very deep, imperfectly drained, coarse loamy soils
7	W021		Very deep, poorly drained, fine soils occurring on level to nearly level recent alluvial plain with clayey surface and moderate flooding associated with very deep, imperfectly drained, fine loamy soils
8	W024		Very deep, imperfectly drained, fine loamy soils occurring on very gently sloping recent alluvial plain with loamy surface and moderate erosion associated with very deep, imperfectly drained, fine loamy soils
9	W027		Very deep, moderately well drained, fine loamy soils occurring on level to nearly level recent

			alluvial plain with loamy surface associated with very deep, imperfectly drained, fine loamy soils
10	W029		Very deep, poorly drained, fine loamy soils occurring on level to nearly level recent alluvial plain with loamy surface associated with very deep, poorly drained, fine soils
11	W030		Very deep, moderately well drained, coarse loamy soils occurring on level to nearly level recent alluvial plain
12	W033	**OLD ALLUVIAL PLAIN (AaC) (Sub-recent soil)**	Very deep, imperfectly drained, fine loamy soils occurring on level to nearly level old alluvial plain with loamy surface associated with very deep, moderately well drained, fine loamy soils
13	W034		Very deep, imperfectly drained, fine loamy soils occurring on level to nearly level old alluvial plain with loamy surface associated with very deep, imperfectly drained, fine loamy soils
14	W035		Very deep, imperfectly drained, fine loamy soils occurring on level to nearly level old alluvial plain with loamy surface and moderate flooding associated with very deep, poorly drained, coarse loamy soils

According to NBSS & LUP the entire state of West Bengal has been divided into several agro-ecological sub regions. The district of Malda falls within the sub region 'Hot moist sub humid (Bengal basin)' unit which stretches from North Dinajpur in the north to north of Gangetic Delta of South 24 Paraganas and coastal sandy soil area of south-eastern part of Midnapur covering entire portions of Malda, Murshidabad, Nadia, Hooghly, Howrah and North 24 Paragonas. It covers eastern parts of Birbhum, Bankura, Bardwan and Midnapur districts, thereby constituting the most extensive sub-region within the state.

This agro-ecological sub-region comprises the Ganga Plain (Bengal Basin) and eastward continuation of Indo-Gangetic Alluvial Plain. The sub region occupies an area of 4.93 m. hectares representing 55.7% of the total geographical area of the state. The soils have been developed in the alluvium laid by Ganga and its tributaries and sub tributaries. These soils are greatly variable in their morphological, physical and chemical properties depending upon the geomorphic situations, moisture regime and degree of profile development.



Map No 24 : Soil map of Study Area, Malda

3.8. Ground Water

Ground water table is very significant item with regards to the genesis and properties etc. of the soil. The depth of the water table of any region is bound to various factors such as – physiography, climate, and porosity of substrata water table in the uplands and in the low lands of the district is thus expected to differ considerably. The depth of the ground water table also depends on the distribution of moisture in the various soil horizons. The level of ground water depends to a great extent on the geological conditions too as the height of the water table depends on the underground relief. The relief of the water table changes constantly in relation to the condition of the water balance of soil and ground water. Ground water table is balanced by the amount of rainfall, rate of evaporation, rate of run-off and of the amount that percolates through the soil body. The conditions of ground water table of Malda district, during both summer and rainy season are discussed below,

During summer the water table lies between 7.97 meters to 50.58 meters below the surface over the whole of the district. Major part of the ground water tables lies between 19.98 meters to 39.96 meters from the surface. Water table remains at a greater depth (above 19.98 meters from the surface) in Chanchal, Dakshinsahar, Malda, Sekhpura, Betla etc. In summer water table lies below on an average of 11.97 meters in Kaliachak Police Station and 19.98 meters below the surface in Habibpur Police station. In most of the area water table lies between 6.90 meters to 39.96 meters covering the blocks of English Bazar, Gazole, Chanchal, Ratua, Harishchandrapur-I etc. The depth of the water table from the surface is highest 39.96 meters in Gazole block of Barind area.

During rainy season ground water table is lies between 2.92 meters to 25 meters from the surface. Ground water table of the district lies nearer to the surface of the soil. But it is not continuous all over the district. On the south-west, east and in the middle of the district, water table lies between 3.96 meters to 5.97 meters below the surface. In the northern part of the district water table lies below 3.96 meters and more from the surface. The general water table lies more or less nearer to the surface.

The below mentioned table has illustrated the last 23 years Ground water level (1996-2018) of Pre-Monsoon and Post-Monsoon of this district;

3.9. Natural Vegetation

As a part of the biotic components of the ecosystem in Malda, flora plays their vital role in human survival and activities. Some portions of Barind area are covered by jungles, which consist chiefly of thorny scrub bush jungles mixed with Pipal, Bat, Simul and Pakur trees and Nepal Bamboos. Species of thorny bamboos are also seen in Pandua areas and ordinary Neem tree, Jack-fruit tree, Tamarind, Bamboo, Peepul tree and Mango tree are seen in plenty in embankment areas of Gour. The soil of the western and southern region of the district i.e. Tal and Diara regions are particularly suited to the growth of mulberry and mango, for the production of both Malda has become famous. Maize and litchi also grown in these two regions. This district of Malda is world famous for mango fruit. Other fruits like jackfruits, custard apple, mulberry, peach, gooseberry, wood apple, betel nut and coconut are also

available. Among the jungle trees babool, wild palm, pepul, acacia, burged, tamarisk, sisoo, sagoon, toon, gamar, arjun, bamboo, simul are noteworthy.

About 22 types of botanical species are identified all over the major wetlands of Malda. Those are: Bara Pana (*Potamogeton Crispus*), Bhringaraj (*Wedelia Chinensis*), Gima (*Polycarpon Prostratum*), Hatisur (*Heliotropium*), Hingcha (*Enydra Fluctuans*), Halencha (*Alternanthera Philoxeroides*), Jangli chal (*Hygroryza Aristata*), Kalmi (*Ipomoea Aquatica*), Kulekhara (*Hygrophila*), Kachu (*Colocasia Esculenta*), Kuchuri Pana (*Eichhornia Crassipes*), Kureli (*Hydrilla Verticillata*), Kutipana (*Azollaceae*), Makhna (*Euryale Ferox*), Nag Phul (*Ovalifolium Forsk*), Padma (*Nelumbo Nucifera*), Saluk (*Nymphaea Nouchali*), Sola (*Aeschynomene Aspera*), Susni Sak (*Marsilea Minuta*), Thankuni (*Centella Asiatica*), Water Fern (*Salvinia Cucullata*) and Pani Phal (*Trapa Bispinosa*). From human point of view, these common hydrophytes play vital role to support the local people needs e.g. economically (salable product) as well as food value purpose (individual consumptive). Hydrophytes like kulakhara, thankuni, hingcha, gima, kalmi sak are also used for medicinal purpose by the villagers. On the other hand, a hydrophyte 'Makhna' is cultivated only in Tal region wetlands of the district. This particular very high protein and economical plant is very much effective to the local people for their economic needs. 'Sola', 'Pani-phal', are mainly grown in Chakla beel of Tal region of the district. Some hydro plankton also found in the wetland of this district. Some of hydrophytes are common in all wetlands of three geographical regions i.e. Tal, Barind & Diara regions. Common hydrophytes like kulakhara, Thankuni, Hingcha, Kuchuri pana, Susni sak, Kalmi sak, Bara pana, Gima, Saluk etc. are found all through the wetlans. From human point of view, these common hydrophytes play vital role to support the local people needs e.g. economically (salable product) as well as food value purpose (individual consumptive). Hydrophytes like kulakhara, thankuni, hingcha, gima, kalmi sak are also used for medicinal purpose by the villagers.

On the other hand, a hydrophyte '***Makhna'*** is cultivated only in Tal region wetlands of the district. This particular very high protein and economical plant is very much effective to the local people for their economic needs. 'Sola', 'Pani-phal', are mainly grown in Chakla beel of Tal region of the district. The reasons of these areal difference may be micro-ecological and beyond the perview of the present research. But from the above descriptive information it is evident that the phyto-geographical components available in the bils ecosystem are more or less uniform interms of their variety.

3.9A. Types of Vegetation

a. Trees :Albizzia lebbek (Sirish); Aegle marmelos (Bel); Acacia arabica (Babul); Azadiracta indica (Neem); Artocarpus integrifolia (Jack fruit); Anona sguamosa (Ata); Baisica latifolia (Mahua); Butea monosperma (palas); Borassus flabellifer (Tel); Ficus glomerate (Jagya dumur); Ficus hispida (Kakdumur); Caesalpinia pulcherrira (Krishnachuda); Cassia fistula (Sonali); Dendrocalamus strictus (Bamboo); Dyospyros melanexylon (Rend); Dalbergia sisso (Sisso); Liblica officianalie (Amloki); Ficus bengalensis (Banyan); Jambulana indica (Jam); Jerminalis arjuna (Arjun); Terminalia tomentosa (Plan); Ficus religiosa (Peepal): Mangifera indica (Mango); Madivika latifolia (Mohul); phoenix sylbestris (Date palm); Odina wodier (Jiyal); Pasidium guava (Guava); Tamarindue indica (Tamarind); Glvcosmis pentanhyla (Ash shaora); Tectona grandis (Teak); Shorea robasta (Sal).

b. Shrubs and herbs Agave sisslina (Mogra/Ageve); Calotropis procera (Shet Akanda): Clerodendron infortunatum (Ghetu); Flacontid nemontchi (Boinchi): Jatropa hossynifolia (Lal bharenda); Clerodendron inerma (Bonjui); immea azZiziphus iulube (Kul/Jujube); Vitex neaundo (Nishinda);

c. Grasses : Cynodondectylon (Doob); Bragrostis sp; Dicanthium annulatum: Saccherum munja (Ser); Solanum niahram (Kakmachi). Weeds Cvnerus rotundus (Muthe); Chenomdium album (Goose foot); Saccharum anontaneum (Kens); Commlina benghalensis (Kansira/Dholapata);

Image No 14 : Typical Riparian Grassy Vegetation Along the Ganga River Bank, 24°50'19.22"N 87°56'58.32"E

Image No 15 : Most of the Diara Area Along the River Bank is Covered with Mango Trees. 24°57'17.06"N 87°58'32.87"E, Birodhi, Malda

Image No 16 : Sankhartol Mango Garden, Dakkhin Chandipur 25° 7'36.80"N 87°52'32.07"E

Image No 17 : Mathurapur Mango Garden, 25° 7'0.90"N 87°53'41.99"E

Total forest area in this district is about 1.70 thousand hectares (Directorate of Agriculture (Evaluation), Govt. of W.B.

Table No 8 : Classification of Forest Area in Malda

Area by Class of forest	Unit	2009-10	2010-11	2011-12	2012-13	2013-14
Reserved forest	Hectare	773.95	773.95	773.95	773.95	773.95
Protected forest	"	373.04	373.04	373.04	373.04	373.04
Unclassed state forest	"	556.05	556.05	556.05	556.05	556.05
Khas forest	"	-	-	-	-	-
Vested waste land	"	-	-	-	-	-

Table No 9 : Forest Area, Out-turn of Forest Produce, Revenue and Expenditure of Forest Department from 2009-10 to 2013-14

Item	Unit	2009-10	2010-11	2011-12	2012-13	2013-14
Timber	Thousand cu. metre	0.460	0.129	0.071	-	0.496
Fuel	"	0.041	0.310	0.012	-	0.066
Pulpwood	"	-	-	-	-	-
Pole	Number	107	-	-	-	-

Table No 10 : Revenue & Expenditure

Revenue	Rs. in thousand	10882	1682	17761	15088	8284
Expenditure	"	34705	38644	38111	7905	7721

Source: Divisional Forest Officer, Malda

3.9B. Adina Deer Park in Malda district of West Bengal, 21 kilometres from the Malda City. The park is an important breeding centre for cheetal or spotted deer in the state and sometimes they overflow in number. The park also has a nilgai population. However, in spite of its name, the deer park is a small fraction of the area and protected within an orchard plantation. The woods are rich in butterfly and birds, specially Asian openbill, paradise flycatcher, prinia, oriole, fish eagle, etc.

Image No 18 : A Glimpses Adina Deer Park

Adina Deer Park was established in year 1982 on a transferred vested land at Adina Mouza, Block Gazole under Gazol;e Police Station of District: Malda, West Bengal with an area of 9.99 Ha inclusive of two water bodies. The Central Zoo Authority (CZA) granted conditional recognition of Adina Deer Park as Mini Zoo. The Park is under the charge of Divisional Forest Officer, Malda Forest Division, who is the Ex-Officio Director. Main objectives of the Deer Park is to establish and maintain facilities for ex-situ conservation and education, research on plants, animals, to organize conservation awareness programme to the visitors to apprise them the art of harmonious living with animal, to exchange spotted deer for obtaining new animal to improve the category of Zoo, to facilitate the eco-tourism along with the Zoo tourism, to provide transit shelter to ailing as well as injured animals & birds rescued from different parts of the district from time to time. Presently the Park houses 90 spotted Deer and 8 Nilgai. Adina Deer Park is about 350 km from Kolkata and is well connected by rail. The nearest railway station is Malda Town where all trains stop. It is situated at a distance of 22.5 km in the north of Malda Town. Average yearly visitors are more than 72,000. The zoo is opened from 9.30 am to 5.00pexcept weekly holiday.

Image No 19 : Saccharum Spontaneum (wild sugarcane, Kans grass) is Common Along River Bank

Image No 20 : Saccharum Spontaneum (wild sugarcane, Kans grass) is Common Along River Bank

3.10. Fauna of Malda

Wild animals were abundant till the first quarter of the nineteenth century. Among them Rhinoceros, Tiger, *Samber*, Leopard, *Bara Singha* deer, Spotted Deer, Antelope, Wild Cat, Wild Buffaloes, Hyena, Wolf, Wild-Cats were found. Among amphibious reptiles the snub-nosed crocodiles were found in large number in the Tangan and Punarbhava river and Gharial in the Ganga river.

According to Malda Gazeteer of 1904 : *Hunter remarks that "Malda has always been celebrated for the unusual quantity of large game which it affords and especially for its tiger hunting." Their breeding grounds were the katal (thorny scrub jungle of the barind) and the jungle covered ruins of Gaur and Pandua : their hunting grounds the grassy swamps which cover such considerable areas of the district and stretch away into Purnea and Dinajpur towards the hills. The last three decades have, however, seen the district cut off for wild animals from the Terai by the construction of the sub-Himalayan railways, and the jungles cleared and their inhabitants exterminated by the sonthals and Paharias, who have crossed the Ganges in large numbers to settle in the barind and other parts of the country. At the present time a tiger is somewhat of a rarity and is invariably a wanderer. The carnivora of the district are now represented by leopards and other smaller species. The ungulata comprise hog-deer and wild pig. Leopards are fairly common, particularly in the vicinityof English Bazar and Malda, where the undergrowth in the mango gardens and the deep ditches of the mulberry fields give them sufficient shelter. The Gaur variety is larger than the ordinary leopard of the village jungles, but has now become rare. The depredations of these animals areusually confined to cattle, pigs, goats, village dogs, jackals and monkeys. Some years ago there was a man-eating leopard near English Bazar which carried off seven boy cowherds before it was destroyed. Hog-deer are scarce, a few are to be found in the Shirshi and Singabad jungles. Wild pigs, though not in great numbers, are common and do some injury to crops.*

3.10A. Wetland Birds

But due to the over-increasing pressure of population most of the wild animals of late suffered extinction in Malda and shifted their habitat further north. Like the floral life, in this district the aqua life also very important. Malda District holds first position based on inland fresh water natural wetlands in West Bengal. Eleven big fresh water wetlands, out of 23 (>100 hectare) in West Bengal, are present in different blocks of this district (Anonymous, 1990). In North Bengal the large or small, permanent or seasonally waterlogged marshes are popularly known as “beel”. As per recent satellite data the estimated wetland area of Malda is 29416.95ha, which is 7.88% of the total geographical area of West Bengal (Bhattacharyya et al. 2000). The wetlands of this region are generally palustrine (floodplains, seasonal waterlogged, marsh), lacustrine (Lakes) and riverine types. All these wetlands are directly or indirectly connected with the different river systems like Ganga, Pagla, Mahananda, Tangan and Punarbhaba. The five most important bird habitats are from Diara & Barind . Farakka barrage (FB) on the river Ganga, Gabgachi-Bhatia wetland complex (GW) , Sagardighi (S) , Belatuli wetland (BW) and Nayabandh wetland complex (NW)) region for this study Among these five sites, GW is a large palustrine composed of several smaller water bodies like

Malanchapally beel, Bhatia beel, Abhirampur beel, Veon beel, Gabgachi I, Nander beel and Koimary beel. The NW is also a large palustrine with several smaller water bodies like Chakla beel, Bakla beel, Ramdole beel, Vikon beel and Sirisdanga. Sagardighi isan old and constructed lacustrine consisting of a single obliquely rectangular water body. FB on the river Ganga is also quite wide and houses various water birds.

NO.	NAME	SCIENTIFIC NAME	HABITAT	ABUNDANCE	STATUS
1	Lesser Whistling-duck	*Dendrocygna javanica*	Wetland	Common	Resident Breeding
2	Greylag Goose	*Anser anser*	Wetland	Fairly common	Winter Visitor
3	Cotton pygmy-goose	*Nettapus coromandelianus*	Wetland	Common	Winter Visitor
4	Common kingfisher	*Alcedo atthis*	Wetland	Common	Resident Breeding
5	Stork-billed kingfisher	*Halcyon capensis*	Wetland	Common	Resident Breeding
6	Pied kingfisher	*Ceryle rudis*	Wetland	Common	Resident
7	Common sandpiper	*Actitis hypoleucos*	Wetland	Common	Winter Visitor
8	Little stint	*Calidris minuta*	Wetland	Common	Winter Visitor
9	Little ringed plover	*Charadrius dubius*	Wetland	Common	Winter Visitor
10	Red-wattled lapwing	*Vanellus indicus*	Wetland, Agricultural Land	Common	Resident
11	Brown-headed gull	*Larus brunnicephalus*	Wetland	Common	Winter Visitor
12	Osprey	*Pandion haliaetus*	Wetland	Common	Winter Visitor
13	Grey Heron	*Ardea cinerea*	Wetland	Common	Resident
14	Great egret egret	*Casmerodius albus*	Wetland	Common	Resident
15	Intermediate	*Mesophoyx intermedia*	Wetland	Common	Resident
16	Indian pond heron	*Ardeola grayii*	Wetland	Common	Resident Breeding
Some Rare birds					
17	Spot-billed Pelican	*Pelecanus philippensis*	Wetland	Rare/NT	Resident Migratory
18	Goliath Heron	*Ardea goliath*	Wetland	Rare	Resident
19	Black-necked Stork	*Ephippiorhynchus asiaticus*	Wetland	Rare/NT	
20	. Tufted Pochard	*Athyra fuligula*	Wetland	Rare	Migratory
21	Baer's Pochard	*Aythya baeri*	Wetland	Rare/CR	Migratory
22	Pallas's Fish-Eagle	*Haliaeetus leucoryphus*	Wetland	Rare/VU	Resident Migratory
23	Greater Spotted Eagle	*Aquila clanga*	Wetland	Rare/VU	Resident
24	Lesser Adjutant -	*Leptoptilos*	Wetland	Rare/VU	Resident

	Stork	*javanicus*			Migratory
25	Black-bellied Tern	*Sterna acuticauda*	Wetland	Rare/EN	Resident
26	Gery-headed Lapwing	*Vanellus cinereus*	Wetland	Rare	Migratory
27	Marsh Sandpiper	*Tringa stagnatilis*	Wetland	Rare	Migratory
28	Greater Painted-Snipe	*Rostratula benghalensis*	Wetland	Rare	Resident Migratory
29	Black-winged Stilt	*Himantopus himantopus*	Wetland	Rare	Resident
30	White-breasted Waterhen	*Amaurornis phoenicurus*	Wetland	Rare	Resident
31	Painted Stork	*Mycteria leucocephala*	Wetland	Rare	Resident
32	Glossy Ibis	*Plegadis falcinellus*	Wetland	Rare	Resident
33	Oriental White Ibis	*Threskiornis melanocephalus*	Wetland	Rare/NT	Resident

NT : Near Threatened , VU : Vulnerable , R : Resident , RM : Resident Migratory, CR : Critically Endangered

Source *: Avifauna in five wetlands of Diara and Barind region in Malda District of West Bengal, India*

Image No 21 : Open Storkbill in the Sagardighi Wetland Area

Image No 22 : Nayabandh Wetland Complex, **Source : Maldah.gov.in during winter season**

3.10B. Fishes

Fish, of which may be mentioned the mullet, rahu, katla, chital, sir, boail, nanin, magor, saul, hilsa, and varieties of crabs, prawns, eels, turtles, and rays. Bhekti are sometimes met with. Snubnosed or man-eating crocodiles are very plentiful, particularly in the tanks and ponds of Gaur. The fish-eating alligator or gharial is common in the rivers, where also porpoises abound. Others are common in the bils.

a. Fish Diversity in Wetlands: Wetlands are hotspots of biological diversity and invaluable for sustainable living. The changes within the Ramsar Convention, the shift from 'save the waterfowl' approach to a more holistic nature-human interface has significantly reflected this approach. Yet, it must be underscored that till date, international dialogue on biodiversity hotspots is restricted to terrestrial systems. It must be noted in this context that although wetlands cover only six per cent of the earth's surface, they provide habitats for about 20 percent of the earth's total biological diversity . Thus it is very much important to assess the faunal diversity of the wetlands, specially the fishes. Here is a list of fish population –

Table No 11 : List of Fishes in Malda District

SL No	LOCAL NAME	SCIENTIFIC Name	DISTRIBUTION IN MALDA	Status
1	KOI	*Anabas testudineus*	MAHANANDA, MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR)	Least Concern (LC) ;
2	Chang	*Channa gachua*	MAHANANDA,	Least Concern (LC) ;

			MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR), ROAD SIDE DICH, LOWLAND, LOCAL PONDS.	
3.	Shal	*Channa marulius*	MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR), LOCAL PONDS.	Least Concern (LC) ;
4.	Khoira	*Gudusia chapra(Hamilton, 1822)*	GANGA, SAGARDIGHI (SODALPUR).	Least Concern (LC) ;
5.	Chapila	*Gonialosa manmina (Hamilton, 1822)*	GANGA, SAGARDIGHI (SODALPUR).	Least Concern (LC) ;
6	Fasa	*Setipinna phasa (Hamilton, 1822)*	GANGA, SAGARDIGHI (SODALPUR).	Least Concern (LC) ;
7	Foli	*Notopterus notopterus (Pallas, 1769)*	GANGA, SAGARDIGHI (SODALPUR).	Least Concern (LC) ;
8	Chital	*Chitala chitala (Hamilton, 1822)*	GANGA, SAGARDIGHI (SODALPUR).	Least Concern (LC) ;
9	Silver Carp	*Hypophthalmichthys molitrix (Valenciennes, 1844)*	GANGA, SAGARDIGHI (SODALPUR).	Near Threatened (NT) ;
10	Mourala	*Amblypharyngodon mola (Hamilton, 1822)*	GANGA, SAGARDIGHI (SODALPUR).	Least Concern (LC) ;
11	Rui	*Labeo rohita (Hamilton, 1822)*	GANGA, MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR)	Least Concern (LC) ;
12	Kalbus	*Labeo calbasu (Hamilton, 1822)*	GANGA, MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR)	Least Concern (LC) ;
13	Mrigel	*Cirrhinus mrigala (Hamilton, 1822)*	ALL OVER MALDA	Least Concern (LC) ;
14	Rai Khor	*Cirrhinus reba(Hamilton, 1822)*	ALL OVER MALDA	Least Concern (LC) ;
15	Bhola	*Garra annandalei (Hora, 1921)*	GANGA,	Least Concern (LC) ;
16	Balichata	*Acanthocobitis botia (Hamilton, 1822)*	GANGA,	Least Concern (LC) ;
17	Boumach	*Botia lohachata (Chaudhuri, 1912)*	GANGA,	Not Evaluated (NE)
18	Sona tengra	*Mystus vittatus (Bloch, 1794)*	GANGA, MAHANANDA	Least Concern (LC) ;

19	Bojretengra	*Mystus tengara (Hamilton, 1822)*	GANGA,	Least Concern (LC) ;
20	Aar	*Sperata aor (Hamilton, 1822)*	GANGA	Least Concern (LC) ;
21	Deshipabda	*Ompok bimaculatus (Bloch, 1794)*	GANGA, MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR)	Near Threatened (NT) ;
22	Boal	*Wallago attu (Bloch and Schneider, 1801)*	GANGA, MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR)	Vulnerable (VU); Date assessed: 12 August 2019
23	Pangas	*Pangasius pangasius (Hamilton, 1822)*	ALL OVER MALDA	Least Concern (LC) ;
24	Shingi	*Heteropneustes fossilis(Bloch, 1794)*	ALL OVER MALDA	Least Concern (LC) ;
25	Kankla	*Xenentodon cancila(Hamilton, 1822)*	ALL OVER MALDA	Least Concern (LC) ;
26	Chada	*Chanda nama (Hamilton, 1822)*	ALL OVER MALDA	Least Concern (LC) ;
27	Bot koi	*Badis badis (Hamilton, 1822)*	ALL OVER MALDA	Least Concern (LC) ;
28	Banspata/kajli	*Ailia coila(Hamilton, 1822)*	ALL OVER MALDA	Near Threatened (NT) ; D
29	Kholse	*Trichogaster fasciata*	ALL OVER MALDA	Least Concern (LC) ;
30	Shol	*Channa striata*	MAHANANDA, MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR), LOCAL PONDS.	Least Concern (LC)
31	Bata	*Labeo bata (Hamilton, 1822)*	ALL OVER MALDA	Least Concern (LC)
32	Magur	*Clarias magur*	MAHANANDA, MADHAIPUR LAKE (NARANPUR), SAGARDIGHI (SODALPUR), BHATIA LAKE (NISCHINTIPUR), LOCAL PONDS.	Rare

Source : Status of Ichthyofaunal Diversity of River Ganga in Malda District of WestBengal, India

b. Fish Diversity of Ganga River: The result showed that 69 freshwater fish species belonging to 9 Orders, 24 Families is found in Ganga stretch of Malda District. Out of 24 families Cyprinidae was found to be dominant having 21 species followed by Bagridae having 5 species. Order wise Cypriniformes contain 24 species followed by Siluriformes with 20 species and Perciformes with 13 species. Order Siluriformes contained 7 families and exhibited

maximum number of families. In this study 3 fishes, Glyptothorax telchitta(Hamilton, 1822), Amblyceps apangi (Nath and Dey, 1989) and Garra annandalei (Hora, 1921) were found to be locally very rare though they all are in Least Concern (LC) category in IUCN list. 4 exotic species, Oreochromis niloticus (Linnaeus, 1758), Ctenopharyngodon idella (Valenciennes, 1844), Cyprinus carpio(Linnaeus, 1758) and Hypophthalmichthys molitrix (Valenciennes, 1844) were also found in this stretch of Ganga.

Image No 23 : Fisherman With Catch in the Main Rivers of Malda

Image No 24 : Fishing Boat With Fishing Nets in the Main Rivers of Malda

c. Some Case Studies of fish diversities of the major Wetlands

i. **Siyali Wetland:** Fish diversity depends upon many physical parameters of aquatic environment as well as represents a rich blending of applied and fundamental ecology, which is achieved by the intersections among fishery science, ichthyology, and ecology *(Hasan et al., 2017)*. In the present study, Siali wetland hosts a wide range of fish species, which are considered to have immense socio-economic and cultural importance to the people of the peripheral area. From the field survey, about 10 species of fish fauna namely; *Arius arius* , *Clarias batrachus Labeo bata, Labeo catla* , *Labeo rohita , Cyprinus carpio, Cirrhinus cirrhosis* , *Hypophthalmichthys molitrix, Heteropneustes fossils, Ophiocephalidae Punctatus* belonging to 8 genera and 5 families are identified. These are mainly fresh water species and some of them arecommercially very important *(Appendix-6)*. Carnivorous air-breathing fishes i.e., live fishes like, Lata, Mangur, Shingi are fed on carp fry, fingerlings, and other unwanted fish species.

The fish fauna in this wetland namely Ar, Katla, Mrigel, and Koi are cultivated for the commercial purposes. Fish are the good source of food for piscivorous bird species and also for other higher vertebrates like frogs, snakes, fishing cats, the presence of which has been reported by the local people during field study. Pisciculture is one of the many occupations of the surrounding region. In Siali wetland, the fishing practice is done on lease basis under the Bhaluka fisheries cooperative society. The local villagers are not allowed to catch fish during the lease time period. But, people belonging to the wetland periphery are used to catch Teuthowenia pellucida (Gugli) local oysters/molluscs, tortoises and other available fishes for their personal consumption and income.

ii. **Chakla Wetland:** Chakla wetland is a typical example of middle Ganga wetlands and one of the very important water bodies of Malda district especially for the availability for fish fauna. It provides food and shelter to a large number of aquatic fauna and harbors many fresh water fish species. In the present study, the investigation has been undertaken to study as well as assess the biotic potential of this wetland with special emphasis on diverse icthyofaunal composition. The field study records that Chakla wetland is endowed with rich faunal diversity of around 13 species namely; *Labeo catla, Labeo rohita, Wallago attu, Cirrihinus cirrhosis, Amblypharyngodon mola, Chanda nama, Labeo calbasu, Pethia ticto, Clarius batrachus, Ctenopharyngodon idella, Tetradon cutcutia, Trichogaster chuna, Hypophthalmichthys molitrix, Ctenopharyngodon idella,* belonging to 11 genera and 6 families. These icthyofaunal species are considered the most abundant fish species, found from this wetland round the year. The major carps like Catla, Rohu, and Mrigel are mostly dominant due to seed stocking. These species are cultivated as well as used for the economic and commercial purposes. Chakla wetland experience fishing practice, which has been developed on lease basis under the fisheries cooperative society of Malda Zilla Parishad. People belonging to the wetland periphery are used to catch local oysters, tortoises and other available aquatic fauna for their own consumption along with the small income.

iii. **Naghria Wetland:** Icthyofauna is considered one of the important elements in the economy of the surrounding villages at the vicinity of Naghria wetland. This perennial cut off water body regularly supports substantial numbers of fish fauna, which is indicative of wetland values, productivity, and diversity. The immense aquatic biodiversity and fish resources support nutritional security and livelihoods of a large section of settlers at the vicinity of Naghoria wetland. 13 species namely; Labeo catla, Labeo rohita, Wallago attu, Cirrihinus cirrhosis, Amblypharyngodon mola, Chanda nama, Labeo calbasu, Pethia ticto, Clarius batrachus, Ctenopharyngodon idella, Tetradon cutcutia, Trichogaster chuna, Hypophthalmichthys molitrix, Ctenopharyngodon idella, belonging to 11 genera and 6 families. These icthyofaunal species are considered the most abundant fish species, found from this wetland round the year. The major carps like Catla, Rohu, and Mrigel are mostly dominant due to seed stocking. These species are cultivated as well as used for the economic and commercial purposes. Naghria wetland experience fishing practice, which has been developed on lease basis under the fisheries cooperative society of Malda Zilla Parishad. People belonging to the wetland periphery are used to catch local oysters, tortoises and other available aquatic fauna for their own consumption along with the small income. Near about 9 fish species, belonging to 6 genera and 5 families have been recorded. Among the identified fish species, majority are fresh water fish species including *Labeo bata, Labeo catla, Mystus tengara, Caridean shrimp, Macrobrachium rosenbergii, Cyprinus carpio, Clarias batrachus, Lebeo rohita , Labeo calbasu.* As this wetland is well connected with River Kalindri, some of the fishes migrate between wetland and the river and many riverine fish species have amalgamated here. Moreover, it is a good breeding ground for number of commercially important fishes like, *Clarius batrachus, Mystus tengara, Macrobrachium rosenbergii* and *Caridean shrimp*. Other than *icthyofauna,* amphibians are represented by different species of frogs and toads and these are mainly fed on insects and small fish species. They serve as food for different birds and reptiles. People belonging to the wetland periphery are used to catch *Teuthowenia pellucida,* local oysters/ molluscs, tortoises and other available aquatic fauna for their self-consumption and income.

iv. **Chatra Wetland :** Fishes are one of the important components in the economy of Malda district, as they have been a stable item in the diet of so many people as well as corroborate the livelihood and nutritional security of many more local fishers of Malda district. Chatra wetland was once one of the region's finest repositories of fish resources, which has been minimized rapidly. Presently, this water body exhibits a moderate ichthyofaunal diversity which is mainly fresh water species and some of them are commercially very important. A total number of 10 species of fish fauna namely, *Chanda nama, Badis badis, Clarias batrachus, Ophicephalus gachna, Labeo rohita, Pethia ticto, Trichogaster chuna, Mastacembelus pancalus, Macrobrachium rosenbergii, and Tilapia sparrmanii* belonging to 10 genera and 8 families are collected and identified from field study. The economically important fish species like Rohu, Bot koi, Khalisa, Mangur etc. are found moderately in this wetland. The declining fish diversity is attributed to unorganized fish catch and makhana cultivation. Apart from mentioned

biodiversity, snakes and frogs commonly feed on shellfishes, leeches and other worms, insects etc. At the time of observation and investigation, the presence of several insects and invertebrates like Diatoms have been identified and reported by the local settlers around the wetland.

Image No 25 : Typical Fish Nets Used for Fish Catching, Chinabazar, Kaliachak II

Chapter 4 : Documenting Nature & Properties of Natural Heritage

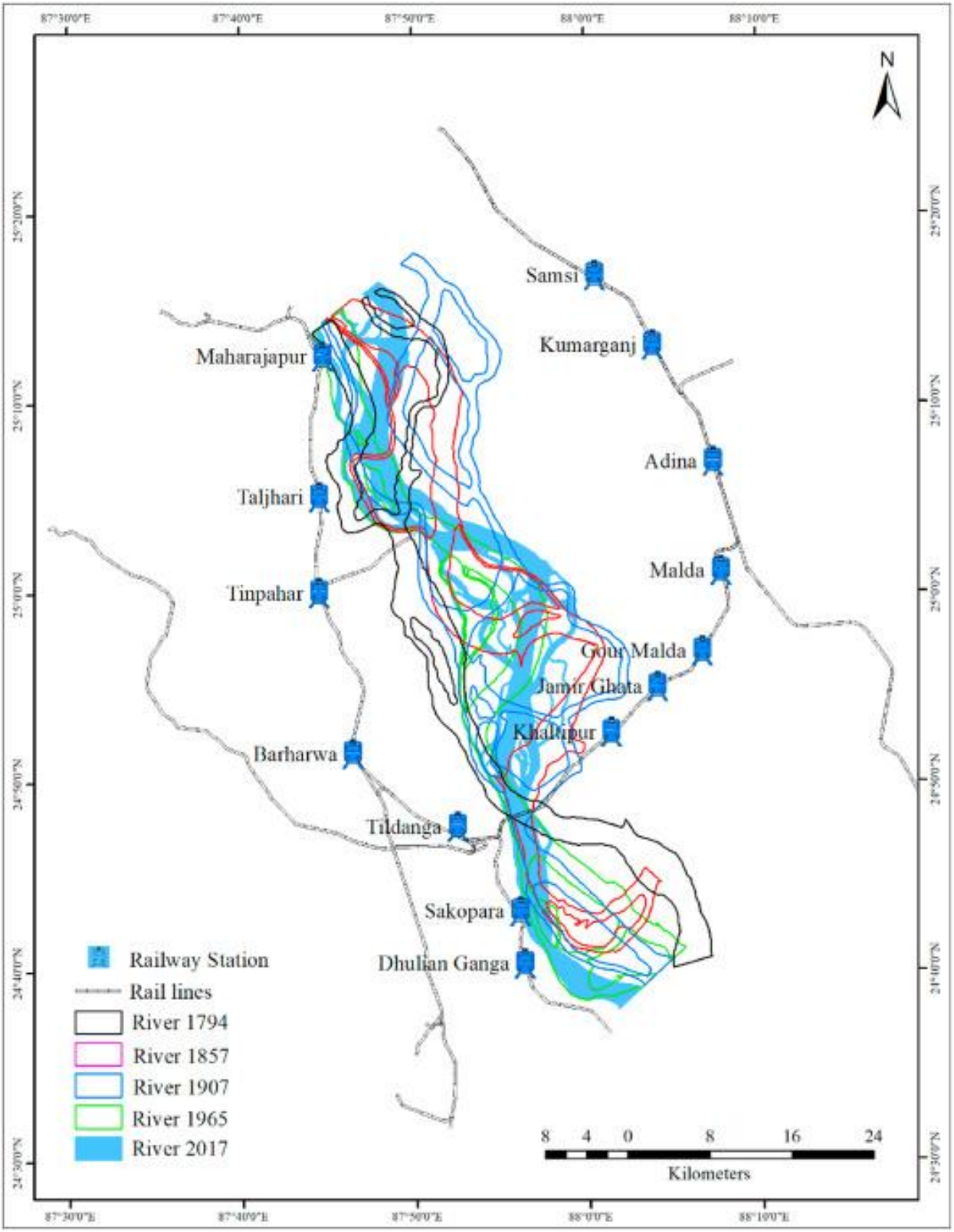
4.1. Characterestics Of The Flood Plain

We have seen how it is difficult to find words (in English at least) which reflect objectively the terrain which results from the behaviour of braided, meandering, avulsing, wildly fluctuating, eroding and land-building rivers, and how humans have attempted on a small scale to influence the changing landscape. It is also evident that our 'scientific' knowledge of the delta is very fragmentary and incomplete, and that there is plenty of scope for new data and new theories. Dr. Kalyan Rudra.

The Ganga river system is one of the largest river systems in the world covering 1.09 million km^2 catchment area which is fed by its numerous tributaries throughout its course (Dewan et al., 2017). As the river passes through different geomorphic characters in the deltaic region, the river repeatedly adjusts itself which leads to erosion and deposition (Mondal & Satpati, 2012). River Ganga has been changing its course for the last three centuries causing inactive channels to be left behind (Rudra, 2009). Das et al. (2017) have observed that the erosion process is very fast in west Bengal specially in Malda and Murshidabad since the last few decades.

4.1A. The Oscillating Ganga – 1777-2019

It has been observed that river Ganga is adjusting its course over a period of time. Thus, in the present study, an attempt has been made to detect the river course change in the study area from 1794 to 2019. The map depicts the change of the river channel at different particular times from nearest railway station. Total of 14 nearest stations along the river Ganga from both the east and west banks were selected for the study of change detection of the river . A historical analysis of river course change over the period of 223 has been done which reveals a drastic change of the river course between the years 1794–2019. The distance of the station from the river Ganga for 223 years has been changing drastically. Higher the variation of the distance from the stations to river Ganga higher the shifting in the river course. It is revealed that Jamir Ghata, Gour Malda, Malda and Adina stations on the east bank side and Dhulian Ganga, Sankopara station distance varies more than 10 km from 1794 to 2017. Concerning the increase or decrease of distance, changing distance from the stations to the river is not gradual except Dhulian Ganga and Sakhopara station. In the case of Malda station, distance from Ganga to Station decreased from 30.62 to 14.72 during 1794–1857 but in 2017 again the distance has increased up to 19.99 km. On the other hand, the distance from the present Dhulian Ganga station has decreased from 14.64 km to 2.11 km from 1794 to 2017 respectively and it is gradual.



Map No 25 : Stations Along River Ganga of 1794, 1857, 1907, 1965 and 2019 in the Study Area

Evolution of river course and morphometric features of the River Ganga: A case study of up and downstream of Farakka Barrage, Md.Nawaj Sarif , Lubna Siddiqui,Neha Parveen, Monojit Saha

S. No.	Name of the station	Year				
		1794	1857	1907	1965	2017
1	Samsi	17.73	18.51	12.99	28.18	23.59
2	Malda	30.62	14.72	13.32	22.15	19.99
3	Adina	32.26	22.99	22.82	22.91	20.96
4	Gour Malda	25.97	11.02	8.06	18.37	14.78
5	Jamir Ghata	20.42	8.66	4.16	19.32	10.81
6	Kumarganj	28.21	24.19	22.25	30.75	30.09
7	Dhulian Ganga	14.64	4.73	4.1	2.53	2.11
8	Khaltipur	12.68	3.316	4.36	12.43	8.38
9	Sakopara	10.34	2.32	1.616	1.05	0.58
10	Barharwa	10.25	18.36	13.57	13.73	13.67
11	Tinpahar	9.22	12.18	12.55	11.93	11.93
12	Taljhari	2.341	4.26	4.77	3.38	3.29
13	Tildanga	5.348	6.94	6.94	6.44	6.29
14	Maharajapur	0.49	3.41	1.44	0.24	0.18

Erosion and deposition mapping of River Ganga in the study area

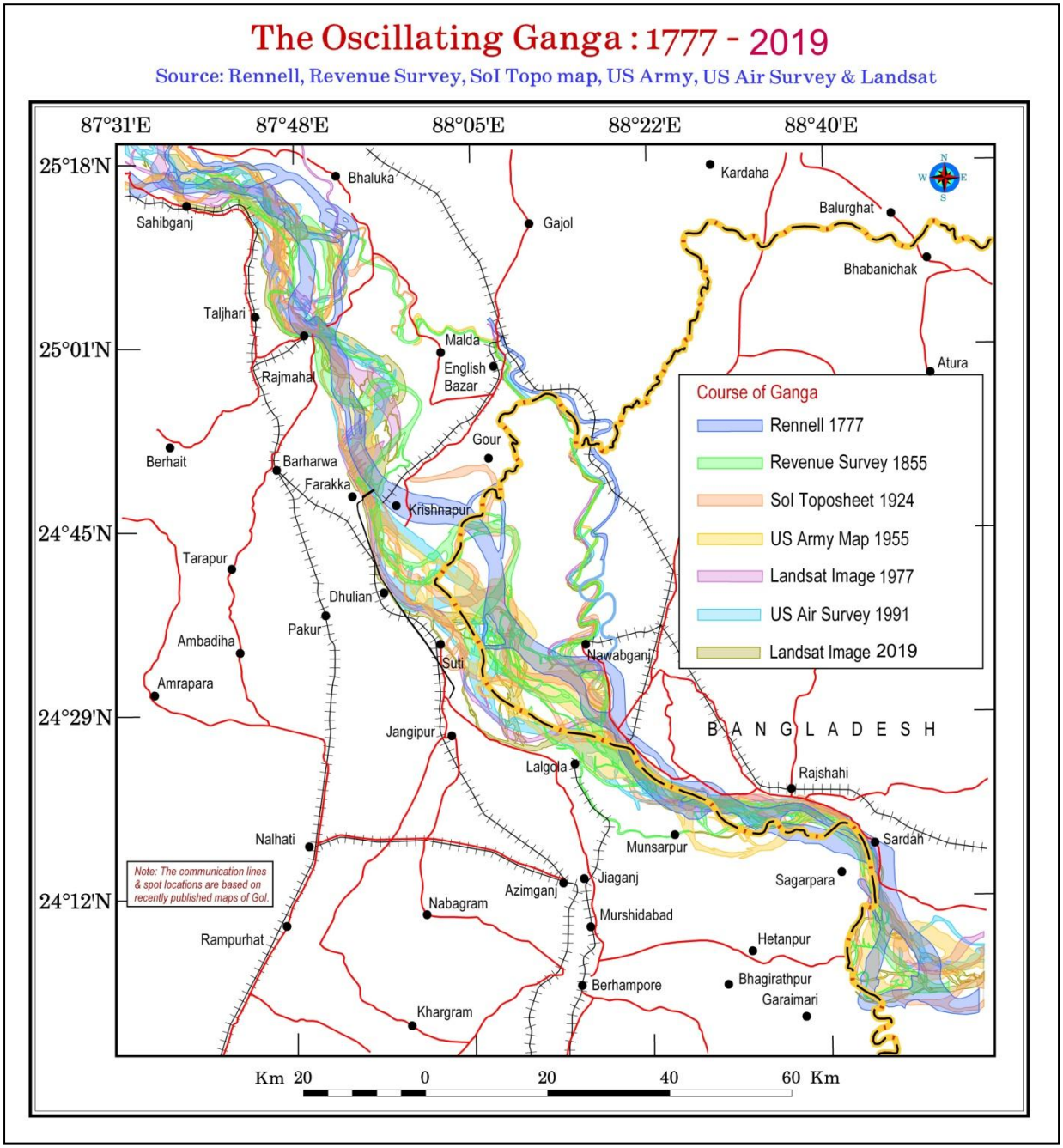
In the study area, both erosion and deposition is taking place from 1965. In fact, both the west and east bank of the river have experienced river bank erosion as well as accretion or deposition During this time period, the river Ganga continued to oscillate its course. The east bank of upstream and downstream of the Farrakka Barrage covers about 67.09 kms and 24.06 kms stretch respectively. This part of the river experienced lateral erosion of 62.64 km^2 whereas 26.7 km^2 land deposited in these sections between 1965 and 1980. In the same time span the west bank which covers 66.72 km at the upstream and 25.51 kms stretches at the downstream of Farakka Barrage eroded 30.13 km^2 and 6.72 km^2 respectively. In the time span, the amount of deposited land at the west bank of upstream was 36.32 km^2 while the downstream of the west bank experienced no deposition of land. It can be manifested that the river Ganga is not stable at the east side of the upstream of Farakka Barrage. However, some of the areas of east bank experienced deposition during 1965–1980 but part of this deposited land was again engulfed by the river from 1980 to 1996 reveals that the bifurcated channel started fading from 1965 to 1980 became moribund during 1980–1996. In the time period of 1996–2017, the east bank experienced lateral erosion of 61.99 km^2 at the upstream of Farakka Barrage and 11.66 km^2 at the downstream. During the same period west bank of upstream and downstream of the Barrage experienced 57.55 and 1.62 km^2 deposition. Meanwhile, deposition occurs over 31.91 km^2 land at the east bank and over 59.17 km^2 land at the west bank . The overall erosion of the river during 1965–2017 was 99.54 km^2 at the east bank upstream while at the downstream it is 13.39 km^2 . The overall erosion at the upstream and downstream of the Barrage during this period was 18.98 km^2 and 7.9 km^2 respectively. In the same duration east bank of upstream and

downstream of the Barrage experienced 6.1 km^2 and 45.45 km^2 deposition while the amount of deposited land at the east bank of the upstream and downstream was 75.48 and 1.62 km^2 .

As discussed, the east bank of river Ganga experienced higher bank erosion leading to **Manikchak, Kaliachak I, II and Kaliachak III** blocks being severely affected by riverbank erosion. It can be confirmed that the amount of erosion on the west bank is less than the amount of deposition.

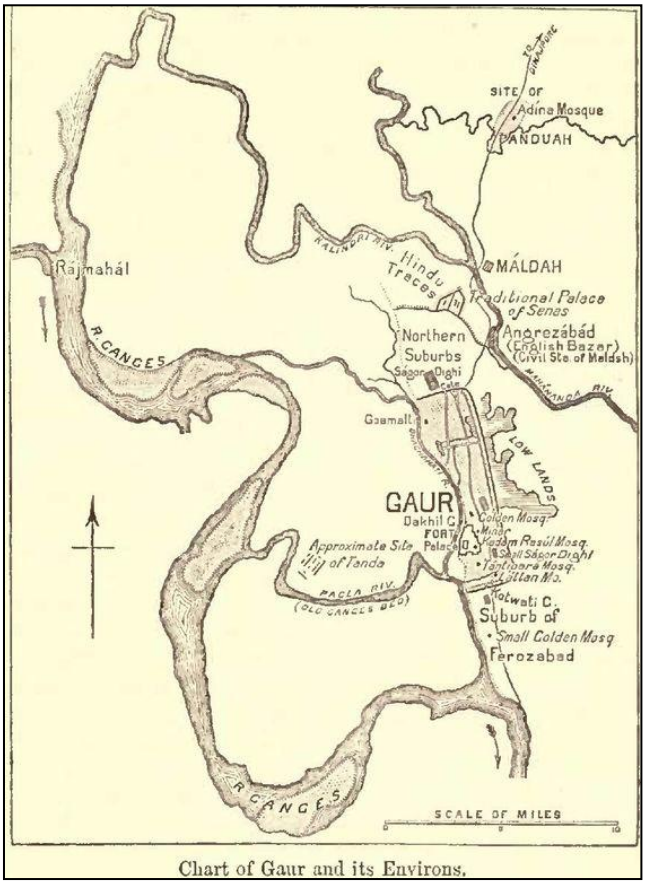
Block	1965–1980	1980–1996	1996–1917	1965–1917
Taljhari	0.19	0.35	0.36	0.24
Rajmahal/Narayanpur	31.93	18.72	33.61	28.79
Udhwa	1.01	0.10	0.002	0.48
Barharwa	0.09	0.01	0	0
Farakka	7.24	3.81	7.78	14.85
Samsherganj	5.29	0.70	0.85	5.34
Kaliachak2	28.0	16.37	11.93	19.34
Kailiachak3	7.96	7.28	7.087	10.42
Manikchak	21.39	35.42	30.68	49.55

Block	1965–1980	1980–1996	1996–1917	1965–1917
Taljhari	.74	1.13	0.94	2.14
Rajmahal/Narayanpur	36.96	36.16	31.12	48.76
Udhwa	0.80	0.48	1.35	2.00
Barharwa	0.003	0.01	0.22	0.13
Farakka	4.61	0.68	1.03	2.36.
Samsherganj	0.26	0.48	1.45	0.69
Kaliachak2	30.32	12.55	2.86	33.84
Kailiachak3	5.93	12.68	23.10	4.74
Manikchak	17.46	20.26	21.85	21.62

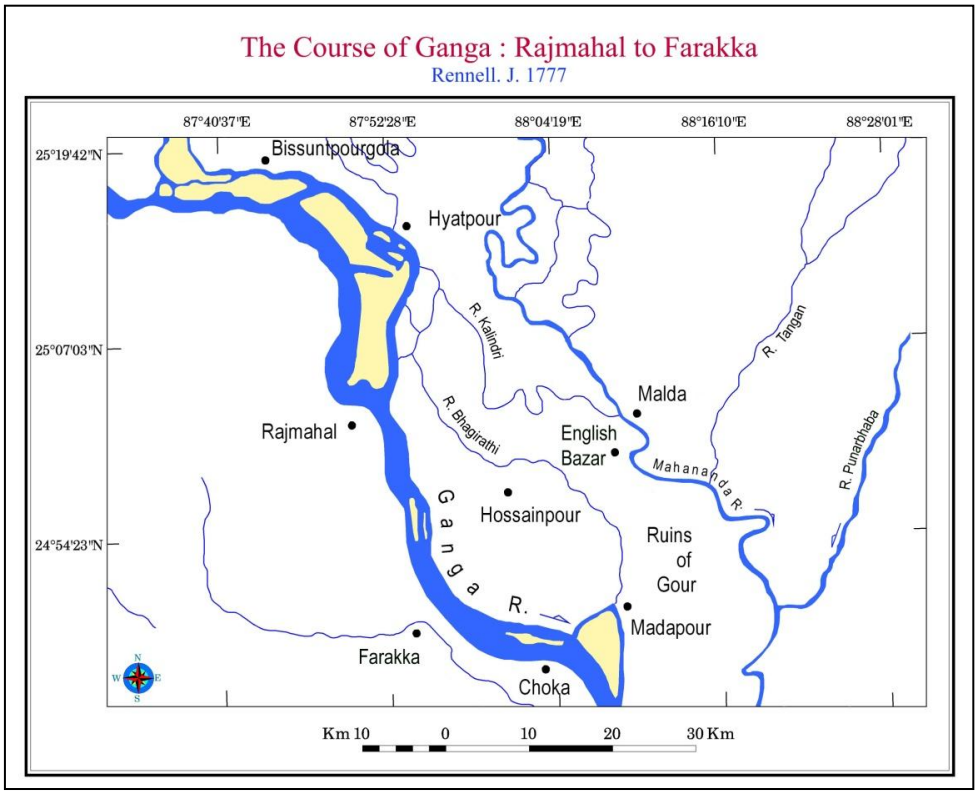


Map No 26 : Shifting of River Ganga from the Year 1777 till 2019. The Zone Between Rajmahal to Farakka is Worst Affected Specially After the Construction of Farakka Barrage

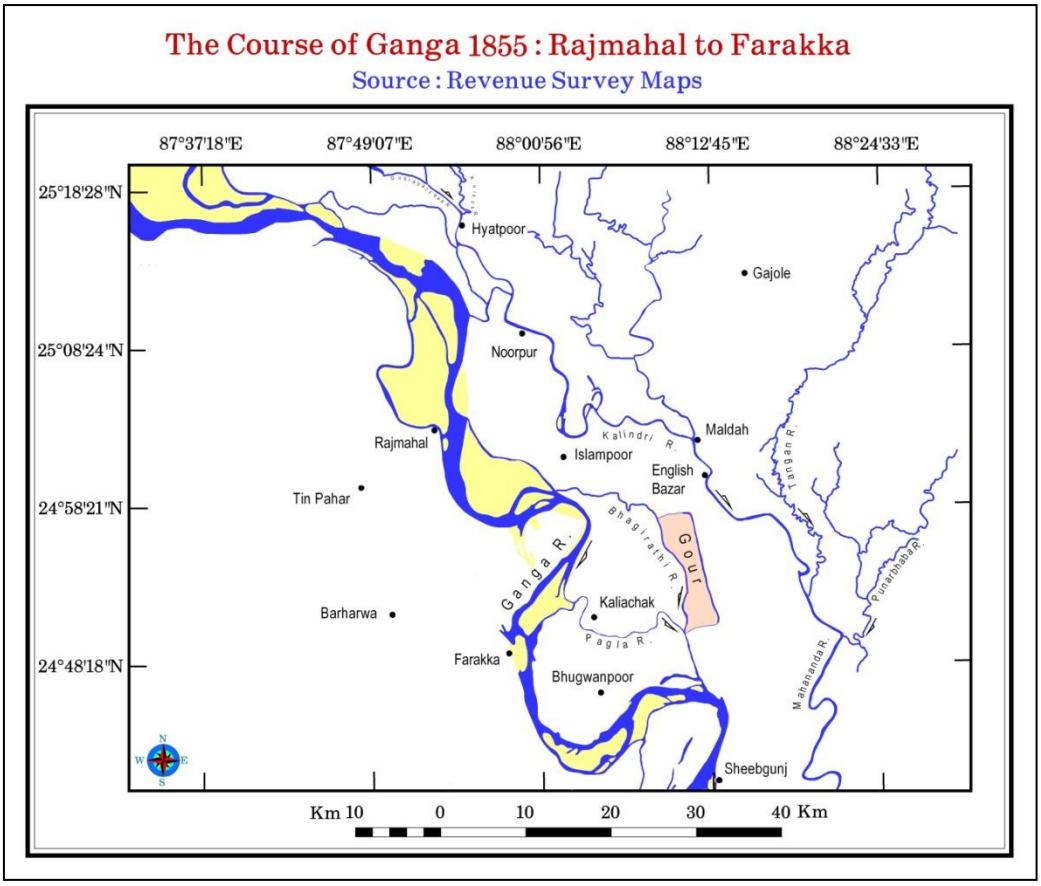
4.1B. Change of Course of River Ganga and other rivers - 1777-1991



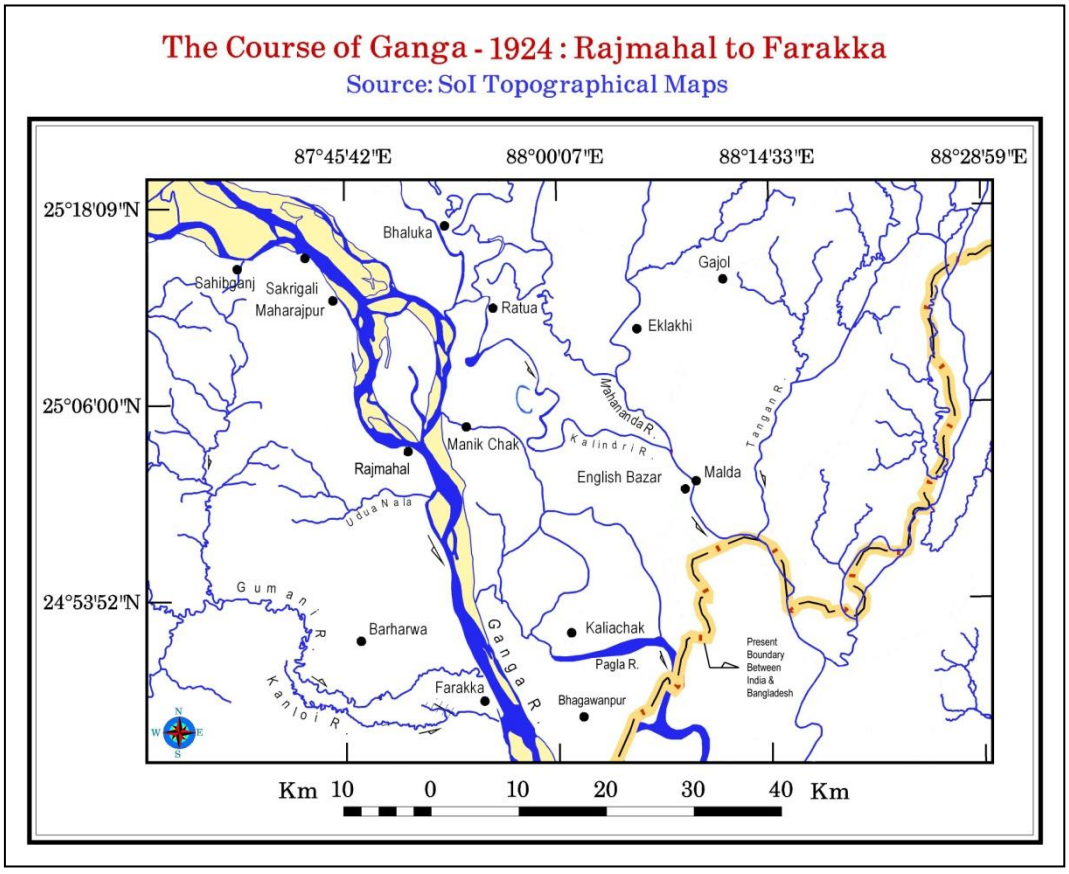
Map No 27 : Course of River Ganga, Near Rajmahal



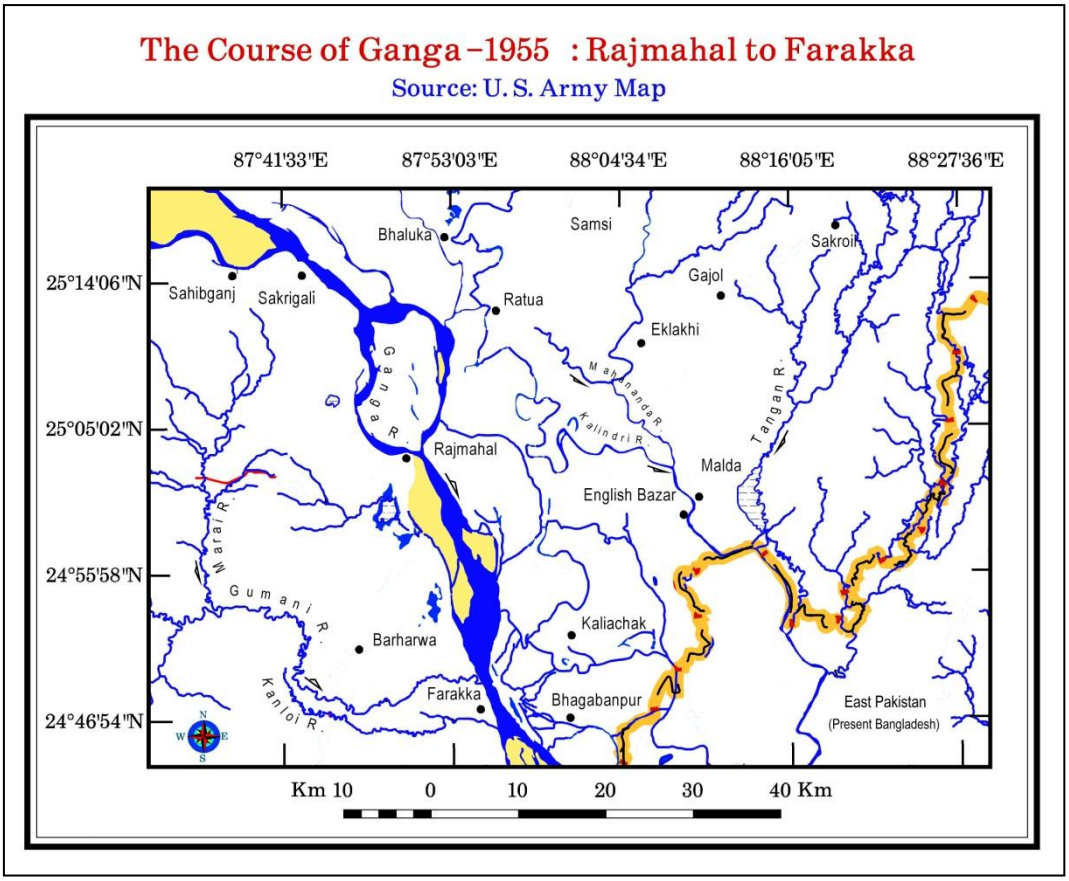
Map No 28 : Course of Gnaga 1777 - Rajmahal to Farakka



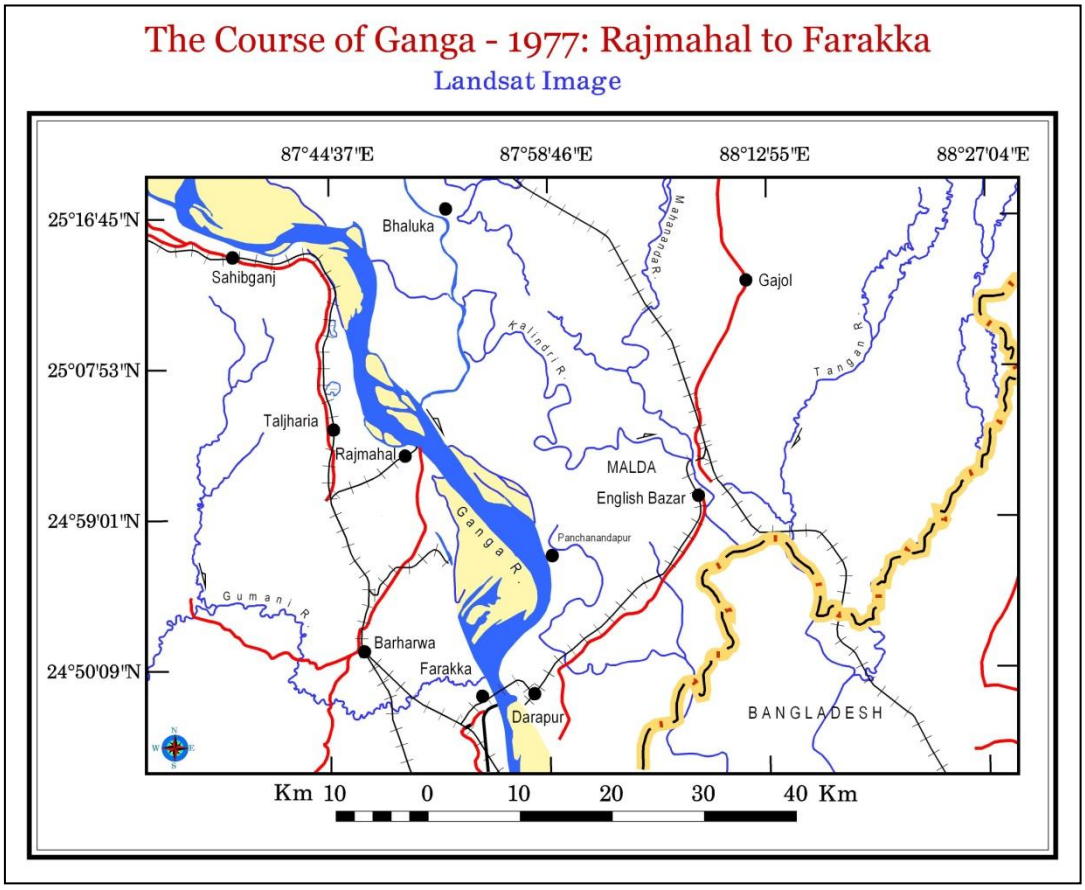
Map No 29 : Course of Gnaga 1855 - Rajmahal to Farakka



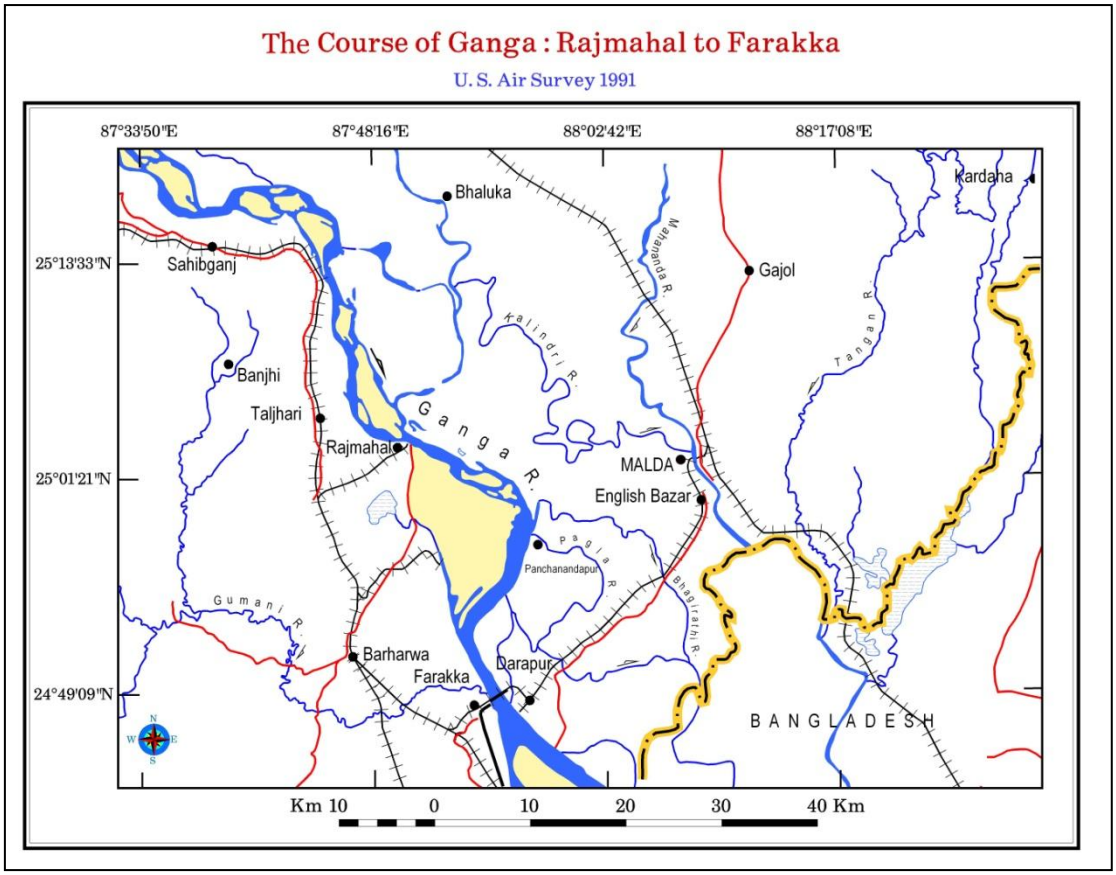
Map No 30 : Course of Gnaga 1924 - Rajmahal to Farakka



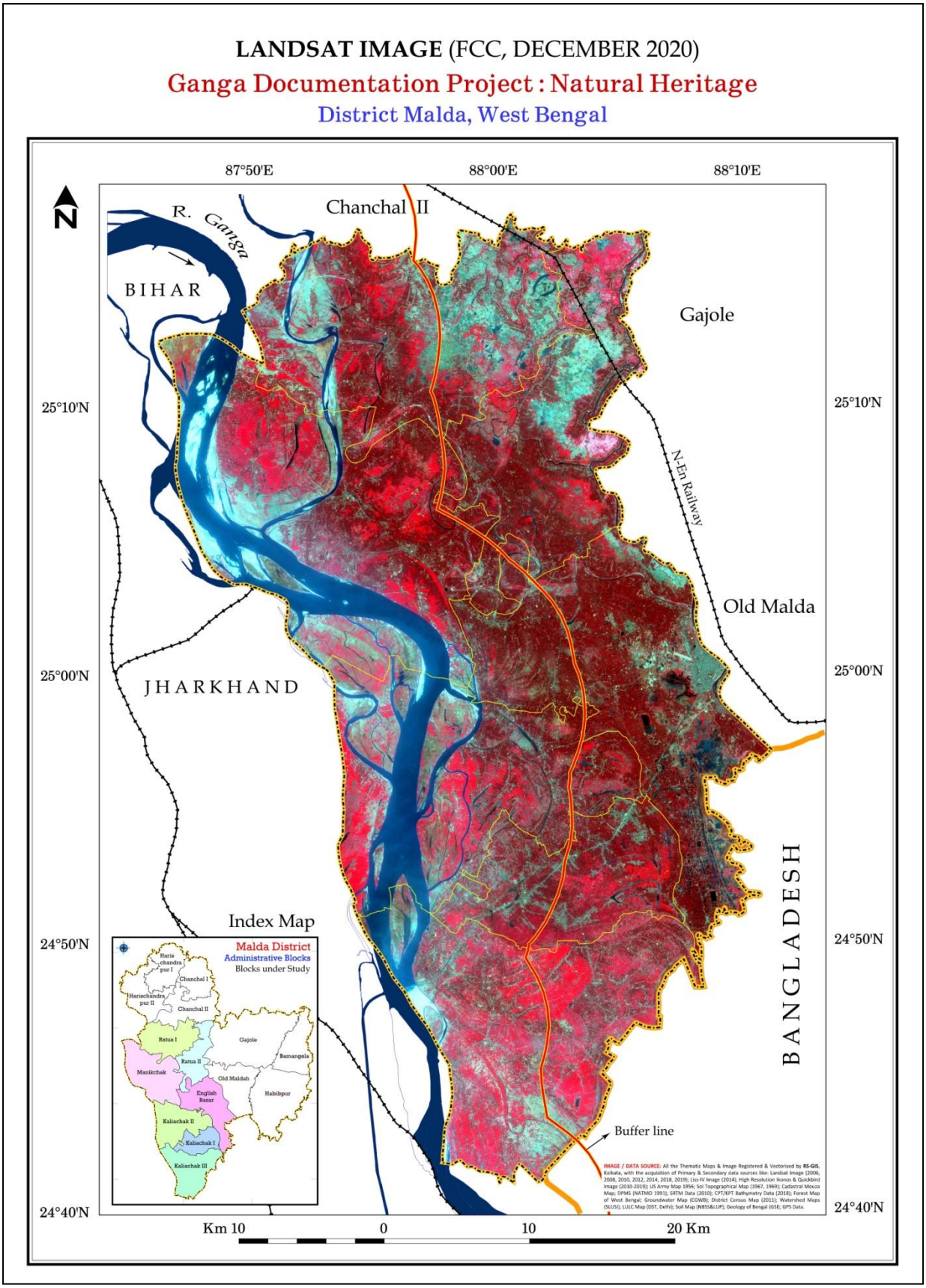
Map No 31 : Course of Gnaga 1955 - Rajmahal to Farakka



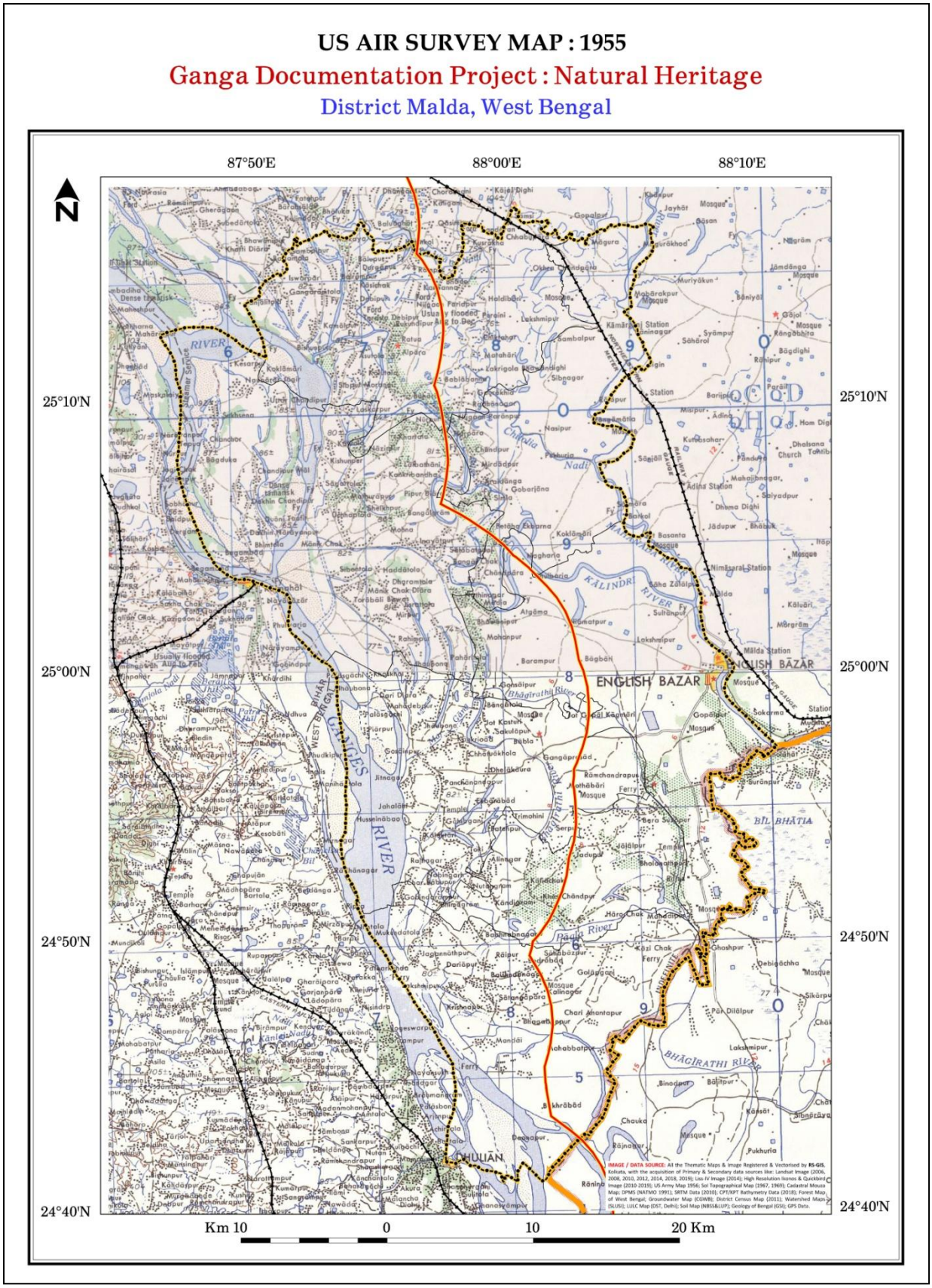
Map No 32 : Course of Gnaga 1977 - Rajmahal to Farakka



Map No 33 : Course of Gnaga 1991 - Rajmahal to Farakka



Map No 34 : Recent Landsat Image Showing the Present Course of Ganga



Map No 35 : US Army Map of 1955 Showing the Course of River Ganga

4.1C. Major Bank Erosion and Channel shifting sites in our study area

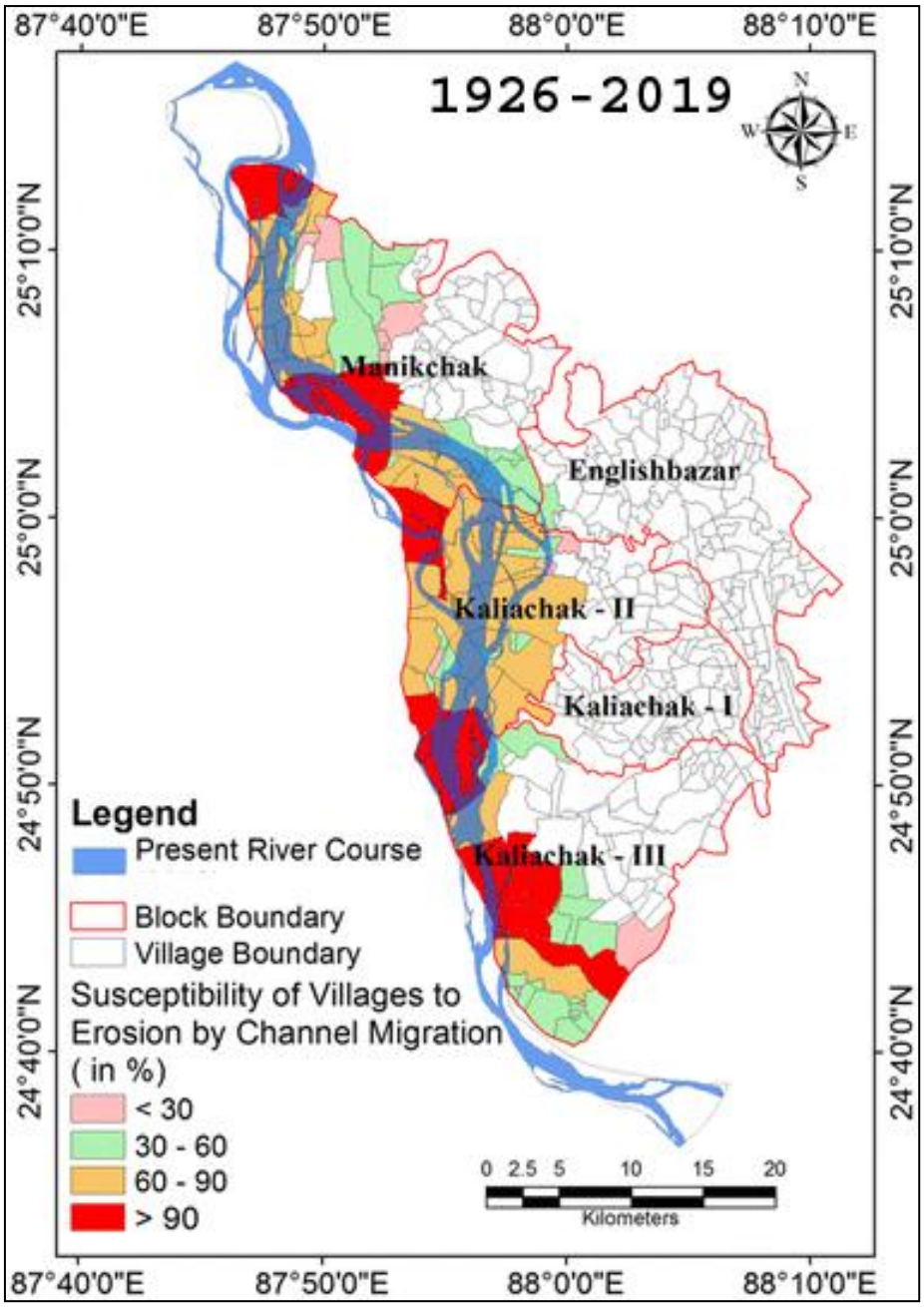
Table No 12 : Location of Bank Erosion and Channel Shifting Sites

SL.NO	LATITUDE	LONGITUDE	BLOCK	PLACE	REMARKS
1	25°12'7.36"N TO 25° 5'0.48"N	87°49'54.01"E TO 87°50'25.86"E	Manikchak	Bhutni Char	**Bhutni** is an island in the Malda district of West Bengal, India. The island is part of the Manikchak community development block and is surrounded by the Ganga River and the Fulhar river. The area shown in the adjoining map is the physiographic sub-region known as the *diara*. It "is a relatively well drained flat land formed by the fluvial deposition of newer alluvium. Very recently a large tract of embankment have been washed away by the erosion. The breach along the embankment caused concern among around one lakh people living in Hiranandapur, Keshabpur and Koshighat.
2.	25° 3'56.76"N	87°52'45.81"E	Manikchak	Narayanpur	Just opposite to Rajmahal Hills , near the confluence of Fulohaar River , Manikchak . Immense erosion takes place resulting in the formation of isolated river island.
3.	24°58'41.18"N	87°59'26.77"E	Kaliachak II	Panchanandapur	Panchanandapur is located in the border area along the river Ganges flowing between Jharkhand and West Bengal. It is also known for flooding and is a very poor area in Malda district. The area is also known as Pagla Ghat because 1998 Ganga Rivers flood was very madly affected the area and damaged many houses.

4.	24°49'22.62"N TO 24°51'49.84"N	87°56'28.42"E TO 87°56'59.67"E	Kaliachak III	Birnagar 1	Birnagar GP with Chinabazar, Sarkartola, Ghoshtola and Mukundatola is one of the worst affected areas of malda district. Being located north of Farakka Barrage , the erosion is pronounced in this zone.
5.	24°48'15.14"N TO 24°46'10.90"N	87°56'36.90"E TO 87°57'19.60"E	Kaliachak III	Chak Bahadurpur	Chak Bahadurpur village is located in Kaliachak Iii Tehsil of Maldah district in West Bengal, India. It is situated 7.4km away from sub-district headquarter Dariapur and 34.5km away from district headquarter English Bazar. There is huge deposition of sand in this part of Ganga.
6.	24°44'5.28"N TO 24°41'34.64"N	87°57'32.41"E TO 87°57'26.32"E	Kaliachak III	Par Sujapur	There is deposition of sediments in the Char Sujapur area of Kaliachak III Block.
7.	24°41'24.77"N TO 24°39'20.87"N	87°57'54.59"E TO 88° 0'55.77"E	Kaliachak III	Par Lalpur, Par Anantapur	There is deposition of sediments in the Par Lalpur , Par Anantapur area of Kaliachak III

In the early decades of the twentieth century, the Ganges flowed in a south-easterly course between Rajmahal and Farakka, but later in the century it formed a large meander to accommodate the additional water because of the barrage construction. Furthermore, nearly 64 crore (640 million) tonnes of silt is accumulated annually on the river bed. All these lead to massive erosion of the left bank.

During the period 1969-1999, 4.5 lakh people were affected by left bank erosion of the Ganges in Malda district, upstream of the Farakka Barrage. 22 mouzas in Manickchak, Kaliachak I and Kaliachak II CD Blocks have gone into the river. Other affected areas are in Kaliachak III, Ratua I and Ratua II CD Blocks. The worst-hit areas lie in the left bank of the river stretch between Bhutnidiara and Panchanandapore in the Kaliachak II block. Even in the 1960s, Panchanandapur was a flourishing river-port and trading centre. It had the block headquarters, high school, sugar mill and a regular weekly market where traders used to come by large boats from Rajmahal, Sahebganj, Dhulian and other towns. After being hit by river bank erosion much of what was there at Panchanandapur has shifted to Chethrumahajantola. The Ganga Bhangan Pratirodh Action Nagarik Committee's survey revealed a loss of 750 km^2 area in Kaliachak and Manikchak. 60 primary schools, 14 high schools, coveted mango orchards have gone leaving 40,000 affected families.



Map No 36 : Malda District with Block and Village Boundaries Showing the Erosion Prone Areas

During the period 1990-2001 Hiranandapur, Manikchak, Gopalpur of Manikchak CD Block and Kakribondha Jhaubona of Kaliachak II CD Block were badly affected by river bank erosion. In 2004-05 large scale erosion took place in Kakribondha Jhaubona and Panchanandapur-I gram panchayats of Kaliachak II CD Block and Dakshin Chandipur, Manikchak, and Dharampur gram panchayets of Manikchak CD Block. Kakribondha Jhaubona, a gram panchayat, was totally lost by river bank erosion. The affected persons and their administrative responsibilities were merged with Bangitola gram panchayet administration.

River bank failures occur in two phases. Pre-flood bank failure occurs because of the high pressure of increasing water on the bank walls. During floods the area is submerged and water seeps into the weak soil. After the floods, the bank collapse in chunks. Every monsoon a large number people are affected by river bank erosion. They become landless and lose their livelihood. It creates neo-refugees with many social problems. Sometimes, poverty leads to increase in crime. The consequences of floods are of the short range as economic recovery is possible, but effects of the slow and steady disaster of river bank erosion are of permanent nature, where the entire socio-economic structure is damaged and the affected population has to move and settle somewhere else. People seriously affected by river bank erosion in Malda have migrated in search of work to as far as Gujarat and Maharashtra. At Byculla, Mumbai, there is a whole colony of erosion affected people of Malda, where they are often branded as Bangladeshi infiltrators, as they have lost not only their belongings but also their documents in the erosion. Such is the tragedy of these neo-refugees in their own country.

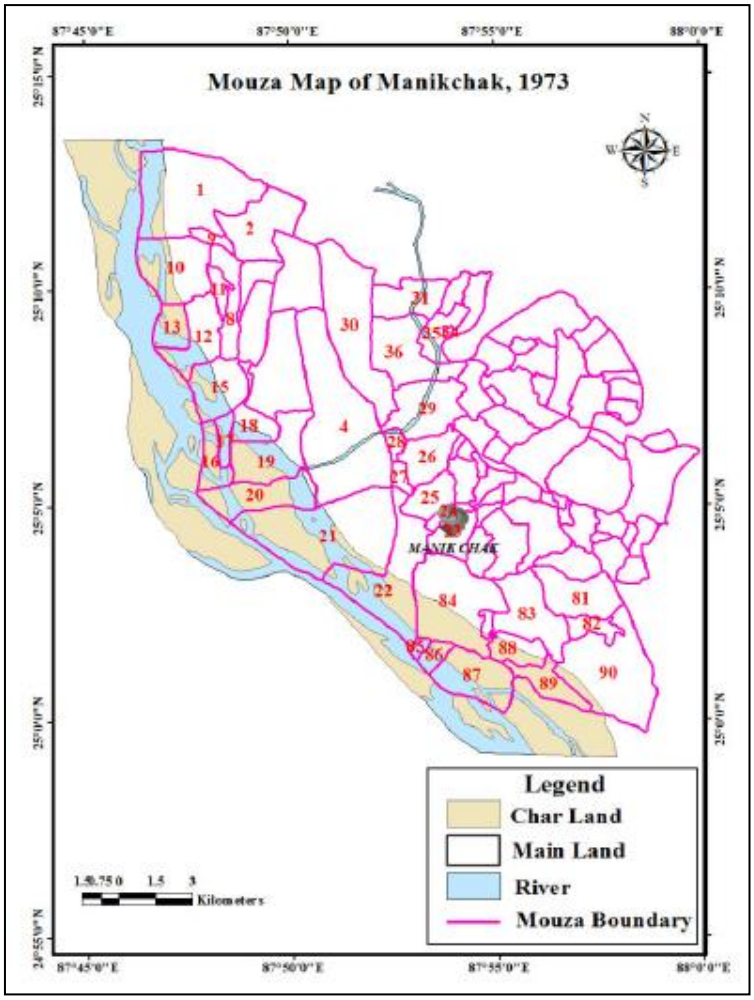
In the remote past, the Ganges used to flow past Gauda, 40 km downstream from Rajmahal. Over a long period, the river shifted westward and now it tends to come to its earlier position. Therefore, the whole belt up to Gauda is risk zone for river bank erosion.

A group of experts has suggested the pressure on the left bank be reduced by diverting flow from the eroding channel. Alternatively, it is possible that in one devastating flood the Ganges will merge with Kalindri in the eastern side and the combined flow will merge with Mahananda at Nimasarai Ghat of Malda and afterwards the collective flow will merge with Ganges/ Padma in Godagari Ghat of Bangladesh. The Ganges has numerous abandoned channels in the area.

4.1D. Block wise Erosion Zones

a. Manikchak block situated in the Malda district, experienced immense land loss due to bank erosion between 1965 and 2019. Around 40 km length of river Ganga passes through this block which covers the western side of the block. It is found that between 1980-1996 and 1996–2017, this block experienced erosion of 35.42 km^2 and 30.68 km^2 respectively.

The interfluve of Fulahar River and Ganga is called as **Bhutnir Char**. The north western part of Bhutni demarcates the boundary between Jharkhand and Bengal. The Kesarpur area of Bhutni is heavily eroded in this year only. The confluence point of Fulahar with Ganga near Narayanpur is another very heavily eroded zone of the block. Uttar Chandipur ,Dakshin Chandipur G.P are also affected because of channel shifting.



Map No 37 : Mouza Map of Manikchak Block Showing Eroded Areas

Image No 26 : Bank Erosion Kesarpur, Bhutnir Char, Manikchak

Narayanpur: Heavy Erosion is taking place every year at Narayanpur where River Fulohar confluences with River Ganga. Over the past few days (October, 2021), close to 100 houses and hutments have been eroded away by the river, along with huge chunks of land. The extreme danger level of Ganga is 25.30m and on Monday afternoon, it was flowing at 25.17m. That is why a number of villages in the low-lying areas are flooded.

Map No 38 : 1985 Image and 2021 Image of Narayanpur G.P of Manikchak Showing Significant Change in River Course.

Image No 27 : Heavily Eroded Bank of Narayanpur Village Near Manikchak Ferry Ghat

Image No 28 : Latthipitha Ferry Ghat, Confluence of Fulohar and Ganga River

Kaliachak II: Bangitola, Hamidpur and Panchanandapur G.P of Kaliachak II Block are heavily eroded zone of Malda in our study area. The river Ganga has changed its course frequently; the present study reveals it since sixteenth century. During sixteenth to middle of eighteenth century, Ganga has shifted its course completely westward. The stretch between Panchanandapur to Farakka has shifted mostly in this period. During middle of eighteenth to nineteenth century, the meandering process of Ganga became prominent and developed big meanders with riverine islands in the south-west of Manikchak upto the southern end of the study area. A huge human intervention has been carved, after 1962, across the river course near Farakka by construction of Farakka Barrage, which actually has disturbed the natural dynamics of river flow. As a result, the upstream stretch of Farakka has shown a major change in its course, but the downstream stretch has remained in almost same position after shifting towards west during 1948-1973. A large meander has developed near Panchanandapur, the length of meander belt has gradually increased and the river has widened gradually from 1973 to 2010. Subsequently the shifting of river course has continued towards east. It has revealed from the study that Ganga is in its second phase of completing its next oscillation cycle and towards the completion of second oscillation since sixteenth century.

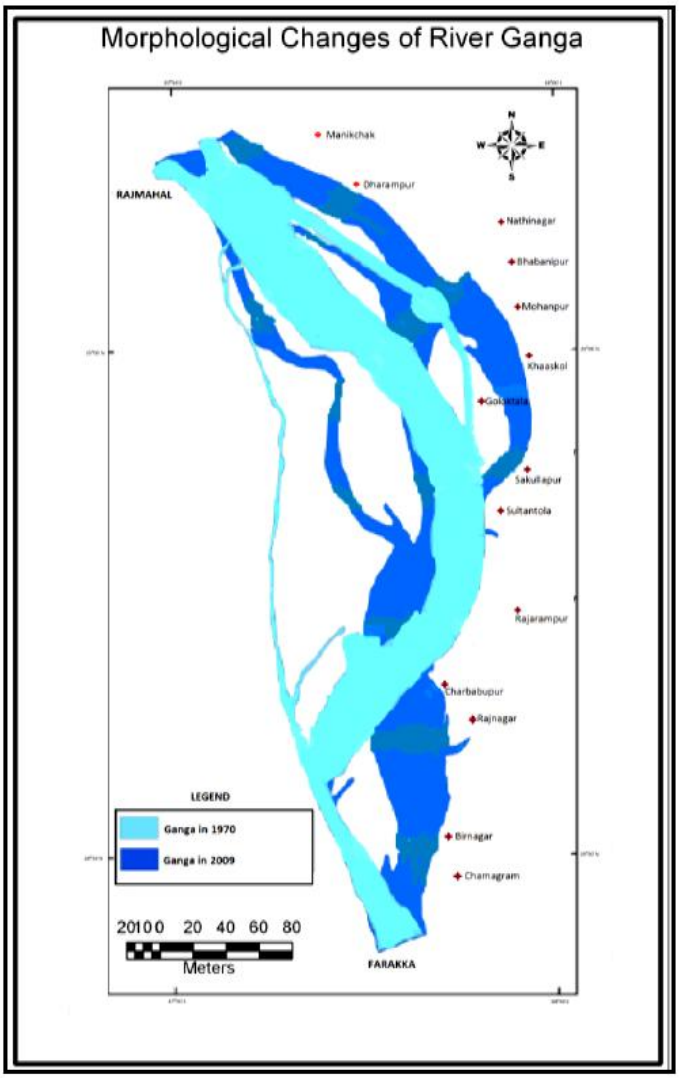
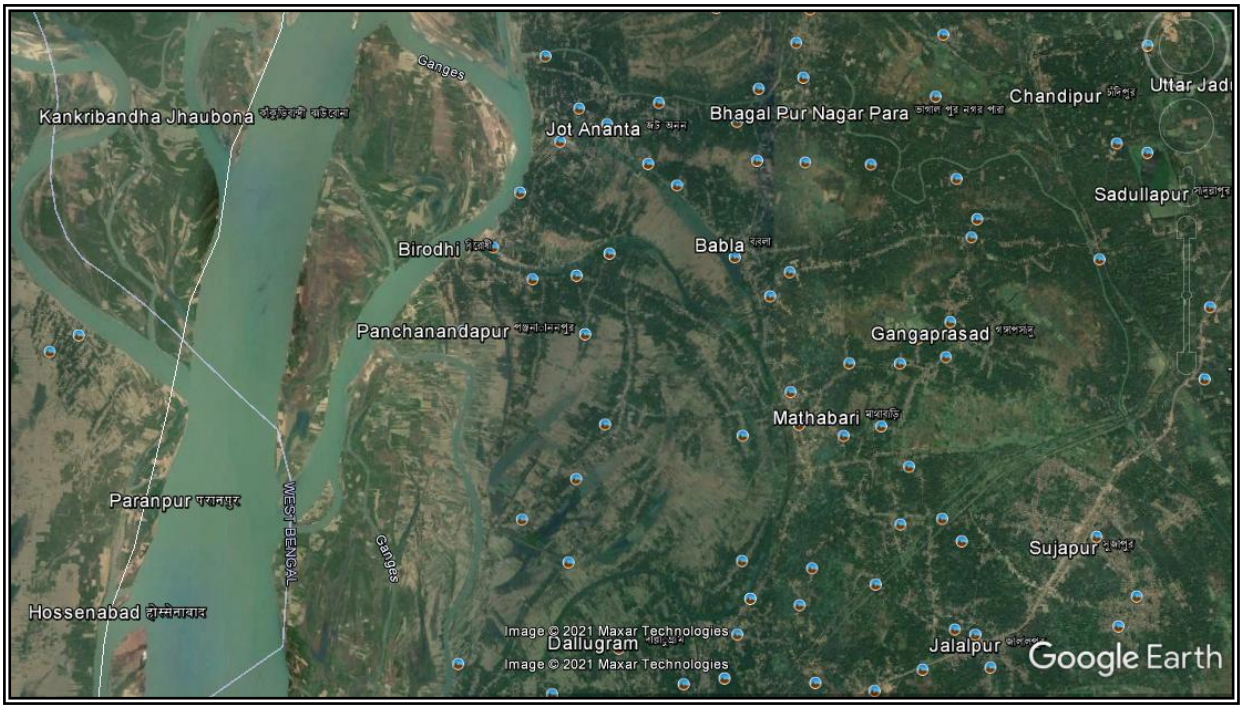


Image No 29 : Shifting of River Ganga, Kaliachak Block



Map No 39 : Recent Image Showing the Erosion Zone, Kaliachak II

Image No 30 : Active Bank Erosion Area, Panchanandapur

Image No 31 : Bank Erosion Taking Place at Babupur Village, Near Palgachi, Kaliachak III, 24°53'8.81"N 87°58'39.76"E

Image No 32 : Extensive Areas are Getting Inundated Because of Channel Shifting, Birnagar G.P, Kaliachak 1, 24°52'44.83"N 87°58'25.36"E

Kaliachak III Block : The northern part of Farakka Barrage , covering the Birnagar I Gram Panchayat area is another vulnerable eroded zone. Chinabazar, Sarkartola, Ghoshtola and Mukundatola is one of the worst affected areas of Malda district. Being located north of Farakka Barrage , the erosion is pronounced in this zone. Sultanganj, Palgachhi, Babupur, Jaganathpur and Baishnab Nagar located along the Ganga River in Kaliachak-III blocks of Malda district are the other areas where inhabitants are facing an intense bank erosion hazard in every year.

Image No 33 : Bank Erosion at Sarkaritola, Birnagar I Gram Panchayet

4.1E. Factors Responsible for Erosion and Deposition

Several factors are responsible for the erosion and deposition in the study area. Among the factors variation in discharge of water, stratigraphy of the bank, geometry of the channel and nature of sedimentation play key role in the erosion and deposition dynamics in the study area. Year wise discharge and sedimentation data could not be obtained because data is restricted by Government of India due to some sensitive international issues related to Farakka Barrage. However, in the District Human Development Report: Malda (Government of West Bengal, 2007) mentioned in the lean season (March–April) the discharge of water in this

area is about 55 thousand cusec (1557.42 m^3/s) and in the monsoon season (August–September) its 18–27 lakh cusec (50970.32 m^3/s - 76455.48 m^3/s). The huge variation in the seasonal flow of the river erodes its concave bank first. As huge amount of sediments are trapped in the **Farakka Barrage** retention pond at the upstream of Farakka Barrage number of avulsion, anabranch and cut off are formed. The problem of siltation increased after the construction of Farakka Barrage at the downstream of Farkka Barrage. The deposited sedimentation on the river bed decreases its channel depth (Rudra, 2014). In the monsoon season when the discharge of water is high, shallow depth of river bed is less capable of carrying water which creates pressure on the bank leading to erosion.

Some anthropogenic factors are also responsible for erosion in the study area. Apart from construction of Farakka barrage, long term land use change in the upper Gangetic palin influences the magnitude of erosion. The river Ganga passes through large parts of northern India. Excess use of river water for irrigation and other human utilization of river causes the lean season discharge of water to be decreased significantly. The variation of water discharge between lean season and peak monsoon season becomes higher playing a vital role in sedimentation and erosion.

Several sandbanks, sand bars, and islands were formed from 1965 to 2017 due to the deposition of the river in the study area. Mature sandbank became suitable for the cultivation and settlement. A small portion of landis used by the people who lost their homes and land due to bank erosion. Mukherjee (2011) reported that people living in the newly formed land known as *'Char'* are deprived of different government schemes. The unstable character of these 'Chars' makes their life more difficult. There are issues regarding the ownership of these land (Islam & Guchhait, 2017). According to the Land Record Office of Murshidabad district, these island and sandbanks are the government's property. The government gives these land to the people according to their needs. However, during the field survey, we came to know these lands are still disputed and these are not recognized by the government. By the discussion with local people, we came to know that most of the deposited lands are used by the people who are financially well off and have power. District Human Development Report: Malda also mentioned that there are some kind of lawlessness regarding occupying these lands. As per the information of Land Record Office of Malda and Murshidabad District (West Bengal) the deposited lands are two types, deluviated and eluviated. The deluviated lands are cultivable in non-monsoon season but in the monsoonal season these lands comes under the water. These eluviated lands is not affected by the water flow in the monsoon season. The government doesnt have proper socio-economic data of the people who lost their property and livelihood due to river bank erosion. By preparing database of affected people government can distribute the eluviated land according to the loss. As these lands are occupied, the government needs to intervene to ensure equal distribution and proper management of the land. The deluviated land can be given to the agricultural labours in seasonal basis contract with the government. Another issue of these deposited land can be found in the Bengal-Jharkhand border region, where the boundary of these two states was demarcated along the river Ganga. Due to instability of the river channel, new sandbanks and island at the boundary areas have become disputed land (Rudra, 2006). Therefore, erosion and deposition process created environmental refugees who are deprived from the supply of

basic rights as citizen which leads to their dire socio-economic status. The simultaneous claim on these deposited lands by the Government of Jharkhand and Government of West Bengal has made this issue more complex. If this unsolved matter can be solved by the government of India, people who are living in these lands may have some basic facilities like ration, school, health facilities etc.

Image No 34 : Few Days Back Md. Alam has Lost all His Land and Home. Bhutnir Char, Malda.

Image No 35 : Binnagar 1 G.P is One of the Worst Affected Area of Kaliachak III. Just north of Malda

Image No 36 : Breaching of Embankment at Bhutnir Char, Source : The Telegraph 2020

Image No 37 : Almost Every Day, Portion of Land Getting Gobbled Up by River Ganges, Dakkhin Chandipur, Bhutnir Char, Manikchak Block. 25° 5'53.61"N 87°50'33.59"E

Map No 40 : Bhutni, in between Ganga and Fulahar river is One of the Worst Hit Left Bank Eroded Area of Malda is With 3 Gram Panchayats and About 90,000 Population.

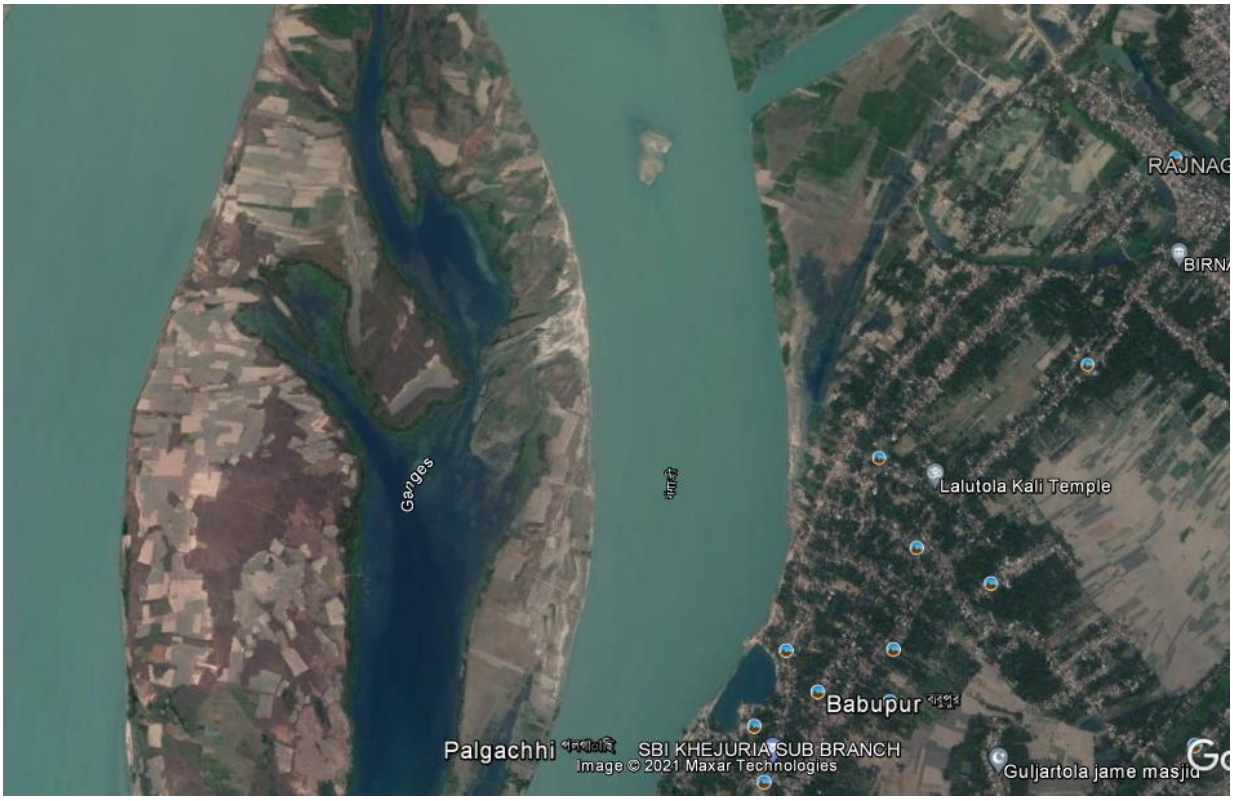
Image No 38 : Narayanpur Village, Manikchak Block, 25° 4'28.02"N 87°51'48.82"E

Image No 39 : Janakiramtola, Along Fulahar River, 25° 5'32.04"N 87°51'1.22"E

Image No 40 : Heavily Eroded bank of Birnanagar II G.P area, 24°50'55.96"N 87°57'30.85"E

Image No 41 : 24°51'42.04"N 87°58'12.43"E, Rajnagar, Birnagar II G.P area

Map No 41 : Eroded Area of Palgachi Area, Birnagar 1 G.P



Map No 42 : Eroded Area of Palgachi Area, Birnagar 1 G.P

Image No 42 : Bangitola, Kaliachak I, 24°58'40.35"N 87°59'27.04"E

Image No 43 : Balugram Village, Kaliachak III Block, 24°55'58.13"N 88° 1'56.30"E

Image No 44 : Panchanandapur, Kaliachak I is Another Worst Affected Area. Here Pagla River Confluences With River Ganga 24°57'29.12"N 87°58'44.47"E

Image No 45 : The Fresh Fertile Soil of the Active Flood Plain is Used for Cultivation Even Though It Can Submerge Under River Bed. Shukurullalpur , Kaliachak I Block

4.2. Lakes and Marshes

The district of Malda lies in the East bank of the River Ganga and also blessed with a number of fresh water wetlands. Based on wetland areas it holds second position in the West Bengal after 24 Parganas (North & South) and hold first position based on inland fresh water natural Wetland. Malda district holds first position based on the number as well as areas of wetlands in this State. Census report data placed by Ministry of Environment and Forests. Government of India that II big fresh water wetlands, out of 23 in West Bengal, present in different blocks of this district (Wetlands of lndia-1990). The Majority of wetlands are Palustrine (floodplains, seasonal waterlogged, marsh) and Lacustrine (Lakes) and Riverine types.

Due to presence a very large number of wetland in this district of West Bengal, many historians called Malda as the "Lake district of Bengal' (Sengupta, 1969). The district covers a total area of 3733 sq km, out of which 156.76 sq km area is occupied by water bodies of less than 10 hectors and 273.89 sq km areas covered by wetlands which are more than I 0 hectors (Wetland of India, 1990). Other wetland type like mudflat, sandbanks, marshy lands and low lying areas covers 450.38 sq km, 78.52 sq. km, 120.34 sq km and 47.27 sq km respectively, the total comes to 645 sq km (Raha eta/., 1994) of wetland. Recurring floods almost every year gradually increases the wetlands in this district. The total I 076 sq km area that is almost 30 % area of the district is fallen under the wetlands. During monsoon all the wetlands forrns single largest water body and covers almost 60 percent of the total land. This largest water body is directly or indirectly connected with the different river system like Ganga, Pagla, Mahananda. Tangan. Punarbhaba, Kalindri etc. Very recent statistics as per satellite data estimated by the IWMED that total wetland area of Malda is 29416.95 hectors, which is 7.88% of total geographical area (Bhattacharyya eta/. 2000). This area reduces to 6844.53 hectors during pre monsoon and covers 15191.58 hectors in post monsoon season. Out of total wetland area 28750.68 hectors i.e 97.73% of total wetland area is natural whereas 665.78 hectors that is 2.23% area are manmade. Detail inforrnation about the wetlands of Malda describes in Table 1.5 and 1.6. The most abundant natural wetlands are seasonal waterlogged (no. 235) wetlands that contribute 20956.49 hectors area are present in this district of West Bengal. The wetlands are locally called as Beel / or Beeloth. Dighi. Khal etc. The most of the wetlands are natural in origin and originated due to river sifting. Except the Natural wetland there are some artificial manmade water bodies located here and among them few are hundreds of years old. The wetlands of Malda can be divided into the following types based on their origin: 1. Marshes and floodplains of Barind region along with small lakes and ponds. 2. Marshes and seasonally flooded Wetlands of Tal region. 3. Marshes and seasonally flooded wetlands of Diara region along with few lakes.

4.2A. Some of the Waterbodies in Malda District and their present status

Table No 13 : List of Waterbodies in Malda District

Sl.1	Location			Type	Status
	Block	Latitude	Longitude		
1.	Kaliachak III	24°40'30.31"N	88° 0'3.00"E	Marsh	Clogged
2		24°40'40.47"N 24°41'9.32"N	88° 0'7.56"E 88° 1'20.59"E	Cut offs	Regular

3.		24°41'14.97"N 24°41'46.34"N	88° 0'54.17"E 88° 1'22.81"E	Cut offs	**Clogged**
4.		24°41'35.52"N	87°59'13.00"E	Marsh	**Regular**
5.		24°41'48.74"N 87°59'8.52"E	24°42'24.63"N 87°59'4.17"E	Cut offs	**Clogged**
6.		24°41'57.74"N 87°58'12.09"E	24°43'16.59"N 87°57'59.15"E	Cut offs	**Clogged**
7.		24°44'56.22"N 87°58'47.22"E	24°43'53.77"N 87°59'54.73"E	Cut offs	**Regular**
8.	**Kaliachak I**	24°48'55.14"N	87°57'18.01"E	Marsh	**Regular**
9.		24°48'56.74"N	87°57'29.12"E	Ponds	**Regular**
10		24°48'54.22"N	87°57'35.06"E	Ponds	**Regular**
11		24°49'5.39"N	87°57'42.15"E	Marsh	**Regular**
12		24°49'15.33"N	87°57'42.82"E	Marsh	**Regular**
13		24°48'42.21"N	87°57'51.69"E	Marsh	**Clogged**
14		24°49'21.71"N	87°57'42.04"E	Marsh	**Clogged**
15		24°49'26.81"N 87°57'33.77"E	24°49'27.47"N 87°57'50.29"E	Cut offs	**Clogged**
16		24°50'26.51"N	87°57'54.19"E	Marsh	**Clogged**
17		24°50'7.75"N	87°57'34.75"E	Marsh	**Clogged**
18		24°50'21.04"N	87°57'34.55"E	Marsh	**Clogged**
19		24°50'31.58"N	87°57'2.59"E	Marsh	**Clogged**
20		24°51'10.66"N 87°57'14.29"E	24°51'49.44"N 87°57'32.31"E	Cut offs	**Clogged**
21		24°52'5.14"N	87°57'54.57"E	Marsh	**Regular**
22	**Kaliachak II**	24°54'26.43"N 87°59'6.42"	24°55'39.25"N 88° 0'32.76"E	Cut offs	**Regular**
23		24°55'7.26"N 87°58'57.89"E	24°56'1.90"N 87°59'50.07"E	Cut offs	**Regular**
24		24°54'23.68"N 88° 0'2.15"E	24°55'10.92"N 88° 0'54.48"E	Cut offs	**Regular**
25		24°58'39.29"N 87°59'41.30"E	24°56'33.66"N 88° 1'51.17"E	Cut offs	**Regular**
26	**English Bazaar**	25° 0'7.79"N 87°59'47.35"E	25° 0'47.05"N 87°59'58.78"E	Cut offs	**Regular**
		24°59'48.54"N 88° 1'22.65"E	25° 0'1.95"N 88° 1'39.36"E	Cut offs	**Regular**
		24°59'59.98"N 88° 0'43.83"E	25° 0'24.57"N 88° 0'52.89"E	Cut offs	**Clogged**
27		25° 0'33.05"N 87°58'57.14"E	25° 1'19.24"N 87°58'49.88"E	Cut offs	**Clogged**
28		25° 3'15.31"N 87°56'32.43"E	25° 3'42.59"N 87°56'6.29"E	Cut offs	**Clogged**
29		25° 4'23.97"N 87°56'35.41"E	25° 4'36.70"N 87°56'12.47"E	Cut offs	**Clogged**
30		25° 6'27.58"N 87°58'10.94"E	25° 7'10.58"N 87°57'33.48"E	Cut offs	**Clogged**
31	**Ratua II**	25°12'30.86"N	87°55'28.85"E	Marsh	**Clogged**
32		25°14'54.24"N	87°53'36.79"E	Ponds	**Clogged**
33		25°15'25.07"N	87°53'50.39"E	Ponds	**Clogged**

34		25°17'17.26"N	87°52'55.49"E	Ponds	**Regular**
35		25°17'55.24"N	87°52'39.62"E	Marsh	**Regular**
36		25°17'49.90"N	87°51'4.87"E	Marsh	**Clogged**
37		25°13'27.42"N	87°59'16.40"E	Marsh	**Clogged**
38		25°15'25.15"N	87°58'56.74"E	Ponds	**Regular**
39		25°16'17.20"N	88° 1'5.29"E	Ponds	**Regular**
40		25°16'33.18"N	88° 0'33.09"E	Marsh	**Regular**
41		25°16'11.73"N	88° 0'54.65"E	Ponds	**Regular**
42		25°17'2.59"N	88° 0'36.24"E	Ponds	**Regular**
43		25°17'10.30"N	88° 0'11.11"E	Ponds	**Regular**
44	**Ratua I**	25°16'40.06"N	88° 0'34.51"E	Marsh	**Regular**
45		25°16'52.72"N	88° 0'30.97"E	Marsh	**Regular**
46		25°17'6.94"N	88° 1'3.53"E	Ponds	**Regular**
47		25°16'10.01"N	88° 1'0.68"E	Ponds	**Regular**
48	**Manikchak**	25°19'31.58"N	87°50'56.56"E	Marsh	**Clogged**
49		25° 5'5.44"N 87°51'22.13"E	25° 4'44.02"N 87°51'43.66"E	Cut offs	**Clogged**
50		25° 6'45.84"N	87°53'48.82"E	Ponds	**Clogged**
51		25° 7'18.48"N	87°55'14.23"E	Ponds	**Clogged**
52		25° 3'37.95"N	87°56'7.06"E	Marsh	**Clogged**
53		25° 3'8.62"N	87°59'22.30"E	Marsh	**Clogged**
54		25° 4'42.12"N	87°54'7.72"E	Ponds	**Clogged**
55		25° 5'2.56"N	87°53'36.89"E	Ponds	**Clogged**
56		25° 5'21.43"N	87°54'0.64"E	Ponds	**Regular**
57		25° 5'56.72"N	87°54'32.82"E	Ponds	**Regular**
58		25° 7'0.40"N	87°53'49.74"E	Marsh	**Regular**
59	**Old Malda**	25° 3'48.87"N	88°10'3.37"E	Ponds	**Regular**
60		25° 4'14.17"N	88°10'14.90"E	Ponds	**Regular**
61		25° 4'29.59"N	88°11'2.53"E	Ponds	**Regular**
62		25° 4'33.61"N	88°12'3.55"E	Ponds	**Regular**
63		25° 3'25.37"N	88°12'40.11"E	Ponds	**Regular**
64		25° 2'58.05"N	88°10'51.96"E	Ponds	**Regular**
65		25° 3'41.32"N	88° 9'24.10"E	Ponds	**Regular**
66		25° 5'7.16"N	88°10'2.00"E	Ponds	**Regular**
67		25° 6'2.42"N	88°10'23.08"E	Ponds	**Regular**
68		25° 6'46.51"N	88°10'39.64"E	Ponds	**Regular**
69		25° 8'39.90"N	88°10'36.86"E	Ponds	**Regular**
70		25° 7'58.07"N	88° 9'8.38"E	Ponds	**Regular**
71		25° 3'57.09"N	88° 6'27.78"E	Ponds	**Regular**
72		25° 3'43.84"N	88° 9'19.79"E	Ponds	**Regular**
73		25° 3'21.87"N	88° 9'52.56"E	Ponds	**Regular**
74		25° 4'53.32"N	88° 9'4.12"E	Ponds	**Regular**
75		25° 5'27.51"N	88° 8'52.91"E	Ponds	**Regular**
76		25° 5'48.16"N	88° 7'55.38"E	Ponds	**Regular**
77		25° 5'27.96"N	88° 6'28.28"E	Ponds	**Regular**
78		25° 6'4.63"N	88° 6'27.94"E	Ponds	**Regular**
79		25° 7'1.39"N	88° 5'58.46"E	Ponds	**Clogged**
80		25° 7'24.13"N	88° 4'39.08"E	Ponds	**Clogged**
81		25° 5'56.09"N	88° 6'31.13"E	Ponds	**Clogged**

82		25° 5'16.79"N	88° 7'29.68"E	Ponds	**Clogged**
83		25° 8'15.38"N	88° 6'23.27"E	Ponds	**Clogged**
84		25° 8'18.58"N	88° 6'6.49"E	Ponds	**Clogged**
85		25° 8'48.29"N	88° 5'27.15"E	Ponds	**Clogged**
86		25° 9'9.00"N	88° 6'7.72"E	Ponds	**Clogged**
87		25°10'4.12"N	88° 5'25.49"E	Ponds	**Clogged**
88		25° 9'49.09"N	88° 4'47.84"E	Ponds	**Clogged**
89		25° 7'7.63"N	88° 5'44.77"E	Ponds	**Clogged**
90		24°50'46.66"N	88° 0'27.34"E	Ponds	

The wetlands of Malda district posses some common characteristics including their origin, dimensions, existing hydrological and biological properties.

1. Most of the wetlands are directly or indirectly linked with the river system of Malda district. The major rivers along with their tributaries discharging the wetlands are Mahananda, Kalindri, Fulahar and Tangan. These wetlands are generally seasonally waterlogged and some are perennial. Significant seasonal variability has been observed almost in all the wetlands in terms of open water extension and water depth in the pre-monsoon, monsoon and post-monsoon. Across all categories of wetlands, the water spread area from post monsoon to the peak of pre-monsoon reduces significantly, which indicates the practice of wetland water use throughout the year. This has major implications for the total water availability of these wetlands and the various functions that they perform in different seasons, round the year. Overall, the seasonal status of water spread area of wetlands varies from a few ha to more than 500 ha. The seasonal variability is also noticeable in wetland water depths, which varies from 2 to 3.5 meter throughout the year in Malda district.
2. Malda district is covered by a good number of wetlands; whose individual area is up to 10 ha. Out of the total number of wetlands, near about 20 wetlands are considered big with an approximate size of about more than 100 ha. Most of the wetlands are within 10 to 100 ha in Malda district (Bhattacharya et al., 2000).
3. As far the shape is concerned, the wetlands of Malda district differ from one another depending on several geographical factors such as the existing topography, hydrological and soil characteristics, frequent shifting of river courses etc. Majority of the wetlands are of irregular shape. Moreover, circular, rectangular, and elongated shaped wetlands along with some isolated cut-off channels are also present here.
4. From the view point of biodiversity, the wetlands and water bodies of entire district maintain a stable aquatic ecosystem by having both the floral and faunal diversity. Aquatic biodiversity is chiefly dependent on the hydrological regime of wetland and its geological condition. Although, the wetland sites, located in Tal physiographic region are considered to be the repositories of diverse species of aquatic plants, fishes, birds, insects, and amphibians because of having an auxiliary ecological environment. These biological resources not only maintain the ecological equilibrium of the environment, but also are responsible for the socio-economic upliftment of adjacent habitat.

Image No 46 : There are Many River Cut-offs Which Remains Generally Seasonally Waterlogged, Manikchak

Image No 47 : Milki, Kaliachak 1, a Marshy Wetland, 25° 0'31.76"N 87°59'53.14"E

Map No 43 : Nayabandh Wetland Complex, 24°56'40.30"N 88°18'1.54"E. The NW is also a large palustrine with several smaller water bodies like Chakla beel, Bakla beel, Ramdole beel, Vikon beel and Sirisdanga

Image No 48 : Some of the Common Wader Birds in the Nayabandh Wetland Complex Area.

4.2B. Some Case Studies

a) Siali Wetland: Siali wetland is located within 25˚18'42.50"N to 87˚53'28.48"E latitudes and in Harischandrapur II block under Chanchal subdivision of Malda district. The nature of this water body is a unique representation of natural fresh water wetland system. In the pre-monsoon period, the wetland is divided into three fragmented water bodies, which are locally known as a) Kachua beel, b) Pajoa beel and c) Siali beel. The wetland is also locally known as “Monla beel”. During the rainy season all the three parts merge into one and take a huge shape.

Siali wetland is appeared from a definite irregular shape. Siali wetland is under the jurisdiction of Harishchandrapur Police Station and Bhaluka Gram Panchayat. The wetland is surrounded by the following mouza namely; Talgachi (J.L. No. 171); Jagannathpur (J.L. No. 172); Fatepur (J.L. No. 173); Par bhaluka (J.L. No. 174); Bhaluka (J.L. No. 175); Degun (J.L. No. 176) and Kariali (J.L. No. 177).

Map No 44 : Siyali Wetland, Location : 25°18'42.50"N, 87°53'28.48"E

Out of the earlier mentioned physiography (*Tal, Diara* and *Barind*) of Malda district, Siali wetlandis located in *Tal* region, which lies to the west of the river Mahananda and to the north of the river Kalindri. This physiographic region is mostly composed of bog lands, which are formed in many marshy pockets around vestigial inland drainages, including innumerable marshes and ox-bow lakes. *Tal* region is practically a low lying area which floods deeply as the rivers rise and drains by meandering streams into swamps or into River Kalindri. It gradually slopes south of the Kalindri down towards the south and south-west and merges with the *Diara* region. Because of their combination of low gradients and the resulting sluggishness in their water flow, all the local rivers are prone to inundate the region during the monsoon season. However, the hydrology of Siali wetland is mainly controlled by surface run off, feeding rivulets and streams. Moreover; the region gets enough rainfall with an ultimate result of flash run off. And the presence of ground water regime has also been noticed during the field study. Siali wetland is fed by two tributaries of river Baramasia, namely; Kankhor and Kali Kosi, through which the inflow of water into this wetland is controlled especially during monsoon. Two outlets are connected with this wetland namely; Kokra Bridge and Elangi canal, which are located in the eastern part of wetland and through which the excess water drains out from this water body. These inlets and outlets, connected with Siali wetland play a significant role in maintaining the hydrology of the wetland throughout the year. The area extent of Siali wetland is recorded 18.74 ha, which has been synchronized during last thirty years (1990-2018) along with distinct seasonal fluctuations. The average water depth in this wetland varies from 2 to 3 meter throughout the year. The Pre-mosoon records an average water depth of 1.5 meter. During the rainy season, particularly

from the month of August, the total area of this wetland gets filled up with the water, the depth of which varies from 2.5 to 3.0 meter . Because of the lack of gradient and resultant regular runoff, most of the tract remains submerged under considerable depths of water during the monsoon rains.

b) Chakla Wetland: Chakla wetland is located in Chanchal 2 block, under *Tal* physiography of Malda district. This natural water body is located within 25°16 30 N to 25° 18 30 N latitude and 88° 02 20 E to 88° 04 30 E longitude. Similar with Siali wetland, Chakla wetland is also divided into several fragmented water bodies especially during the pre-monsoon period. Some of its parts include: a) Singhra, b) Khanpur and c) Chakla wetland etc. Singhra beel falls under Gopalpur Mouza and appears to be the largest water body within this wetland complex. Chakla wetland lies in the north-east of Singhra and is relatively isolated than the other two wetlands. Khanpur wetland is located in the south-east of Chakla wetland. Chakla wetland is appeared from irregular to semi-circular shape. The lower portion of this wetland is seasonal as well as water logged immediately after monsoon and the upper portion is perennial and a considerable water spread area is maintained. During the monsoon and postmonsoon months, these isolated parts merge together into one water body and takes a huge namely; Gangadebi (J.L. No. 112); Gopalpur (J.L. No. 113); Damipur (J.L. No. 114); Shimultala (J.L. No. 118); Hazaratpur (J.L. No. 185); Jalalpur (J.L. No. 186) and Khanpur (J.L. No. 19) shape. The wetland is under the jurisdiction of Samsi police station and following mouzas Chakla wetland is also a part of *Tal* depression. The entire wetland complex is a low lying plain, which is covered with a succession of village sites with their adjacent fields and swampy tracts. The formation of Chakla wetland complex is the result of century"s fluvial action by the old channels; out of which Mara Mahananda still exists. The general slope is from north-west to the south-east. The slope is gradual, as is proved by the meandering course taken by the Mara Mahananda River, which flows through south-west portion of this wetland and on the west by River Mahananda. The hydrology of this wetland complex is mainly run-off feeding. The catchment area of Chakla wetland is large and it gets enough rainfall with an ultimate result of flash run off.

Map No 45 : Chakla Wetland

Moreover, Nuna river in the north and Bhoga river in south are two tributaries of Mahananda River, which chiefly control the inflow of water during the pre-monsoon and check the outflow during the monsoon with its southern flow in Chakla wetland. The Mahananda River is flowing just 8 km away from the eastern side of this water body. There exist fluctuations in the water level as well as the spatial extent in each of these wetlands during the pre-monsoon, monsoon, and post-monsoon seasons. In the present study, as per satellite image (1990), the wetland area is found 1137.13 ha, which has been synchronized to 842.50 ha (2018). In the pre-monsoon period the water spread area of the wetland is reduced, but in post monsoon it fills out at a peak. Chakla wetland is basically shallow one and the average depth of water is recorded 2.5 meter during monsoon and maintains up to post-monsoon season. The depth of water within this water body goes down to less than 2.0 meter during pre-monsoon season.

c) Naghoria Wetland: Naghoria wetland is a cut off meander, which is fed by the Kalindri River, a tributary of Mahananda. The extreme bend of the Kalindri River has cut off from main stream and rejected channel forms an oxbow lake as well as a wetland, which appears to be Naghoria wetland. The wetland is placed in the extreme end of the northwestern part of English Bazar block; 12 km away from the Malda town and 1.5 km away from the Malda Manikchak road. The wetland is situated between geographical coordinates 25˚01 30 N to 25˚05 45 N latitude and 87˚ 59 45 E to 88˚ 0430 E longitude. Naghoria wetland is a cut off meander, comprises larger area and have developed an ecological set up with the surrounding natural systems. The wetland is well situated on the northern side of the Kalindri River, which follows near about 110 meters apart from the water body and is taken as an offshoot of the eastern branch of the Ganges. But actually it is branch of River Mahananda and renamed as Fulahar, which passes through the district of Purnea in Bihar. It enters into Malda district near Mihaghat in Harischandrapur police station, from where it is known as River Kalindri. It flows mainly in the south-eastern direction to its confluence with the Mahananda at Nimasarai, near Old Malda block. Water volume and circulation of this cut off wetland is directly related to the Kalindri River, which shifts its course at number of times.

Map No 46 : Naghoria Wetland

The Kalindri River has long been considered a dynamic river because of having frequent changes in its entire course, including a number of paleo channels and ox- bow lakes. It has been recorded that River Kalindri has changed its course towards the south in recent years. Administratively Naghoria wetland is located under the jurisdiction of following mouzas namely; Phulbaria (J.L. No. 24); Nagharia (J.L. No. 25); Lakshmighat (J.L. No. 26) and Uttar Lakshmipur (J.L. No. 41) of English Bazar and Ratua 2 block in Malda District. The Kalindri River flows mainly eastward and divides the western part of the district into two distinct portions. As mentioned earlier, the portion to the north of this river has been distinguished as *Tal* land and the portion to the south as *Diara*. Naghoria wetland is situated in the *Diara* physiographic tract, and is formed due to abrupt change of river course by Kalindri, which is very commonly found in the plains of West Bengal. The overall topographic set up is just like a wide alluvial plain spreading out like an inland delta, with channels diverging out like distributaries, to fall ultimately into the water from north-east to south running Mahananda River, near Old Malda. The making of the Naghoria wetland is a product of fluvial action and is formed by excessive silting of Kalindri River. The maximum portion of this region is a part of active flood plain, which is covered by immature and loosely compacted alluvium of recent origins. This alluvial is typically dark, loosely compacted with a high water and organic material content. The general slope of the wetland region is towards east and south-east and is perceptibly gentle. The main support of its drainage is rain water, along with the inlet and outlet of Kalindri River. The Kalindri River receives water from small inlets namely Kali koshi, Kankhor, and Baromasia. In Naghoria cut-off, water enters through these inlets during monsoon and drains out in another wing through the outlet. As per the field visit and satellite imagery, the area extension of Naghoria wetland is recorded 228.13 ha, which has been reduced down by 56.49 ha during last three decades. The depth of water in this wetland keeps on varying during different seasons with an average depth of 2.0 meter in pre-monsoon, during the month of March to end of May, and indicates the dry phase of summer season. The water level increases with an average 2.7 meter during monsoon and 2.5 meter in post-monsoon as the surface run off from the vast catchment area enters into this cut off by Kalindri River and through Nurpur connection via Nurpur barrage from Ganga River. Loss of either inlet or outlet of this oxbow lake has converted the flowing lake into stagnant wetland. The wetland generally swells up by the end of July and the water recedes gradually from the mid October to its previous position. Naghoria wetland experiences fluctuation in the water level and in the spatial extent throughout the year.

d) Chatra Wetland: Peri–urban wetlands are located in the areas adjacent to cities and towns. Chatra wetland is a peri-urban water body and is considered the only one of this specific type in the entire the North Bengal. This natural wetland has great ecological and environmental importance. It is located in the south-east of English Bazar block and at the south-western fringe of English bazar municipality. Chatra wetland is located between 24° 58 30 N to 25°00 30 N latitudes and 88°06 E to 88° 08 E longitudes. The wetland is attatched with National Highway (NH) 34 and the Eastern Railway track, connecting North Bengal with the South Bengal. The formation of this peri-urban wetland is new, as it has not been identified in the topographical map of 1949-51 and 1968-69 by SOI. The wetland first came out as a part of huge water body of „Bhatiar beel", which is located in the eastern side of the NH 34 along with the eastern railway line. Later on, with the extension of double railway

track, Chatra wetland got partially separated from the Bhatiar beel, except the Godrail bridge connection on NH 34 and railway line connects it. Presently, Chatra wetland is considered a separate water body, which has detatched from Bhatiar beel. The nature of this per-urban wetland is a unique representation of the fresh water wetland system, and its shape and size has also been changed substantially. Excessive downpour, including massive flood occurrence during 1998 had dumped huge quantity of water in this wetland and finally caused spatial extension of the wetland area and rise of average water level. Administratively this wetland is located adjacent to municipal wards no. 3, 23, 24 and 25. Furthermore, several mouzas namely; parts of Pirojpur (J.L No. 69); Arazi Dilalpur (J.L. No. 70); Abhirampur (J.L. No. 91); Gabgachi (J.L. No. 90) & Uttar Jadupur (J.L. No. 88) encircle this wetland. Along with mitigating the flood risk, this natural water logged area acts as kidney of landscape by filtering the city"s sewage, which is entering into this water body from adjacent municipal wards through the recovery of nutrients in an effective manner. Moreover, this wetland contributes to the well-being of the community by performing urban green space, as well as provides aesthetic appeal, landscape diversities and recreational opportunities. Similar with Naghoria cut off, Chatra wetland is a part of *Diara* physiographic unit. The Kalindri and Mahananda River are flowing from north-west to south-east direction and the meeting point is in a very close proximity, just 1.6 km away from the northern side of this.

4.3. Sacred Trees and Groves

According to Santhini Govindan·, a Hindu shloka says: *A tree provides shade while standing in the sun, bearing fruits for the benefit of others. The tree's mission is welfare and nourishment for all, providing shelter and nutrients to even those who pelt stones at it, giving truly a great message of unconditional love by being the most silent and graceful spokesperson of nature. This is why trees are universally respected. Some trees however, are revered and are considered sacred.*

In Malda, the major sacred trees are as follows –

a) **Tamal Tree** *(Cinnamomum tamala or Indian Bayleaf)* **of Ramkeli:** In the heart of Malda, lies the small village of Ramkeli, popularized on Bengal's tourist map as the land of Rup and Sanatan, the two famous disciples of Sri Chaitanya Mahaprabhu. Around 10 kilometres from Kaliachak market, a straight road enters the village and it takes a quarter to an hour to spot the famous temple of Mahaprabhu, the great religious reformer of Bengal. In the summer of 1515 AD, Prabhu was travelling to Vrindavan and for a short while he had stayed at Ramkeli. Two brothers, Rup and Sanatan Goswami who lived a life of opulence and luxury, were so inspired by Prabhu's spiritual lessons that they decided to denounce luxury and embrace Vaishnavism after listening to his speech. It was right at the footsteps of the Madan Mohan temple that still stands tall in Ramkeli, that Sri Chaitanya Dev had delivered his preaching. At the temple entrance, there is a pair of 600-year-old Kadamba and Tamal tree under which Prabhu

Image No 49 : Footprints of Chaitnya Mahaprabhu

meditated for hours during his stay. It is as famous as the *Mahabodhi tree of Bodh Gaya*. These two trees are said to have been present even during that era when Rup and Sanatan attained enlightenment through Krishna consciousness. Once upon a time during summers, Ramkeli would face severe water scarcity. Before leaving for their spiritual voyage to Vrindavan with Prabhu, the brothers dug eight large kundas (religious ponds or tanks) in and around Ramkeli to help the villagers. All the waterbodies are now titled after the Goswamis, namely – Rup Sagar, Shyam Kunda, Radha Kunda, Lalita Kunda, Bishakha Kunda, Surabhi Kunda, Ranjha Kunda and Indulekha Kunda. One of them is just adjacent to the temple itself.

Image No 50 : 600 year old Tamal Tree of Ramkeli, Where Shri Chaitnya Meditated for Hours

Image No 51 : The 600 Year Old Tamal Tree of Ramkeli, Malda

The mighty Banyan Tree of Jahura Temple Complex : Jahura Kali is the *adishakti* or the presiding deity of Malda. The temple, situated on the outskirts of the town, is shrouded in myths. The name Jahura comes from the word *jahar* or *jawahar* in Hindi, which means jewellery, possibly a reference to the loot which was once hidden there.

Image No 52 : Johura Kali

Another legend says the name is a corruption of *zeher*, or poison, and the temple came to be known as such after an abortive attempt to rob it. Arabian dacoits feature in this story too. They are said to have come to pillage the temple, but the deity, Devi Chandi, appeared at the spot. The looters fled, saying there was *zeher* or poison in the temple and, hence, the name.

Image No 53 : The Great Banyan Tree Inside the Complex of Johura Kali Mandir

There are different estimates of when the temple was constructed. Some historians put the date at around 1500 AD while others say the original temple was built by Raja Ballal Sen, the third ruler of the Sena Dynasty, in 1159-1179 AD. Other versions say the temple was built by a priest named Salwara Tiwari who invoked Goddess Chamunda to protect the villagers of Raipur from natural disasters and attacks by the enemy. Many years later, Hiraram Tiwari, the grandson of Salwara Tiwari, had a vision of the goddess in the temple and described her as having a long tongue, a third eye and sharp teeth. Based on his vision, he created a mask to represent the goddess.

So the month of Baisakh is quite important here and people from all over Bengal come here to offer prayers. Bangladesh is only about 2 km from this place. it is said that earlier people from Bangladesh also used to come here to offer prayers to the Goddess. Situated amidst Mango Orchard, there is an ancient Banyan Tree inside the complex which is also worshipped.

** As our study area mostly falls under the active flood plain, the entire stretch is heavily eroded. Constant oscillation of the channel takes place. Therefore old trees or groves are not found in Kaliachak I,II,III , Manikchak bank area.

Chapter 5 : Documenting Structures In the River

5.1. The National Waterway 1 or NW-1

Ganga-Bhagirathi-Hugli river system is located in India and runs from Haldia (Sagar) to Prayagraj across the Ganges, Bhagirathi and Hugli river systems. It is 1,620 km (1,010 mi) long, making it the longest waterway in India. It is of prime importance amongst all the national waterways considering its locational advantages. The NW-1 passes through West Bengal, Jharkhand, Bihar and Uttar Pradesh and serves major cities and their industrial hinterlands like; In West Bengal there are 7 major terminals and amongst them Santipur in our study area is one of the most important one.

5.2. Major Bridges in Malda

5.2A. Farakka Barrage Bridge on River Ganga - The **Farakka Setu** or **Farakka Bridge** 24°48'5.18"N 87°55'17.87"E to 24°48'27.15"N 87°56'36.79"E is a four-lane bridge located 500 meters downstream of Farakka Barrage. The bridge is intended to reduce traffic congestion on the Farakka Barrage and to connect North and South Bengal. It connects Murshidabad with that of Malda. Total Length - 5.468 kilometres , Total Width – 25 meters.

Image No 54 : Farakka Barrage Bridge, 24°48'11.68"N 87°56'3.55"E

5.2B. The other bridges are on Mahananda and Kalindri River in our study area . They are as follows -

i. **Sahapur Bridge Rd, Malda, West Bengal:** 24°59'49.89"N 88° 9'10.07"E to 24°59'54.62"N 88° 9'0.24"E. The 2nd Mahananda Bridge in Malda Town. This is

a bridge over river Mahananda connecting Sahapur with Englishbazar at Malda Town. The said bridge was started it constructional work on 09/05/2003 under P.W.(Roads) Department Govt of West Bengal and the agency was Mackintosh Burn Limited. This project is not completed yet because some bottle nakes from English Bazar End. The Agency Mackintosh Burn Limited has left their work since 16/02/2008.

ii. **Phulbaria Bridge,Malda**: 25° 3'14.12"N 88° 1'37.60"E. Phulbaria Bridge is located in Amrity, Malda on Kalindri River.

iii. **Lakshmi Ghat Bridge , Malda:** 25° 3'17.51"N 88° 2'4.70"E. Lakshmi Ghat Bridge is located is Amrity, English Bazaar on Kalindri River. It covers the area of Amrity, Atgama, Koklamari, Madapur, Nagharia, Niamatpur, Phulbaria, Sattari.

iv. **Nagharia Ghat Bridge , Malda:** 25° 2'51.60"N 88° 1'5.40"E. Nagharia Ghat Bridge is located is Amrity, English Bazaar on Kalindri River. Amrity, Atgama, Koklamari, Madapur, Nagharia, Niamatpur, Phulbaria, Sattari

Map No 47 : Mahanada River Bridge, 25° 2'12.73"N 88° 7'57.85"E

Image No 55 : Mahananda Bridge (2) on Mahanada River 24°59'4.66"N 88° 9'4.07"E

Map No 48 : Mahananda Bridge on River Mahanada at Malda Town, 24°59'4.66"N 88° 9'4.07"E

5.C. Major Ferry Service at Malda

Malda and Murshidabad are plunged by perennial flood problem .Due to eastern tilt of the lay of the land in West Bengal , the gap between the main tributaries of the Ganga-Padma river is closing at a rapid rate with some inter distance being less than 1000 mts. which is reducing day by day. As a result , the ferry service is not very regular in this district. Here are the list of Ferry Ghats in our study area.

Sl.No	Block	Service from Longitude/Latitude	Service to Longitude/Latitude	Condition
1	Manikchak	Bhutni Ferry Ghat 25° 5'54.96"N 87°50'43.73"E	P.Narayanpur Lathipitha Ferry Ghat 25° 5'44.77"N 87°51'16.77"E	Fulhaar River Regular
2		Mathurapur 23°51'21.59"N 88°12'8.89"E	Shankar Tala Ferry Ghat 25° 6'40.94"N 87°52'56.99"E	Fulhaar River Depends on availability of water
3		Manikchak Ferry Ghat 25° 3'51.35"N 87°52'48.88"E	Rajmahal Ferry Ghat 25° 3'18.86"N 87°50'10.70"E	Connects Jharkhand with West Bengal
4		Kalitola Ferry Ghat 25° 7'20.33"N 87°53'39.46"E	Jalalpur 23°57'32.24"N 88°11'46.66"E	Regular
5	Kaliachak II	Panchanandapur Ferry Ghat 24°57'30.94"N 87°58'45.75"E	Jharkhand	Also known as Paglaghat because of eccentric nature of Ganga.
6	Old Malda	Old Malda Ferry Ghat 25° 2'18.42"N 88° 7'58.44"E	Old Malda Ferry Ghat 25° 2'25.59"N 88° 8'3.48"E	Confluence of Kalindri & Mahananda River
7		Char Kadirpur Ferry Ghat 24°58'46.09"N 88° 9'12.77"E	Char Kadirpur Ferry Ghat 24°58'48.67"N 88° 9'25.16"E	Mahananda River
8	English Bazaar	Sadar Ferry Ghat 25° 0'27.26"N 88° 9'14.66"E	Sadar Ferry Ghat 25° 0'28.20"N 88° 9'15.87"E	Mahananda River
9		Nimesarai Ghat 25° 2'25.47"N 88° 7'56.62"E	Nimesarai Ghat 25° 2'25.91"N 88° 8'3.50"E	Mahananda River

Source: WBTC

Image No 56 : Manikchak Ferry Service, 25° 3'50.33"N 87°52'48.12"E

Image No 57 : Manikchak Ferry Ghat, 24°57'30.65"N 87°58'45.40"E

Image No 58 : Shankartala Ferry Ghat, Mathurapur, Manikchak

Image No 59 : Bengal Jharkhand Ferry Ghat, Rajmahal to Manikchak

Chapter 6 : Documenting Livlelihood Pattern & Activities

6.1. Landuse Landcover

Land use – Land cover: Based on the recent satellite image**, Land sat Image 2021,** we have done Unsupervised Classification and found out the following database of the Malda District. The major classification are – a. Waterbody , including bills, marshes , small channels and main river . b. Land under Agriculture , including mono and multiple cropped land , c. Settlement – Urban and rural settlement including homestead , d. Wasteland – Depressed land , not fit for agriculture , e. Char or Sand Deposits , found on the river bed.

Our study area falls under "Diara" (lowlying area is composed of new silt, to the south of river Kalindi flowing along the south-western part of Malda district) mostly under agriculture. The fertile soil is used for agriculture for at least more than once in a year. About 60% of the area that is about 928 sq.km of area is under cultivation. There is about 8% of land under the category of wasteland . They are very depressed and most of the times it remains waterlogged. About 13% of land is under settlement which is mostly rural in nature. There is only 2 municipalities in the whole Malda District. They are – a. English Bazaar and b. Old Malda . Rest of the area is still under Gram Panchayats. As the major rivers are very much prone to shift their course , the region is full of cut-offs and palaeo- channels. About 11 % of the total area is under waterbody. Malda is also referred to as the lake district of Bengal.

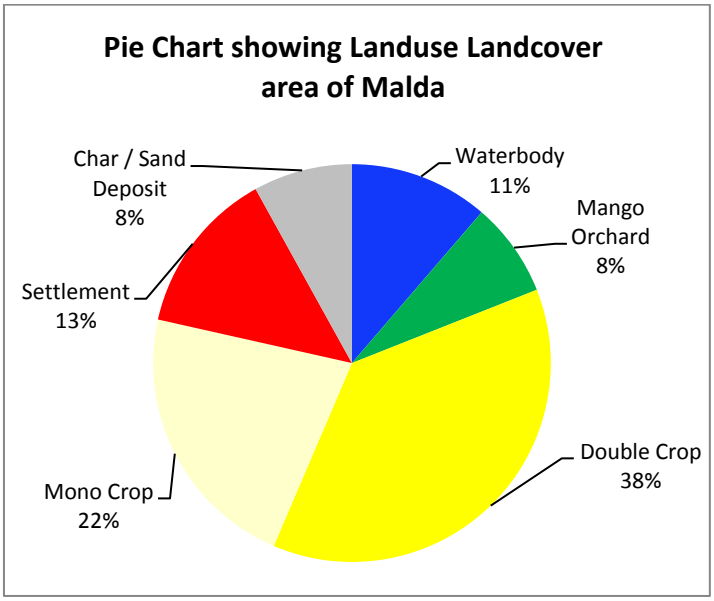
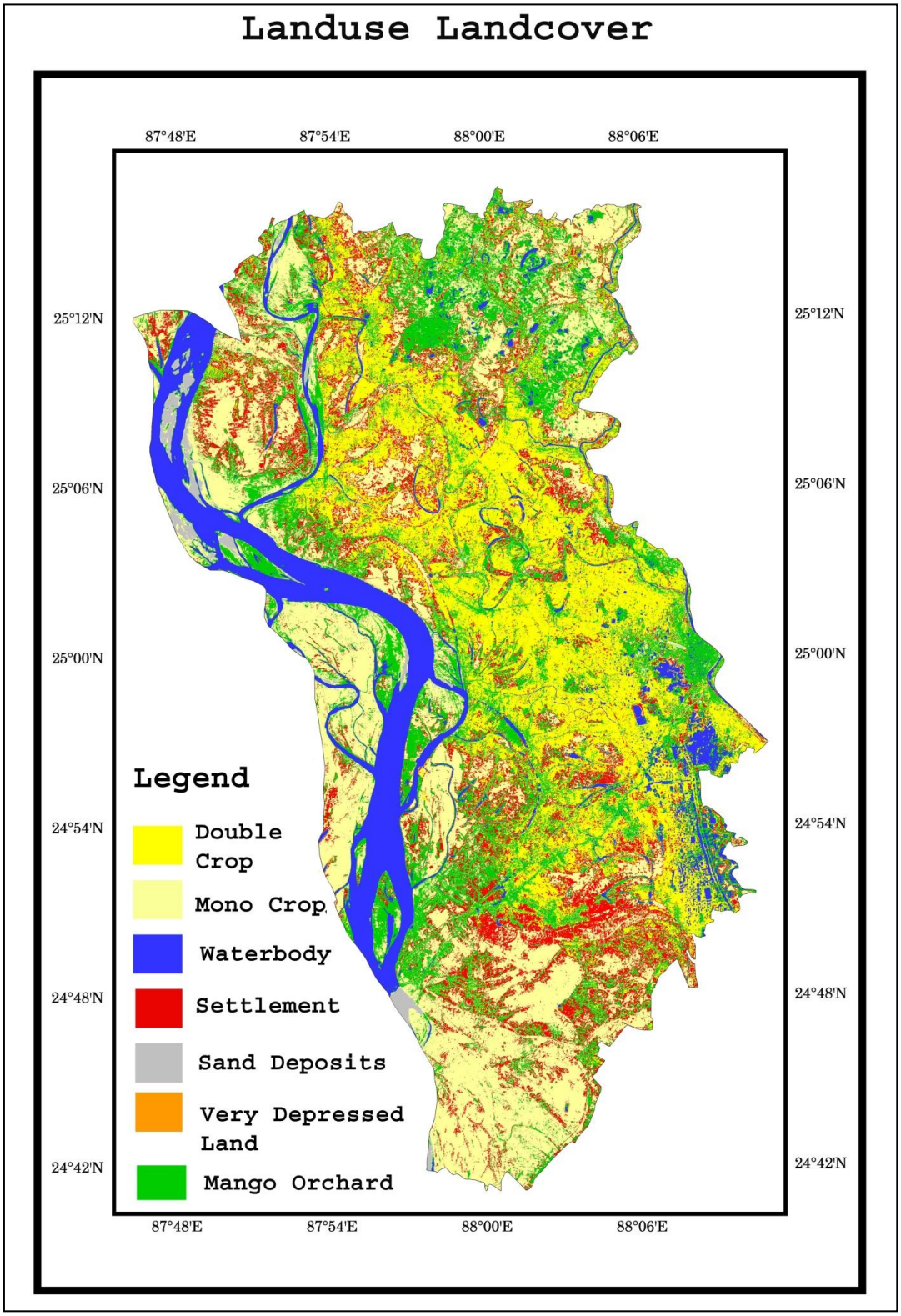


Table No 14 : Landuse & Landcover of Malda District

Sl.No	Landuse Landcover	Area (sq.km)
1	Waterbody (River,Bills,Cutoff,)	176.2
2	Double Crop	583.31
3	Settlement	209.35
4	Single Crop	344.03
5.	Wasteland	119.74

6.	Char	125.36
Total		**1557.99**



Map No 49 : Landuse Landcover Map

6.2. River / Channel bank using for various Economic activities

6.2A. Agriculture

People of Malda are primarily dependent on agriculture as the land is very much fertile. The main crops of the land of this area are paddy, jute, pulses and mustard. Jute is the main cash crop of the district. Malda is the largest producer of excellent quality of jute in India.

The average annual rainfall of the district is about 1260 mm: for cultivation, however, variations in rainfall are secondary in importance to the annual inundations, except in the high lands of the barind. The rate of rise of the rivers and the time that they remain in flood determine for the rest of the district the character of the cultivation, that is, whether a quick-growing or slow-growing crop of rice, the staple food crop, can be grown. The best rice is of course, the transplanted variety harvested in the winter, but such land does not as a rule give a second crop and so is less valuable than the inundated land, which retains its moisture in the cold weather. The ordinary field of the later alluvium is either saucer- shaped with a swamp or *beel* at its lowest part or slopes down towards water-courses. In the saucer-shaped field the water in the beel rises gradually and remains for a period long enough to permit the cultivation of the winter rice not transplanted, known as *aghani,* which rises with the water.

The higher lands of the circumference grow quick-growing or *bhadoi* crops under rainfall, but dram too quickly for winter rice. Similarly in the case of land sloping towards a water-course, there is a tract between the bed of the stream and the higher parts of the land, on which aghani can be grown, the lower and upper portion being suitable for the quicker growing crops, grown by flood water and ram water, respectively.

In the case, however, of the Ganges *diara*, the rapid rise and fall of the river level only permits *bhadoi* crops to be raised in the rains, whilst in the *tal* and *duba* land the

same effect follows from the great depths the water quickly reaches and maintains. In the stiff clay of the barind which is above flood level, the rain water is retained in the fields by low parapets of earth and the ordinary transplanted winter rice is grown. In the cold weather this soil becomes very hard, and cultivation of cold weather crops is only possible with irrigation.

Common soils of the later alluvium are clay with small admixture of sand called *matiyal* or *matal*: dorash or doasla, a mixture of matal and sand, and as its name implies, suitable for growing two crops: the mixture of Ganges mud and fine sand known as *mashina*: *chama or jhenjar*, sandy soil with a somewhat hard crust, only suitable for occasional cropping. *Basta* and *rangamati* are the names of the clay soils of the barind which are blackish and red, respectively.

Principal Crops: More than 70% of the population of the district depends on agriculture. The major crop grown is paddy, which occupies 66% of the gross cropped area followed by jute, wheat, oilseeds, vegetables, pulses etc.

Considerable areas in the centre and south are permanently laid down with mulberry and crops mango: apart from these the main field crops are the bhadoi, the aghani and haimantik

and the rabi crops. Bhadoi is early crop sown in May and reaped in the month of August-September, and includes paddy, jute, maize and various millets. Aghani and haimantik are the winter rice crops, the distinction being that aghani is sown broad-cast whilst haimantik is transplanted: the rabi is the cold weather crop and includes kalai, khesari, barely wheat, mustard, peas, linseed, gram.

Rice :

Bhadoi : The ordinary *bhadoi* rice is sown in May and reaped, as its name implies, in August-September, but a variety of sixty-day rice known as *jethi* is sown in small quantities in April. In the Ganges *diara* , in the mud at the edge of the river, and reaped in June before the river begins to rise. There is some tendency for jute cultivation to encroach on the high land *bhadoi* area and for more extensive sowings of bhadoi rice to be made in the low lands. The outturn in such areas, which are very considerable in the diara tracts, depends entirely on the rate of rise of the rivers and, in particular, the Ganges. If the main flood comes before the crop is ripe there are in heavy losses: if the rains are normal, and the main flood is late, there is a bumper crop and there is not sufficient time to harvest it. A total loss of 25 per cent of the produce of such areas represents an average full crop. *Bhadoi* rice, unlike winter rice, does not keep and is mainly kept by poorer classes.

Aghani, the non-transplanted winter rice, is grown mainly in the north of the district: as its name implies, it is reaped in the month of Aghran (November-December). It is sown in June and July. This rice, though it has keeping properties, is not so fine as the transplanted rice.

Haimantik, It has already been mentioned that transplanted winter rice grows in the higher land of the barind. It is known as *haimantik* rice. As soon as the rams commence, low lying plots of land, or plots near a tank which can be irrigated, are prepared and sown broadcast for seedlings. At the same time the fields are ploughed from four to six times, the rain water being retained in each plot by low walls of mud or ails. On steeper slopes the ground is terraced, and frequently there is a tank at the top of the slope from which the upper fields are irrigated as necessary. Before transplantation of the seedlings the soil in the fields is reduced to soft mud. Transplantation goes on from July to September according to the rainfall. Varieties of haimantik rice are *chenga, tilkaphul, kalam, tal sail, jhagari, basphul, shubandan, madhubinni, phorbini, binnaphul, indra sail, malsara, jhinga sail, parbbat jira, etai dadkhani, kataribhog, kanakchur, parijat, sonamukhi, gopalbhog*. The crop is reaped in December-January, and is largely exported.

The spring rice, known as *boro*, is largely cultivated in the beels in which water remains throughout the cold weather. The land up to the edge of deep water is ploughed as for winter rice during the months of November-December and the surface of the fields, which are divided by ails, made into a soft batter of mud. Water is lifted from the bil by means of the jat, a trough closed at one end. The trough is pivoted, so that the closed end can be let down Into the water to be raised: the contents, when the trough is lifted, run out at the other end at the higher level. Usually, to facilitate lifting, in addition to the pedal at the open end, there is an upright near the trough, to which is slung a weighed cross beam connected with the closed end of the trough by a piece of rope. The operator pulls the weight till the trough rises high enough to let him apply his own weight to the pedal. By a series of jats water can

be lifted in large quantities to a considerable height. The seedlings are grown either in a specially prepared piece of ground, or more frequently in the soft mud left on the banks of the rivers as they fall in October-November. Transplantation is done as for *haimantik* paddy, and the crop is cut in April-May being kept watered by means of the jat.

Other bhadoi food crops are marua (*Eleusine Coracana*), saina(*Panicumfrumentacum*), koda(*Paspalum bhadoi scrobiculcatum*), china (*Paricum miliaceum*)which arc sown in small quantities at the same time as and very often mixed with bhadoi paddy, with which they are reaped. Maize (*Zea Mays*) is also grown, chiefly by the Sonthals in the higher lands of the barind which are not suitable for rice.

The main rabi crops are kalai (*Phaseolus radiatus*), peas, wheat, barley, gram (*Cicer arietinum*), mug, (*Phaseolus mungo*), masuri (*Ervum Lens*), arhar (*Cajanus indieus*) and khesari (*Lathyrus stivus*), besides oliseeds, the first five being the most important of the food-stuffs. As soon as the *bhadoi* crops are harvested on the higher lands and when the floods have subsided on the lower, ploughing is commenced for the rabi crops. The first sown is kalai, which is frequently grazed off and followed by another rabi crop. The higher lands are ploughed four to six times for wheat and barley, and twice for peas. Khesari is chiefly cultivated with *aghani* rice, being sown broadcast in the rice fields on October. In the diara tracts two rabi crops are frequently grown together: the richness of the soil from the Ganges silt otherwise causing plants to grow big at the expense of the produce.

Oilseeds - Of oilseeds the most important are mustard (*Brassica campastris*), til (*Sesamum indicum*), linseed (*Linum usitatissimuml* and sirguja (*Guizota Abyssinica*). For these crops the land is ploughed four limes, and laddered till a smooth surface is produced. Of recent years there has been a great extension of oil-seed cultivation in the *tal* and *duba* lands.

Jute - The best quality is known as poli jute, grown in the low of Gajol thana. The ordinary deshi jute is of inferior quality due in the main to the seed not being properly selected and indifferent methods of retting. Sunn hemp is also grown in small quantities for local use.

Mulberry - In West Bengal, mulberry is grown in 15 districts and among them Malda, Murshidabad and Birbhum have the highest area . Mulberry varieties such as Ber-1, S-799, S-1, and S-1635 are popular in West Bengal. According to the Block Sericulture Office, Mothabari, Malda District in 2014, the total cultivable land has been recorded as 12944.55 acres under mulberry garden in the study area where most of the gardens are fragmented and dispersed in nature. The local varieties i.e. S1 and S1635 of mulberry are predominant in the rainfed area while some superior varieties i.e. S1, S1636 are cultivated with the help of irrigation . Most of the rearing houses are found adjacent to the dwelling places of the farmers. For the suitable climatic conditions most of the sericulturists prefer the Agrahani and

Image No 60 : Mulberry Plantation, Kaliachak

Phalguni crops. In these cropping seasons mainly Bivoltine silkworm races are raised . The mulberry tree commonly grown is the *Morusindica* and it is cultivated as a shrub, the plants being arranged in lines at a distance apart of 45 cm to 60 cm. The plant is propagated from cuttings, and once established is very long-lived, resembling in this and in its method of cultivation the tea plant. It is pruned in August or September so as to prevent its reaching a height of more than 2 feet. The manure most generally used is decayed vegetation from the bits, of which the chief ingredient is the kachu. In the cold weather this is cut in great quantities and stacked at the side of the beels to drain and decompose. Its value is about Re. 1 per cart-load. The fields are regularly hoed and weeded and kept scrupulously clean, as an admixture of leaves of other plants kills the silk-worms. The leaf is also useless for feeding purposes if the ground is flooded, and in years of very high flood there IS much loss from this source. Leaf plucking goes on practically throughout the year, though there are three main seasons, November, April and June. Mulberry leaf raising is one of the most important industries of the Kaliachak block of Malda district. The conditions which this plant requires to give remunerative results are a light soil above flood level with good drainage, and a water level which does not fall below a moderate depth. These conditions obtain naturally, or can be created by embanking the land, over large areas of the southern and central portions of the disrict. The chief centres of the cultivation are locally known as *juars*, of which the main divisions are upper juars round Jot, Dhanlola, Kagaicherra, Chandipur; the diara juars round Goyesbari, Jalalpur and Sujapur; and the Bholahat juars round Bholahat and Kasimpore.

Image No 61 : Traditional Methods of Rice Farming at Kaliachak, Malda

Image No 62 : Women Involvement in Rice Fields, Manikchak, Malda

Image No 63 : In the Month of September / October, Jute Fible is Taken Out and Sticks are Dried to Use Different Purposes

Image No 64 : In the Month of September / October, Jute Fible is Taken Out and Sticks are Dried to Use Different Purposes

Image No 65 : Hay and Jute Sticks are Stacked in Most of the Households for Useing Them for Different Purpose.

Image No 66 : Hay and Jute Sticks are Stacked in Most of the Households for Useing Them for Different Purpose.

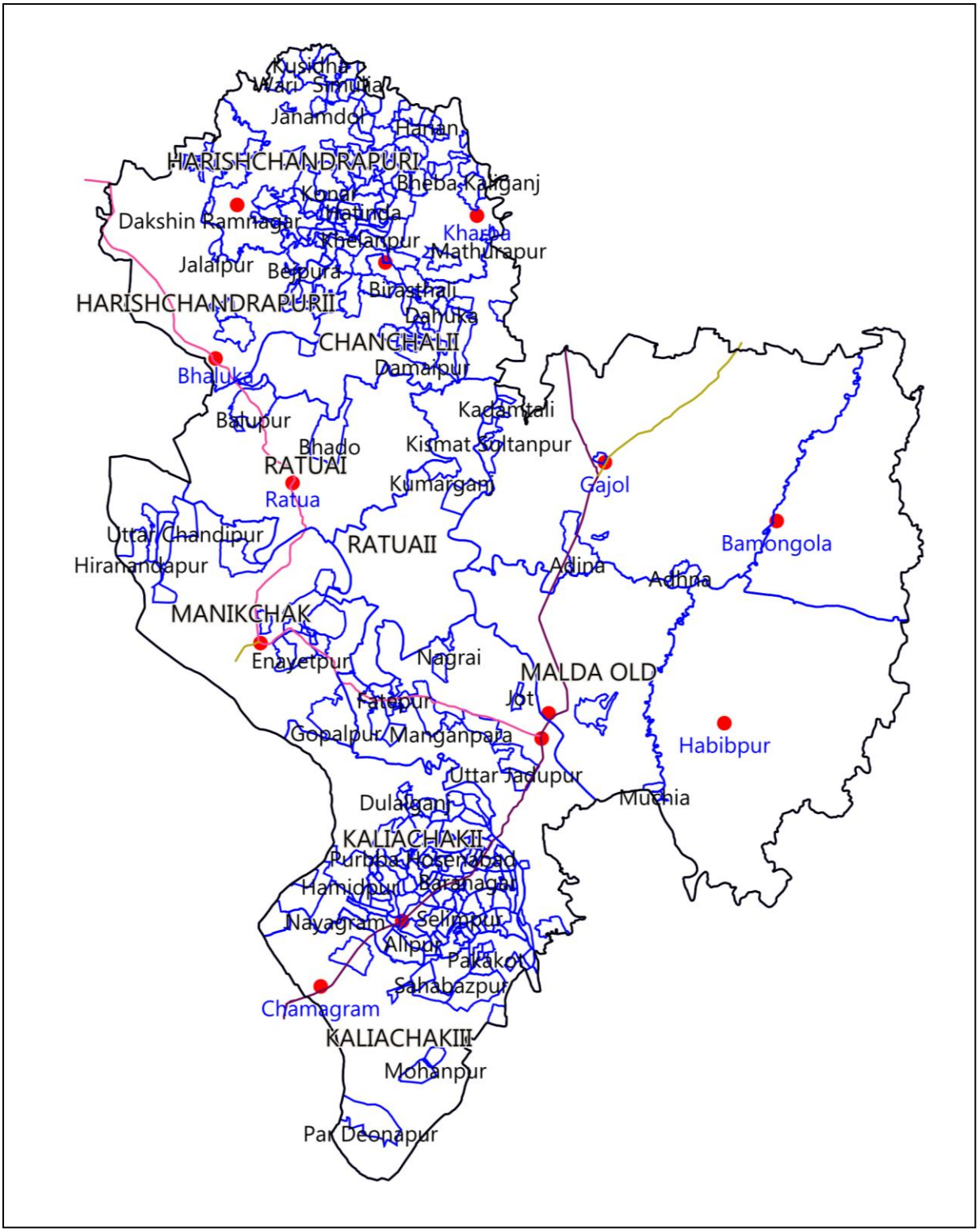
6.2B. Sericulture

Sericulture is an agro based industry and plays a vital role in the economy of Malda district comprising 60% of national share and 75% of state share in raw silk production. 80% of this industry is confined in Kaliachak block I, II and III. Sericulture is now practiced in about 660 villages in Malda district. More than 19,000 acres of land is under mulberry cultivation and more than 60,000 families are directly and indirectly earning their living from sericulture. Out of the total workers engaged in sericulture and silk industry, 98% (Directorate of Sericulture, Malda.) belong to minority communities (i.e. Muslim). Women folk of the rearer families also play a pivotal role in this industry contributing approximately 60% of the total work force.

Annual production of commercial cocoon exceeded 11,000MT, raw silk production also exceeded 1,200MT; silk waste was above 1,000MT and Matka production was also above 100MT in 2005 in Malda district. The face value of the produces was from 110-112 crores of rupees in the said year. Generally the annual per capita income ranges from Rs. 18,000/- to Rs.20, 000/-.

History : Silk industry had been of high merit in Malda ever since the older times. There has been reference to a kind of silk fabric of Pundabardhan even in the “Arthashastra” of Kautilya.3 Colour of that silk was black and its smoothness was like that of precious gems. Besides these, two special kinds of silk was produced named “Kshauma” “Dukul” and their demand was worldwide. In older times silk producers in Gauda were called „Pundarikasha‟, and the term originated from „Pundarika‟ the name of silk worm there in these days. This silk fabric of Gauda was called then „Pattabastra‟. Some time in between, during the invasion by the Muslim, proscription was imposed on production of that pattabastra; but releasing the commercial importance that production was revived. Production of high quality silk fabric at Gauda-Malda has been referred to in Aain-e-Akbari. In 1577 A.D.4 an eminent merchant Shaikh Vik of Gauda-Malda had been to Russia taking merchandise of three ship loaded of silk. Of these three, unfortunately two ships soak in the Gulf of Persia; yet trading in Russia silk goods of only one ship that merchant amassed huge fortune.

Since times long past demand of silk throughout our country and abroad was fulfilled by supply from this Malda district. Attracted by those treasure-houses of silk at Malda (Old Malda) the Dutch‟s built up trade centres there.5 Provoked by this the East India Company too decided to build up their own trade centres there. In April, 1680 Matthews Vincent, the chief of the commercial affairs of the East India Company negotiated with Mr. Littleton of Cossimbazar Commercial House and with the Commercial House at Malda established the Commercial House of the of the East India Company at the confluence field of rivers Kalindri and Mahananda..



Map No 50 : Major Sericulture Producing Areas

Table No 15 : Sericulture Centers of Our Study Area

Sl.No	Block	Major Sericulture Villages
1.	**Kaliachak III**	Par Deonapur, Mohanpur Sahabazpur, Sashani
2	**Kaliachak I**	Pakakot, Alipur, Selimpur

		Suzapur, Bara Hamidpur, Nayagram, Dulalganj
3	**Kaliachak II**	Gopalpur, Manganpara Fatepur, Uttar Lakshmipur Debipur
4	**Manikchak**	Enayetpur, Nazirpur Hiranandapur, Uttar Chandipur
5	**Harischandrapur II**	Bhaluka ,Bhairabarpur Jalalpur,Dakshin Ramnagar Sultannagar
6	**Harischandrapur I**	Chhatrak, Konar Hatinda, Khelanpur Mathurapur

Image No 67 : A. Mulberry Raw Silk Yarn B. Herbal Dyed Silk Yarn C. Raw Silk Yarn, Malda

Image No 68 : Silk Thread is Extracted Out From Silk Worm, Baluforara Village, English Bazaar

Image No 69 : Thread is Prepared From the Silkworm

Image No 70 : Silkworm are Boiled to Take Out the Silk Thread

Image No 71 : Silkworm are Kept to Dry

Image No 72 : Govt. Outlet of Sericulture, Kaliachak 1 Block

Image No 73 : Local Vendors Selling silk in the Nearby Areas.

6.2C. Horticulture

A. Mango Orchards: The mango (*Mangifera indica*.) is the most important fruit crop in India and is titled as the king of fruits. It is being cultivated for well over 4000 years in India.

The mango cultivation in Malda and its historical associations date back to very early times. The mango of Malda district is mentioned in the Hindu epic Mahabharata. Its cultivation started before Pala and Sena Dynasty. The Chinese traveller Hwen T'sang mentioned in his travelogues regarding the mangoes of Gaur. The Khalimpur copper inscription of Dharmapala revealed the existence of gardens of mango, palm, jamun and variety of lemon etc. in Barindra region. Humayun was so much overwhelmed with the mangoes of Gaur that he renamed it Jannatabad and stayed there for three months. Nawab Murshid Quli Khan used to send an armed guard to safeguard the mangoes of the trees reserved for his use. It occupied a prominent place in the daily life of people. The most common festival of the district is Gambhira (folk song) which depict the sorrow or happiness of people arising out of failure or success of the crop. The lease out system of the garden has prevailed since long. The intercultural practices were done in rainy season. As record tells that the method of cultivation has undergone changes since 1970s but its conventionality is still persisting. Still growers have fewer propensities to adopt the advanced orchard management strategy due to the prevailing socio-economic causes. However, this traditional commercial exotic fruit crop is still being conventionally cultivated with mother's care. Malda has long been famous for its mangoes; it is recorded the Nawab Murshid Ali Kuli Khan used to send an armed guard for the trees the fruits of which were reserved for his use. Dr. Buchanan Hamilton writes "*The mangoes called Malda have a high reputation, and may be considered as one of the finest fruits in the world, but few of these grow at Malda(the present police-station of Old Malda): all the plantations of the most valuable kinds are on the opposite side of the Mahananda in the Purnea district* (the present police station English Bazar). Still, however, the mangoes of the left bank of the Mahananda are preferable to any others in Dinajpur. As the produce of the mango tree, even in its present state, is one of the most valuable in this district (Dinajpur), and as the management is better understood at Malda than anywhere else.

Image No 74 : Mango Orchards in Malda

Image No 75 : Fazli Mango Found in the Banks of Mahananda, Malda

source :https://sahasa.in/2021/04/26/malda-fazli-mango/

The Diara region C.D. Blocks of Manickchak and English Bazar constitute the traditional growing area for mangoes in Malda district, together accounting for 57 per cent of the total mango area and the mangoes produced by the district. From this core area, mango cultivation has spread southwards to the other Diara region C.D. Blocks of Kaliachak-I and II, followed by the C.D. Blocks of Ratua-I, Ratua-II and Chanchal-I in the Tal region. While the share of the Diara region in total mango area and production has come down as a result, the six C.D. Blocks in the Tal region together now account for just over 28 per cent of area and production of mangoes in Malda. Old Malda is the only Barind region C.D. Block that grows mangoes to a significant degree. The other Barind region C.D. Blocks of Gajol, Bamangola and Habibpur together contribute only about 2 per cent of the total mango area and production in the district. Since mangoes are already grown on a wide scale in the Diara region, future extension of mango cultivation in Malda district is likely to occur in the Tal region rather than the Barind region due to its climatic advantages. Such trends are already visible in the growth of mango area and production in many C.D. Blocks of Tal region.

Fruits of eighteen mango varieties *(Amrapali, Ashwina, Fazli, Gopalbhog, Khirshapati, Lakshmanbhog, Langra, Baishakhi Gooti, Rakhalbhog, Golapkhas, Ashudagi, Arajanma, Mallika, Krishanbhog, Michrikanta, Laxmibhog, Phunia and Brindabani)* were collected from eight mango growing blocks of two Subdivisions of Malda district. Both physico-chemical parameters were assessed at optimum ripening condition of fruits. Among the mango cultivars, the fruits of Fazli and Mallika were superior to others with regard to fruit weight and size. Phunia was the smallest in weight and size. The proportion of edible portion was highest in cv. Lakshmanbhog and was lowest in Michrikanta. In the present investigation, the maximum percent of total

soluble solids was in cv. Mallika of 23.60 and minimum of 12.80 in cv. Lakshmanbhog. The total sugar, reducing sugar as well as non-reducing sugar contents was maximum in cv. Mallika. The acidity of fruits varied from 0.15 –0.35%. The highest content of ascorbic acid was recorded in cv. Langra (56.34 mg / 100g). The highest TSS :Acid ratio was also recorded in the mango cvs. Mallika, Brindabani, Amrapali, Aswina, Gopalbhog, Rakhalbhog, Ashudagi and Kishanbhog. The highest and lowest amount of β-carotene was recorded in cv. Kishanbhog (17897 µg/100g) and cv. Brindabani (1089 µg/100g), respectively. The fruits of cv. Lakshmanbhog though contains lowest TSS: Acid as compared to Mallika (157.33), but have good attractive appearance, firm fruit, good keeping and transport quality, optimum size and shape, high fibreless edible proportion. The cv. Langra with high TSS : Acid (55.88) is one of the most popular cultivars of India. Thus, considering the fruit qualities, it was observed that some of the lesser known varieties viz. Michrikanta, Phunia, Ashudagi, Arajanma etc. have great potential for commercial exploitation. Also, regular bearing cultivar 'Laxhmanbhog' having good fruit quality and attractive colour could be a potent variety for export from the state.

Mango Varieties of Malda

Sl No.	Name	Description	Image
1	**Fazli (G.I. No. 113)**	Fazli is full of sweet mystery and a lot of juicy pulp, coming in at the end of June and continues upto end of July. A single mango weighs a kilogram, or even more. Just couple of them could serve as a full royal repast. The technical specifications of hard ripe fruits are given below: Fruit weight 600-1000 g Pulp content 74-75 % Peel and stone percentage 25-26 % TSS 15-16 0Brix Acidity 0.19-0.25 % Fibre content Low fibre	
2	**Aswina**	The mature fruits become available between mid- July to mid-August and the fruits are suitable for processing. Fruits are greenish yellow and firm, a single fruit weighs about 500 g or more. Fruit weight 500-750 g Pulp content 65-70% Peel and stone percentage 30-35% TSS 15-16 0Brix Acidity 0.23- 0.27% Fibre content Medium fibre	
3	**Himsagar (G.I. No. 112)**	The mature fruits become available between 2nd week of June to end of June, with its unmistakable golden hue, complete absence of fibre and unparallel sweetness. It is probably the best-loved one of the royal family all over the world. The important characteristics of hard ripe fruit are outlined as under: Fruit weight 300-350 g Pulp content 77-78 % Peel and stone percentage 22-23 % TSS 21-23 0Brix Acidity 0.20% Fibre content Free from fibre	
4	**Laxmanbhog**	Available from mid-June to 1st week of July, has a poetic bent of taste and radiating golden yellow skin with reddish tinge. Fruits are with light sweetness and completely free from fibre. The technical specifications of hard ripe fruits are given below:	

	(G.I. No. 111)	Fruit weight Pulp content TSS Acidity Dry matter content Fibre content Vitamin A	300-350 g 77 % min. 14 0Brix 0.23-0.44 % 24 % Free from fibre 2990µg/100 g	
5	**Langra**	Mature fruits are available from 2nd week of June to end of June, fruits are greenish yellow, firm and nearly devoid of all fibre. Its sweet-n-sour flamboyance of flavour is full of rich promise of pleasure. The technical specifications of hard ripe fruits are given below: Fruit weight Pulp content TSS Acidity Fibre content	 300-350 g 74 % 20-25 0Brix 0.35-0.55 % Low fibre	
6	**Amrapalli**	These varieties enchant the palate from 4th week of June to 3rd week of July. Although they are relatively recent members of the royal family, they have already gathered quite a fan following the world over. Born out of Dashehari and Neelum varieties, the sisters tantalize taste buds with their cadmium hue and irresistible sweetness. Fruit weight Pulp content TSS Acidity Fibre content	 200-250 g 70-75 % 20-25 0Brix 0.35-0.55 % Low fibre	
7	**Mallika**	These varieties enchant the palate from 4th week of June to 3rd week of July. Although they are relatively recent members of the royal family, they have already gathered quite a fan following the world over. Born out of Dashehari and Neelum varieties, the sisters tantalize taste buds with their cadmium hue and irresistible sweetness. Fruit weight Pulp content TSS	 400-500 g 72-77 % 15-18 0Brix	
		Acidity Fibre content	0.30-0.50 % Low fibre	

B. Litchi Farming at Malda: Litchi has been cultivated around 1,420 hectare of land this year, up from the coverage of 1,380 hectare in 2020, he said, adding that no major damage to the fruit due to nor'wester or hailstorms and pest attack was reported this season. We see the area under litchi cultivation in Malda is growing by around 40-50 hectare every year. The summer fruit is mostly produced in Kaliachak and Ratua areas.

Image No 76 : Litchi Orchards

According to the Directorate of Food Processing Industries and Horticulture, Govt. of W.B. Malda we find the following data showing the area devoted to the fruit farming and their production.

Name of the fruits.	***Area (Thousand hectares)***					***Production (Thousand tonnes)***				
	2011-12	**2013-14**	**2015-16**	**2017-18**	**2019-20**	**2011-12**	**2013-14**	**2015-16**	**2017-18**	**2019-20**
Mango	27.00	27.40	27.60	28.50	28.70	180.00	196.00	221.00	257.00	200.00
Banana	0.80	0.81	0.91	1.01	1.09	14.50	14.80	16.49	18.30	19.75
Pineapple	-	-	0.03	0.04	0.05	0.08	0.08	0.60	0.74	1.20
Papya	0.24	0.24	0.25	0.26	0.27	7.80	7.86	8.07	7.39	8.55
Guava	0.43	0.43	0.44	0.45	0.45	7.25	7.26	7.47	7.62	7.63
Jackfruit	0.38	0.38	0.39	0.40	0.41	4.50	4.50	4.68	4.90	5.03
Litchi	1.00	1.00	1.09	1.18	1.20	9.00	9.40	8.50	12.24	15.00
Other Citrusfruits	0.20	0.21	0.22	0.27	0.29	1.80	1.80	1.93	2.46	2.65
Sapota	0.24	0.24	0.25	0.25	0.25	2.80	2.80	2.86	2.94	2.95
Others	0.23	0.23	0.22	0.24	0.25	1.40	1.40	1.44	1.29	1.50

Image No 77 : Mango Orchards All Along the River Bank of Mubarakpur, Kaliachak I, 24°58'7.17"N 87°59'19.10"E

Image No 78 : The Entire Diara Area of Birnagar G.P is Under Mango Orchards

6.2D. Beedi Rolling Industry

BEEDI rolling industry is one of the informal industries in India. This industry is now blasting day by day. It employs millions of workers. Most of them are all BPL labourer and deprived of many facilities. Kaliachak III of Malda District is a huge centre of Beedi Industry. Based on some primary survey data some important observations are:

a. Homebased workers—Self-employed in non-agricultural activities—Majority of the females are engaged. Mostly muslim women are engaged in beedi rolling.
b. Workers' dependency on contractor for supply of ingredients and delivery of the finished products—Dependent workers or Sub-contracted workers
c. 2 kinds of beedi—1 No. Pataka beedi and 2 No. Pataka beedi (local brand)
d. Average working hours per day —4 hours
e. Average working days—231 days; average annual income earned— Rs 11777.68
f. Only 1 No. Pataka beedi workers earned a provident fund which is voluntary

The *Diara region* of the district comprising Baishnabnagar, Kaliachak, Manikchak, and English Bazar police station areas where beedi rolling is a very popular activity. Kaliachak II and III and Manikchak blocks have largest concentration of Child labours engaged in beedi rolling industry. These three blocks are devastated by recurring bank erosion (Ganga's bank erosion) and perennial flood etc. Loss of fertile and productive land, live stock, and shelter etc. coupled with high density of population and lack of alternative job opportunities has made the situation worse. High growth rate of population (both natural and immigration from Bangladesh) along with low intake in others sectors of economy and virtual absence of rehabilitation drag theses tender aged to this hazardous occupation. Beedi merchants lure the parents by offering some advance which poor families cannot afford to refuse to accept. Once the advance is accepted the families are trapped into the vicious cycle of indebtedness and sometimes near bondage.

Image No 79 : In all the Bank Eroded Area, F family Members are Engaged in Beedi Rolling Work. Kaliachak II Block . 24°49'26.59"N 87°56'42.81"E

Image No 80 : In all the Bank Eroded Area, F family Members are Engaged in Beedi Rolling Work. Kaliachak II Block . 24°49'26.59"N 87°56'42.81"E

Image No 81 : women are Involved in Beedi Rolling Work, 24°57'6.13"N 87°58'53.02"E, Birodhi, Kaliachak I Block

Image No 82 : All the Family Members are Engaged in Beedi Rolling, Manikchak

Image No 83 : Kamalpur, Manikchak Block 25° 4'10.50"N 87°54'10.43"E

Image No 84 : Mathurapur, Manikchak 25° 6'24.32"N 87°53'24.09"E

6.2E. Handicraft Industry of Malda

Handicrafts of Malda district are hugely acclaimed not only in the country but also across the globe. The history of these crafts is enrooted in the ancient past when these craftworks flourished under royal patronage. Since then, a number of artisans emerged in different parts of the district. Numerous artefacts are produced with a variety of materials such as ivory, wood, sholapith, bell-metal and silk. Meticulous and elaborate designs are furnished on the handicrafts, some of which takes a long time to complete.

a. Bamboo Craft : Total 78 crafts persons of Gajole and Bamangola located in Malda district are covered under the project. In Malda majority of the crafts persons belong to Mahali community. Bamboo works is the primary source of livelihood for majority of the crafts persons.

Image No 85 : Bamboo Baskets are Found in all Blocks

Manik Rabidas is a resident of Alampur village in Gajole block of Malda district. He has won the District Award 5 times and the State Award thrice. An ace craftsman he has made a name for himself. Manik makes winnows, baskets and decorative items like flower vase, pen stands and he also specializes in jewellery. Rabidas works as a master trainer in the states of West Bengal, Tripura, Assam, UP, Uttarakhand and Haryana. He has participated in fairs in Kolkata, Delhi and Tripura.

A craftsman of repute from Majlishbag village of Malda district, Jatin Tudu makes winnows, baskets and decorative items like flower vase, table lamps, pen stand etc. He has participated in fairs in Kolkata, Delhi, Goa, Mumbai, Kerala, Siliguri and Aizawl and has won the District and State award in the year 1983 and 1984 respectively.

Manoranjan Mondal is a resident of Sarkarpara in Malda district and has been working as a bamboo craftsman since 2007. He has learnt the craft from his wife Durga Mondal who has been in this craft for long. He makes traditional items like winnows, baskets and decorative items like flower vase, pen stands, lampshades etc. He has participated in fairs in Goa, Kerala, Chandigarh, Delhi, Siliguri and Asansol. Manoranjan has also participated in the international fair at Lithuania in 2017.

Srinath Tudu started working as a bamboo crafts person in the year 2000.He has learnt the craft from his father Jatil Tudu. He makes table lamps, pen stands, hairclips, incense stick holders, candle stands and jewellery boxes. Srinath has participated in fairs in Kolkata, Siliguri, Durgapur, Asansol, Delhi, Mumbai, Pune and Kerala. He has won the State Award in 2007, and District Award in 2006 and 2007.

Image No 86 : Bamboo Crafts of English Bajar, Kaliachak I, Old Malda

Image No 87 : Banboos are Cut to Create Different Items

Image No 88 : Banboos are Cut to Create Different Items

b. Earthern Vessels:

Image No 89 : In Some Areas of Manikchak We Found Some Earthern Vessels are Made

Image No 90 : Metal Work Found Near Mathurapur, Manikchak Block

d. Jute Craft:

Like any other state West bengal also produces wide variety of Grass Leaf items. This art is totally derived from nature and are free from chemicals and are environmentally friendly. The high- tensile strength of bamboo and easy to mould in any shape qualities have made it very popular for architectural uses. These artists give shape to many household items such as baskets, rice and vegetable strainers and brooms. Designer items such as furniture, racks are also in vogue. Bamboo has a great specialty; it does not require much of maintenance as once in a year wood polishing is sufficient for its longevity.

The articles from tender palm leaves which have their ribs removed and are then dried in the Sun include bags, dinner cases and ornamental hand held folding fans having anything between 37 to 56 blades.The blades are tied together by copper wire through holes on them and sewn together to spread out as a fan.The fans are made attractive in appearance by painting floral motifs on the blades.Palm leaf and stem weaving is a flourishing craft in southern Kerala with bags, hats, and suitcases being made both for the Indian and international markets these days.A reed is a firm-stemmed grass, with a hollow stem that looks like bamboo.It is a sturdy material and reed mats are used as walls for structures and roofs.The reed is first split and shaved before it is woven in a twill weave into mats. They are made starting at one corner and plaiting or weaving is done diagonally.Long strips are folded at the middle and another strip is inserted crosswise, which is in turn folded and the next strip is again inserted crosswise and so on.The creases of the crosswise strips form the edges of the mat.Reeds are also used to make very sturdy baskets.

Image No 91 : Raw Jute Fibre are Used to Prepare Various Jute Products

Once the plant is ready for harvesting, it is cut very close to the ground and left in the ground for a day or two when the leaves fall off. The cut plant is then absorbed and dipped in water to separate the fibre from the plant. This process is known as retting. The, thus separated Jute is dried and given various forms. The fiber is knit into threads. Sometimes the threads are weaved to make rags and cloths. The cleaned fibre, the threads and the rags all are used to make beautiful craft products like the bags, rags, carpets, hangings, footwear, coasters, jewelry, show pieces, etc. Some very fine quality jute is also used to make furnishing material and dresses.

Harischandrapur Cluster falls under West Bengal State in Malda district mostly specialises in jute handicrafts.The Harischandrapur cluster is able to form 60 plus Artisans & 4 SHGs supporting the strong work force. The mobilisation gains momentum day by day. Raw jute is grown in the Kalichak , English Bazaar area and the transported to Harishchandrapur for preparation of items.

Image No 92 : Raw Jute Fibres are Dried to Create Products

Image No 93 : Different Jute Items are Prepared and Supplied to Exhibitions and Fairs

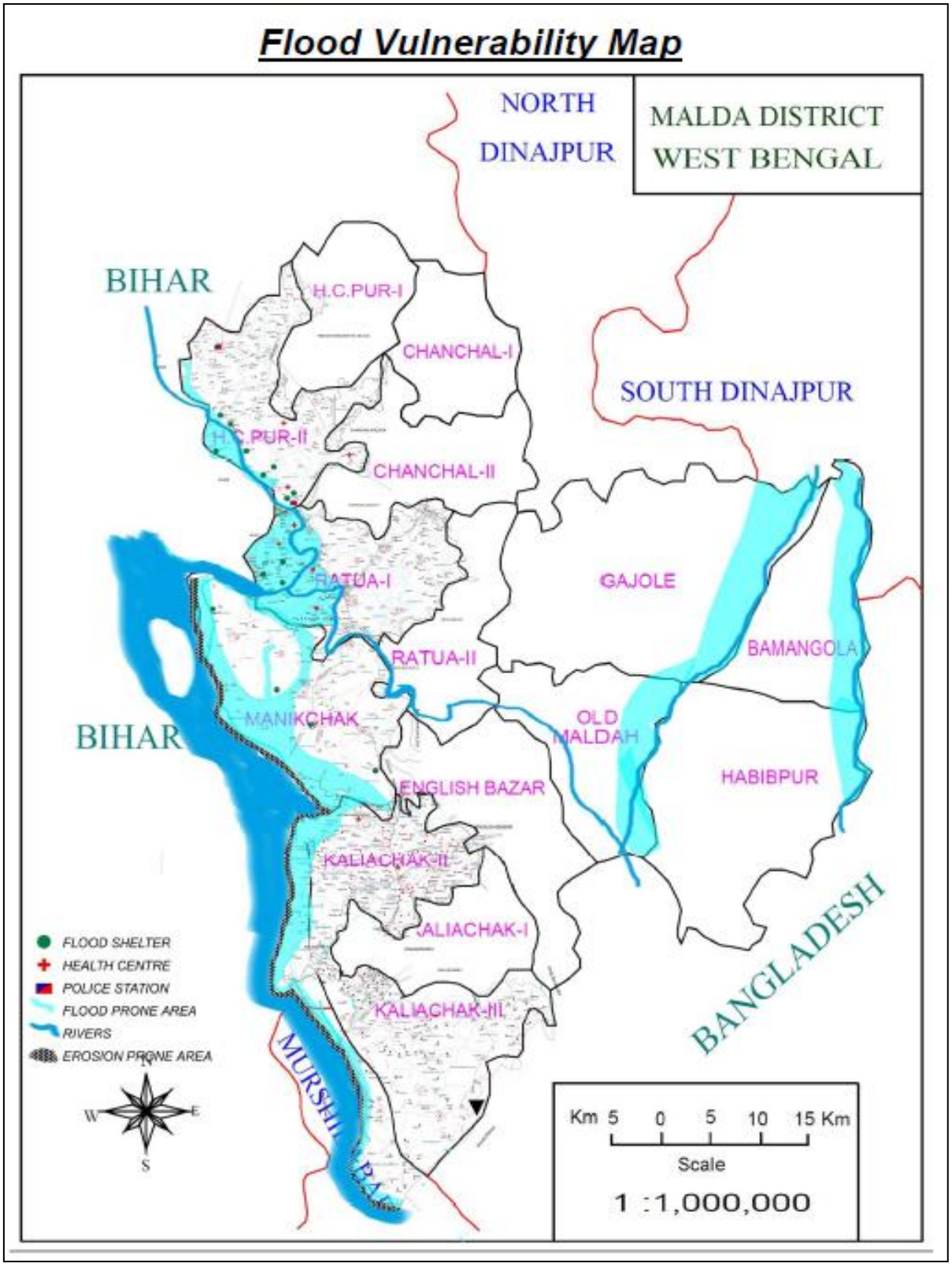
Image No 94 : Different Jute Items are Prepared and Supplied to Exhibitions and Fairs

Chapter 7 : Documenting Environmental Problems

7.1. Flood

The Malda district is one of the most flood prone districts of West Bengal. Floods of destructive character are of frequent occurrence in Malda. Between 1850 and 1870, there occurred three several inundation, which caused great distress in all parts of the district especially in the low lands along the rivers. After 1870, the years of high flood were 1875, 1885, 1906, Foods also affected the district in the years 1918, 1922, 1935 and 1948. In the recent past, severe inundation was experienced in the years 1987, 1988, 1991, 1995,1998, 2017 and 2019. These floods resulted not so much from rain in the District but due to overflow of water in the rivers caused by rainfall in the upper catchments areas. Most of the rivers and streams in Malda, the most important of which is the Ganges take their rise in the Himalayan mountains and are therefore, susceptible to sudden inflow of huge water caused by the melting of snow or by excessive rainfall in the mountains. This district experienced devastating flood in the last year mainly due to breach of bundh over Fulohar at Dhabol in Bihar and sudden flush of flood water combined with incessant rain for three to four days from 12th August 2017 engulfed almost the whole district. The Chanchal sub division and Gazole, Bamongola, Habibpur, Old Malda and Englishbazar blocks were the worst affected.

Image No 95 : Ganga Eats Away 250 Malda Homes in Eight Hours- Telegraph,18th October, 2021



Map No 51 : Flood Vulnerability Map of Malda District, Source : Disaster Management Cell

The span of flood was more than 20 days causing a havoc to the lives and property of our district. The District Administration with the help of various line deptt rose to occasion to restore normalcy. The threat of flood and erosion still hang over the district this year also. This year , still now , Ganga has gobbled out a large part of Manikchak , Kaliachk area for 3 times-April, June /August , September-October.

Table No 16 : Water Hazard Situtation in Different Blocks

Name of the Block	Type of Hazard	Cause or Vulnerability	Villages	Name of The GPs / Wards Affected
Manikchak	Water Logging	Overflow of Ganga &Fulohar	Kamaltipur, Sahabattola(part), Balutola, Nasutola(part), Kalitola, Iswartola (part) & Elahitola(part). Wahedmara, Barabagan(part) & Sonapur. Ramnagar, Jotpatta, Rabidaspara, Sibantola, 2No. Bridge para, Darbari tola, Narayanpur, Narayanpur Id gaha para, Manikchak ghat Bandh Para, Jalalpur (part), New sonapur, Mankud, Domhat, Chamatola. Madantola & Palpara. Mahendratola, Raghunath tola, Bhabani tola, Bipin tola, Durgaram tola, Payari tola, Panchu tola, Ratan tola, Duyani char, Bhojan tola, Jaipaltola, Sukdev tola, Bhim tola, Nayan tola,Lutihara, Debu tola, Krishnatola, Bhabanathtola, Ganesh tola, Nabadiptola, Amintola & Pulintola bandh. Gadai, anditola, Mathurtola, Bagdukra, Benutola colony, Kaluton tola, Rajkumar tola, Bagedantola, Piyaritola, Debutola, Anantalaltola, Giridharotola, Gourangatola, Domontola, Lutihara, Baikunthatola & Chabiltola. Laksikol (part), Laskarpur (part), Haripur (part) & Jitmanpur (part).	Gopalpur Dharampur Manikchak Dakshin Chandipur Hiranandapur Nazirpur
Kaliachak II	Flood/ Water logging	Ganga	Jote kostuty, Mahadevpur, Bintola, Sadipur, Gosaihat & Chowdhutytola. Dolboxtola, Ramlaltola (part), Lohariditola, Sultantola, Laskaritola, Paglaghat Bus stand, Jinerditola & Nasarattola Dhelfora, Jitnagar & Jugaltola. Shibutola, Etwaritola, Shripur colony, Piaritola(east & west) Tofi, Mathabhanga, Jatintola, Chumkitola, Chechrutola, Khatiakhana char & 8 No.Spar bandh.	Bangitola Uttar Panchanandapur 1 Uttar Panchanandapur II Hamidpur
Kaliachak III	Water logged (flood like situation)- 2019-2020. Farakka barrage and river Ganges are the main factors.	Ganga	Dinutola, Asgarhajitola Ajimtola, Atartola, Hajrattola, Bhangatol, Jagantpur, Mouza Mondai, Charsujapur, Surenmandalpara & Kalitola Deonapur Noornagar & Sabdalpur Parlalpur, Shibpur,Par anupnagar, Golapman & Dalpra	Birnagar II Laxmipur Krishnapur Bakhrabad Kumbhira

Source- District Disaster Management Plan, Government of West Bengal,2019-20

According to 2019, Disaster Management Report the most vulnerable villages of the Kaliachak II Dev Block are :

Sl.No	Gram Panchayat	Name of the Villages	Remarks
1	Uttar Panchanandapur-I	a) Dalboxtola , b) Ramlaltola (Partly) , c) Lohardtola , d) Purba Sultantola , e) Laskoritola , f) Paglaghat Bus Stand , g) Jinerditola , h) Nasarattola	Water - logged in the Year 2011 2013 , and 2015 2016 ,2019
2	Uttar Panchanandapur-II	a) Dhelfora , b) Jitnagar , c) Jugaltola	Water - logged in the Year 2011 ,2019
3	Bangitola	a) Jote Kostury , b) Mahadevpur , c) Bintola , d) Sadipur , e) Gosaihat , f) Chowdhurytola g) Chhatiantola , h) Sakullapur, i)Majiasaran	Water - logged in the Year 2011, 2013, 2014 2015 and 2016 ,2019
4	Hamidpur	a) Shibutola , b) Etwaritola , c) Shripur Colony , d) Piaritola (East & West) , e) Tofi , f) Mathabhanga , g) Jatintola , h) Chumkitola , i) Chethrutola , j) Khatiakhana Char , k) 8 no. Spar Bundh	Water - logged in the Year 2011 , 2013 2015 and 2016 ,2019
5	Rajnagar	a) Nayagram Model , b) Bromottar	Water - logged in the Year 2011, 2013 and 2016 ,2019

Image No 96 : Bank Erosion at Birnagar G.P, Kaliachak III 24°50'54.10"N 87°57'14.69"E

Image No 97 : Immense erosion at Palgacchi, Babupur area of Kaliachak II Block 24°50'23.56"N 87°56'53.94"E

Image No 98 : About 150 Houses were Washed Off Because of Heavy October Rainfall at Birnagar Sarkarpara 24°50'21.24"N 87°57'5.46"E

Image No 99 : Sandbags are Used to Protect the Bank Line, Birnagar G.P, Kaliachak

Image No 100 : Collapsing of Banks at Narayanpur Area, Manikchak

Image No 101 : Collapsing of Pucca Houses, School Building Because of River Action, Birnagar G.P

Image No 102 : Collapsing of Pucca Houses, School Building Because of River Action, Birnagar

7.2. Bank Erosion and its impact

Channel instability and rhythmic fluctuation through erosion-deposition sequence are very familiar phenomena in the lower course of a river in monsoon climate. The river Ganga and Bhagirathi-Hooghly, in West Bengal resorts to massive bank erosion at an alarming scale in Murshidabad District along with Nadia, Purba Bardhaman ,Malda and contributes to a dominant irreparable loss of farm lands of a very high quality each year. It has been estimated, that about 43% of the total geographical area of the state has been declared as flood prone. Form reports of West Bengal Irrigation Department, it has been seen that the average annual quantum of land, engulfed by the rivers in West Bengal is about 800 hectares.

7.2A. Consequences of river bank erosion in different blocks of Malda District

In the early decades of the twentieth century, the Ganges flowed in a south-easterly course between Rajmahal and Farakka, but later in the century it formed a large meander to accommodate the additional water because of the barrage construction. Furthermore, nearly 64 crore (640 million) tonnes of silt is accumulated annually on the river bed. All these lead to massive erosion of the left bank.

During the period 1969-1999, 4.5 lakh people were affected by left bank erosion of the Ganges in Malda district, upstream of the Farakka Barrage. 22 mouzas in Manickchak, Kaliachak I and Kaliachak II CD Blocks have gone into the river. Other affected areas are in Kaliachak III, Ratua I and Ratua II CD Blocks. The worst-hit areas lie in the left bank of the river stretch between Bhutnidiara and Panchanandapore in the Kaliachak II block. Even in the 1960s, Panchanandapur was a flourishing river-port and trading centre. It had the block headquarters, high school, sugar mill and a regular weekly market where traders used to come by large boats from Rajmahal, Sahebganj, Dhulian and other towns. After being hit by river bank erosion much of what was there at Panchanandapur has shifted to Chethrumahajantola. The Ganga Bhangan Pratirodh Action Nagarik Committee's survey revealed a loss of 750 km^2 area in Kaliachak and Manikchak. 60 primary schools, 14 high schools, coveted mango orchards have gone leaving 40,000 affected families.

During the period 1990-2001 Hiranandapur, Manikchak, Gopalpur of Manikchak CD Block and Kakribondha Jhaubona of Kaliachak II CD Block were badly affected by river bank erosion. In 2004-05 large scale erosion took place in Kakribondha Jhaubona and Panchanandapur-I gram panchayats of Kaliachak II CD Block and Dakshin Chandipur, Manikchak, and Dharampur gram panchayets of Manikchak CD Block. Kakribondha Jhaubona, a gram panchayat, was totally lost by river bank erosion. The affected persons and their administrative responsibilities were merged with Bangitola gram panchayet administration.

River bank failures occur in two phases. Pre-flood bank failure occurs because of the high pressure of increasing water on the bank walls. During floods the area is submerged and water seeps into the weak soil. After the floods, the banks collapse in chunks. Every monsoon a large number people are affected by river bank erosion. They become landless and lose their livelihood. It creates neo-refugees with many social problems. Sometimes, poverty leads to increase in crime. The consequences of floods are of the short range as economic recovery is possible, but effects of the slow and steady disaster of river bank erosion are of

permanent nature, where the entire socio-economic structure is damaged and the affected population has to move and settle somewhere else. People seriously affected by river bank erosion in Malda have migrated in search of work to as far as Gujarat and Maharashtra. At Byculla, Mumbai, there is a whole colony of erosion affected people of Malda, where they are often branded as Bangladeshi infiltrators, as they have lost not only their belongings but also their documents in the erosion. Such is the tragedy of these neo-refugees in their own country.

In the remote past, the Ganges used to flow past Gauda, 40 km downstream from Rajmahal. Over a long period, the river shifted westward and now it tends to come to its earlier position. Therefore, the whole belt up to Gauda is risk zone for river bank erosion.

Image No 103 : The Eroded Bank of Ganges, Kaliachak

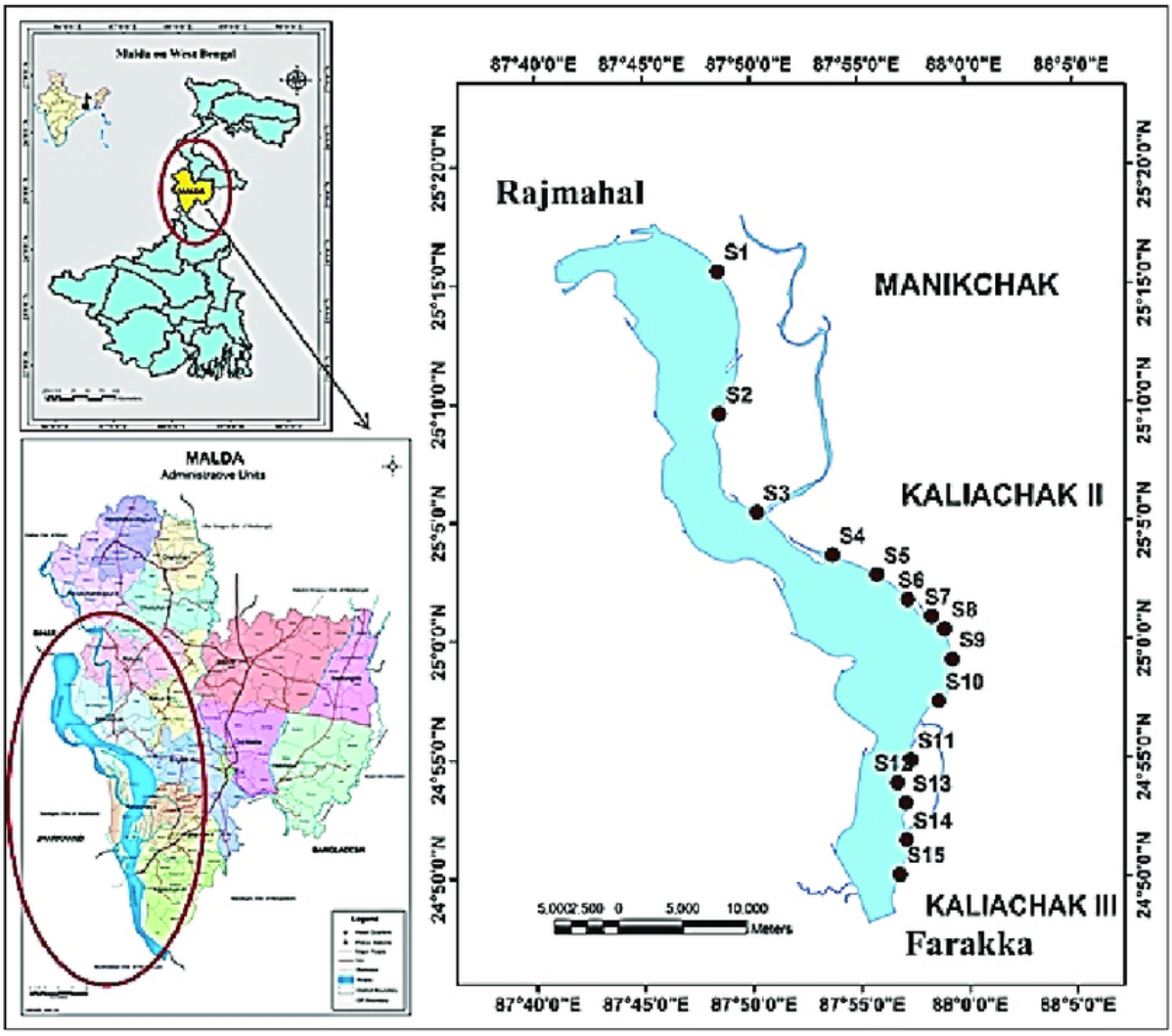
A group of experts has suggested the pressure on the left bank be reduced by diverting flow from the eroding channel. Alternatively, it is possible that in one devastating flood the Ganges will merge with Kalindri in the eastern side and the combined flow will merge with Mahananda at Nimasarai Ghat of Malda and afterwards the collective flow will merge with Ganges/ Padma in Godagari Ghat of Bangladesh. The Ganges has numerous abandoned channels in the area.

Image No 104 : An Instinct for Self-preservation has Prompted Residents of Sahebnagar-Kanchantola, a village in Manikchak block of Malda district on the banks of Kalindri river, to team up and prevent erosion caused by the river, without waiting for measures by the state irrigation department.

Image No 105 : Bank Erosion and Damaged Structure at Sahebnagar - Kanchantola

Image No 106 : Dakkhin Chandipur G.P, Bhutnir Char, Manikchak

Image No 107 : Dakkhin Chandipur G.P, Bhutnir Char, Manikchak



Map No 52 : The Erosion Sites of Malda District Along River Ganga and River Fulohar River

Image No 108 : Jodhikosturu Village, Manikchak

7.2B. Major Conditions Leading to Vulnerability

A. Physical vulnerability

i. Dangerous locations of villages

The Ganga River located in the western part of the district. Among fifteen C.D. blocks of the district, five C.D. blocks under the Diara region fall under the river eroded areas. Among these five, four C.D. blocks namely Manikchak, English Bazar, Kaliachak II and Kaliachak III are highly affected by the river bank erosion due to their geographical location . According to the field survey, altogether 88 villages in these C.D. blocks are affected and 42 villages out of total 88 are un-inhabited and the remaining 46 villages are vulnerable for their hazardous location which is mainly due to the close proximity to the river.

ii. ii. Unsafe infrastructure in villages

The civic infrastructures in many villages of Diara region like as Gopalpur, Narayanpur, Khaskol Chandipur, Palgachhi, Piarpur and Par- Anantapur are quite deplorable in terms of their physical strength. The road and sewerage system are very poor and there is prolonged water logging due to inadequate drainage system for the proper disposal of the waste water generated by the village households. At the time of rainy season, these areas are isolated from the neighbouring areas for its waterlogged conditions.

B. Economic vulnerability

i. Employment sectors at risk

The Diara region is a well-drained flatland formed by the alluvial deposition of newer alluvium and is very fertile for agriculture. Consequently, the livelihood of people in these areas is centred on agriculture. Most of the population are engaged agricultural sector. The continuous river bank erosion due to which agricultural lands vanish has become a cause of their miseries. This not only results to shortage of agricultural lands in these vulnerable areas but also uproots the people from their dominant source of economy. According to census report, the proportion of main workers within the rural workforce has declined whereas the proportion of marginal workers of the total rural workforce has increased. Secondary source of economy, fishing, is also affected by this type of hazards. Due to a lesser amount of edification and limited options of employment opportunity in other sectors, the villagers in such vulnerable areas are forced to migrate to other states as wage labourers.

ii. Low income level

The income level of people in these villages is quite low. The field survey (out of 100 HHs) of villages 11 HHs of Gopalpur, 8 HHs of Khaskol Chandipur, 5 HHs of Narayanpur and 10 HHs of Palgachi indicates an alarming scenario of economic condition of people as most of the households are living under the poverty level. Above 10 to 60 percentage of HHs, average monthly income is about rupees five thousands.

A number of residents (family) of these villages neither have BPL cards nor has any access to the MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) scheme. Surplus number of workforce, which is actually the result of loss of agricultural lands to the river

bank erosion, leads to labour exploitation. Wage paid to the labourers is much lower to the minimum wage rate as fixed by the government. Consequently, the people are unable to enjoy a good quality of life. Their low financial status continues to increase their vulnerability to any kind of disaster.

Image No 109 : Homeless, Landless People of Balugram, Kaliachak II

Image No 110 : Homeless, Landless People of Balugram, Kaliachak II

C. Social vulnerability

i. The problem of low education

The residents of these villages are not highly educated as the learning process is unstable and uncertain. The river bank erosion has also affected the superstructures in these villages. According to census report, total gain of male literacy rate of these affected villages has come down from the previous decades. The primary and elementary schools in some of these affected villages (Gopalpur and Par Anantapur) once engulfed by the river are yet to be substituted. Even though the people are interested to send their children to schools but they have no proper educational platform available in their make shift places. Due to the insufficient institutional facilities, many students who enrol to the far off schools drop their studies in due course of time due to long distance and lack of proper roads and transport and unsuitable housing conditions. Therefore, low levels of education and drop-out among the residents have become a common phenomenon in these villages. The number of drop outs among the male is higher than the female (based on field survey). As a result, the people are mostly engaged in primary occupations which do not require any special skills or technical training.

Due to the lack of proper education, villagers are involved in incommunicative activities.

ii. Poor health conditions

Health issues are a matter of major concern in these vulnerable villages. Not only human beings but also the livestock get affected by the hazards. Vector-borne diseases like malaria, typhoid break out frequently due to the favourable conditions during the rainy season. Lack of hospitals and health centres in and around their make shift settlements very often aggravates the conditions of the patients and therefore, high rate of death of pregnant women and elders is observed in these vulnerable areas. In addition to it, absence of different scheme of immunization (pulse polio) affects the children's health. But in the last two to three years, some positives changes have come in the health conditions of these people due to the implementation various Health and Nutrition schemes (ASHA, ICDS and Anganwadi centre). In spite of this, the overall intensity of malnutrition is still rampant in many parts of the vulnerable villages. Access to safe drinking water is one important precondition for long and healthy lives for the people of the area. Diara region is arsenic prone, so arsenic fluoride contamination is another serious problem in the region as well as the district.

iii. Lack of public amenities

Among the 46 inhabitant villages, a few villages have secondary types of schools. The higher educational facilities are also inadequate. The minimum distance of the high schools and colleges is 5 and 10 km respectively. Good educational institutions and health facilities are also insufficient in these villages. The most shocking is the case of Kaliachak III block (only affected inhabited villages), where primary health centre is not at all available. Villagers of such areas cover 5 to 10 km distance to reach to the hospital or private clinic for treatment of their health problems. And as per as drinking water is concerned, most of the villagers use hand pump or tube well for drinking purposes. A small numbers of villages have treated or untreated tap water facilities. Private tank is very costly and it is, therefore, not possible for

everybody to arrange a private tank for clean drinking water for their family. Transport and communication is another grave area. Geographical location of certain villages caters to adverse conditions on transport and communication systems. There is always serious deficiency of proper means of public transport because of lack of connection to national highway, state highway and district roads. Most of the parts of the villages are connected with unmetalled or Kuccha type streets and lanes. Even the residents of such areas face the problem of proper sewerage system, the absence of which causes an unhygienic condition in these villages. Further the bank services among the villages are not sufficient.

Image No 111 : The Vulnerable Kesarpur Villagers of Manikchak

Image No 112 : The Vulnerable Kesarpur Villagers of Manikchak

iv. Lack of disaster preparedness

The people of these villages are aware of all the problems arising out of this river bank erosion. However, they are not at all prepared to face any kind of disaster. Such low level of preparedness is actually due to their lack of edification and poor economic status. Moreover, the local government has taken no measures to increase the level of preparedness of the concerned population or villagers in order to mitigate the effects of the disaster occurring (especially bank erosion) in the nearby river bank areas.

D. Political Vulnerability

After the river bank erosion, vulnerable people face insecurity problems due to their loss of home land, loss of property and loss of occupation. Afterwards due to the displacements, people of such areas also face identity crisis in their internal land . Border dispute or cross border conflict or rightful belonging to a state is major problem of the peoples who are settled in the adjoining border areas of the Malda district and the Jharkhand state. As a result, land eviction is a common phenomenon in those particular areas.

7.3 Sand Mining and its impact

Huge quantity of quality sands and silts are found to occur in part of Mahananda, Ganga, Nagri and Fulahar River. Smaller patches are also available locally in the other smaller rivers as well. The rivers in the districts are filled by 70% of silt and 30% of sand only. These materials are primarily utilized for construction purpose. As per the present practice, mining is done by manual method with tools and tackles.

Table No 17 : List of major sand mining areas

Sl.no.	Administrative Block	Mouza	Latitude	Longitude
1	Kaliachak III (River Ganga)	BAGDUKRA(015), DAKSHIN CHANDIPUR(019), PASCHIM NARAYANPUR(021), NARAYANPUR(022), DHARAMPUR(073), MIRPUR(088)	24°59'40.113"N	87°56'56.83"E
2		CHAK BAHADURPUR(040), DEBIDASPUR(192), PAR DEONAPUR(193), PAR PARANPARA(194), JIOLMARI(196), PAR LALPUR(197), PAR ANANTAPUR(199), PAR SHIBPUR(200)	24°48'25.045"N	87°56'17.176"E
			24°39'22.586"N	88°0'5.694"E
3	Manikchak (Fulahar River)	MAHABBATPUR(031), GHASIGAON(027)	25°10'8.052"N	87°52'51.261"E
			25°5'32.287"N	87°50'55.395"E
4	ENGLISH BAZAR (Mahananda)	JATALPUR(054), , RAIPUR(096)	25°2'6.626"N	88°7'57.97"E
			24°57'59.39"N	88°10'17.627"E

All though most jurisdictions have legal limit on the location and volume of sand that can be mined, illegal sand extraction is following in many parts of the country due to rapid urbanisation and industries. Removal or extraction of too much sand from rivers leads to erosion shrinking of river banks. Deltas can recede due to sand mining. These destructive effects of sand mining ultimately results in loss of fertile land and property. It also destabilized the ground and causes the failure of engineering structures for civilization

In-stream mining directly alters the channel geometry and bed elevation. By removing sediment from the channel, in-stream material extraction disrupts the pre existing balance between sediment supply and transporting capacity, typically inducing incision upstream and downstream of the extraction site. The resultant incision alters the frequency of floodplain inundation along the river courses, lowers valley floor water tables and frequently leads to destruction of bridges and channelization structures Sand Mining in beaches disturbs the ecosystem of different fauna of the beaches. The sand mining from natural barriers, made up of sand, causes flooding of the natural habitat. The sand mining activity destroys the aesthetic beauty o beaches and river bank and makes the ecosystem unstable. If there are popular tourist destination, tourism potential of such areas will lose.

It could be concluding that there has been little in depth research in to the environmental and social also political effect of land use practice and calls for urgent redressed by the competent authority.

Image No 113 : Sand Mining Near Milki, Englishbazaar

7.4. Mobility and Migration in Malda district:

As already mentioned in the introductory section, the District Human Development Report, 2006, reports seasonal out-migration in the district to be as high as 90% in certain areas. Field interactions during this study were aimed at capturing ground-level data for this, as also at understanding the specific reasons thereof. As a result, patterns of mobility and migration emerged in course of this study, in the Bamongola, English Bazar, Gazole, Habibpur and Old Malda blocks of the district. Mobility and migration of both genders was found to be socially acceptable and regular in the said blocks of Malda district. Out-movement starts from the age of 12 on an average. The social sanction for such movement was found to result in specific patterns that vary across age-groups and genders. Some such patterns are captured below :

- Agricultural labour is considered to be suitable for girls and young women. This results in girls in the age-group of 12 – 18 years migrating to Bardhaman district during the farming seasons to work as daily labourers in cultivation related jobs.
- Boys from the age of 14 onwards start migrating to Chennai, Delhi, Goa, Haryana and Mumbai to work as construction workers.
- Some girls in the age-group if 12 – 14 are also sent off with agents to work as domestic labour in cities.

The reasons described by the District Human Development Report behind such mobility and migration were confirmed through field interactions. Paucity of employment opportunities throughout the year was mentioned by everyone to be the primary reason behind such high rates of movement away from the district. Also, even when income-earning opportunities are available within the district, the pay is never as good as it is when people go outside to work. To quote one of the returnee migrants interviewed: *'Jobs are available during the mango season; but the orchard owners pay Rs 20/- or less per day to take care of an orchard spread over 5 - 6 bighas. We get much better rates when we go out to work.'*

The major findings from exploring the patterns of mobility and migration in the district of Malda are encapsulated below:

1. Acute survival needs, combined with a situation of no employment options being available locally, result in high rates of migration of both genders, supposedly happening out of choice
2. Migration options include extremely exploitative systems like *dadon* and other seemingly non-exploitative options are not safe either
3. The migration of children above 12 is quite high – through marriage (especially for SC/ST communities), for schooling (especially for Muslim boys) and for work (again, particularly SC/ST girls) – all of which happens with the consent of the family
4. The lure of employment and income earning has started having clear impact on the choices children in the age-group of 14 and above are making, especially boys who sometimes defy parents and run away to work – thereby putting themselves at risk of being trafficked and/or be otherwise exploited.
5. Migration returnee children interviewed during the field work unanimously mentioned that once they have crossed Malda station, they lose complete control over their lives passing through many unknown hands along the route before reaching the final

destination and feel helpless in an alien land among strangers whose language also they do not understand

6. All of the above happen through a well-organised network of agents – known and unknown – who remain active in Malda for facilitating the processes captured above
7. Trafficking happens almost smoothly behind this so-called spontaneous migration, where children migrate with the consent of the family
8. Villagers are not completely unaware that trafficking for sexual purposes and others forms of exploitative labour happen under the guise of facilitating migration, but seem to lack the agency of doing something about it
9. Organisations working in Malda on child protection issues have failed to capitalise the existing knowledge of the communities to motivate them towards developing preventive mechanisms for the safety of children
10. There has not been much pressure on the district administration to take cognizance of this nexus between migration and trafficking, so that District Human Development reports can still mention migration without mentioning the issue of trafficking at all.

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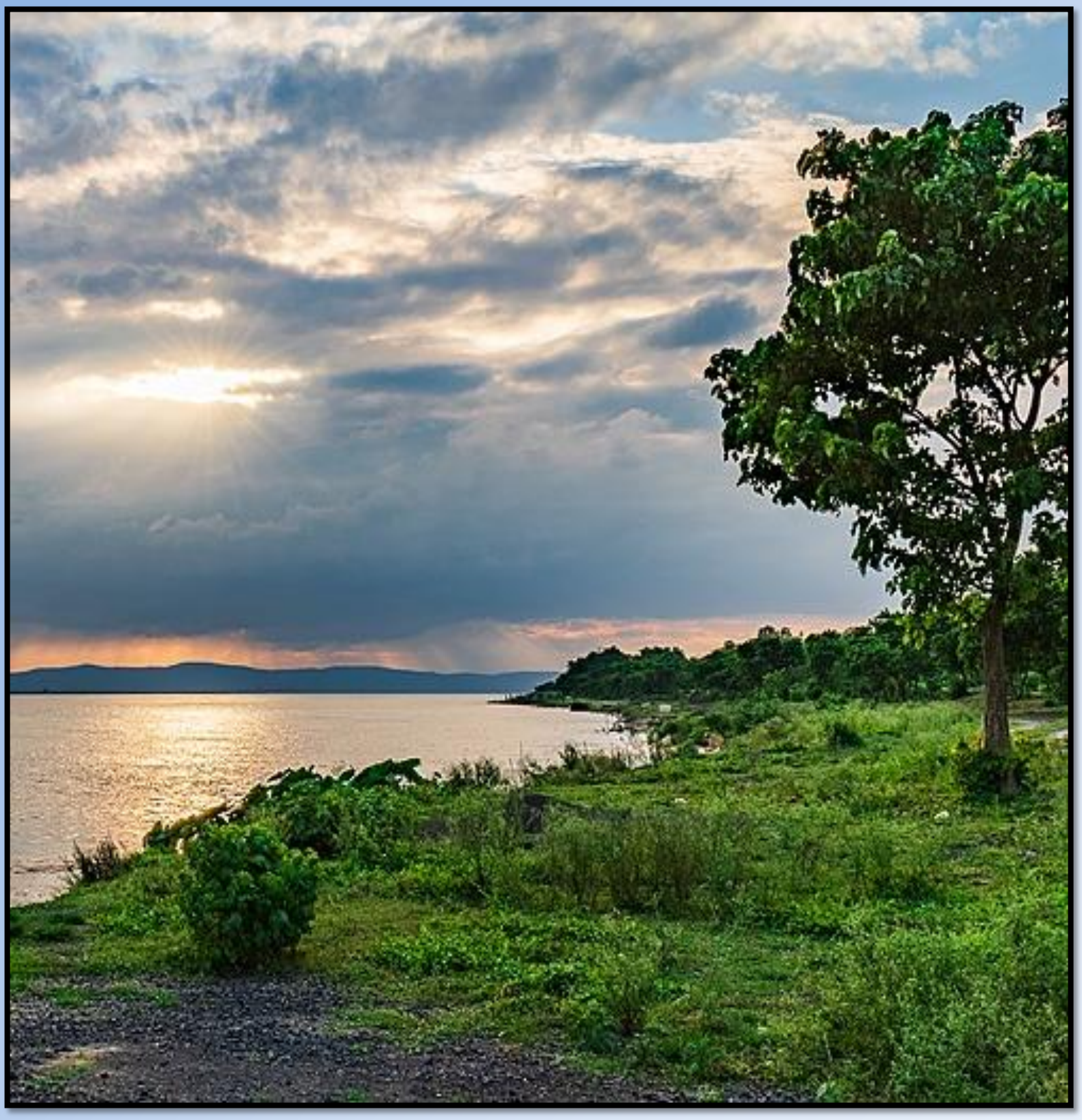

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