

CHAPTER: 2

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2. STUDY AREA

The district of Maldah is very ancient and is the gateway to the Northern part of West Bengal was formed in the year 1813, taking out some outlaying areas of the districts of Purnia (Bihar), Dinajpur (West Bengal) and Rajshahi district of adjoining country Bangladesh. During sixteenth century this place was treated as capital of Bengal, when it was ruled by the Hindu King *Sashanka*, later on Pal and Sen Dynasty ruled over the area. After the Pal and Sen Dynasty Muslim Nababs were governing this district followed by British Empire. So, the most of the monuments (*Gour, Adina, Pandua* etc.) and remains bearing the evidence of Muslim dynasty and British Government constructed some buildings in different places of the district to use as godwans for indigo. Few of those buildings are now used as school, offices. At present this district constitutes two sub-divisions, English Bazaar with 9 Blocks and Chanchal constitutes of 6 blocks.

2.1. Location

This ancient district Maldah is situated on North-East bank of river *Ganga* and also located almost at the central part of the state of West Bengal (Plate-III). It is located between the $24^{\circ} 40' 20''$ and $25^{\circ} 32' 08''$ N latitude and between $87^{\circ} 45' 50''$ and $88^{\circ} 28' 10''$ E longitude and is covering 3733 sq km of total land area of West Bengal. This district is 350 km away from Kolkata by road distance. The place is nicely connected with road and railways.

2.2. Topography

The district consists mainly of low lying plains, slowly rolling towards south and extending up to the Northern bank of the river *Ganga*. The river *Mahananda*, flowing North-East, divide the district into two distinct regions of which the Eastern part is called as *Rarh* and *Barendra* which is generally referred as *Barind* is the Western part. *Barind* constitutes the undulating highland with larger track of depression forming several small and large water bodies along with rivers and streams. The soil of *Barind* areas (Gajol, Old Maldah, Habibpur and Bamongola blocks) are red and old alluvial soil with undulating topography. The Western part of *Mahananda* is again divided by the River *Kalindri* in to two smaller parts and the Northern part is referred as *Tal* (Harishcandrapur I and II, Chanchal I and II, Ratua I and

II) which is a low land area composed of largest number and area of marshy wetlands. The soil of this region is new alluvial and fertile. The Southern part of *Kalindri* and Western part of *Mahananda* Rivers is referred as *Diara* which is old left-over channel of *Ganga* rich in fertile fluvial deposits. The most striking features is the continuous line of islands and accretions formed in the bed of *Ganga* by its ever changing currents. The large river island on *Ganga* is “*Bhutni Diara*” situated within the boundary of this district. The *Diara* regions (Manikchak, English Bazar and Kaliachak I, II, III) are newly formed land with new alluvial soil which is more fertile than two other regions.

Among these three distinct physiographic zones (**Plate-IV**), *Tal* region is centrally depressed and having an average ground water level between 3.60 to 5.70m. On the other hand water level of *Diara* and *Barind* region is between 6 to 70m and 6m to 7m respectively (Sengupta and Bhowmik, 2001).

2.3. Land Distribution

Out of the total 3733 sq km area of the districts, most of the parts i.e. 1849.20 sq km area is used for agriculture. Water bodies or wetlands area constitute 1073.38 sq km out of which 172 sq km area under river system. The wetland areas are also subdivided into Water bodies (>10 ha), Water bodies (<10 ha), Sandy, Marshy, and Mud flats with areas 273.89, 156.76, 72.01, 120.34 and 450.38 sq km respectively. Tree covers 718.35 sq km area; built up area is 48.22 sq km; and roads and rails covers 30.96 and 12.89 sq km areas respectively (Fig. 2.1).

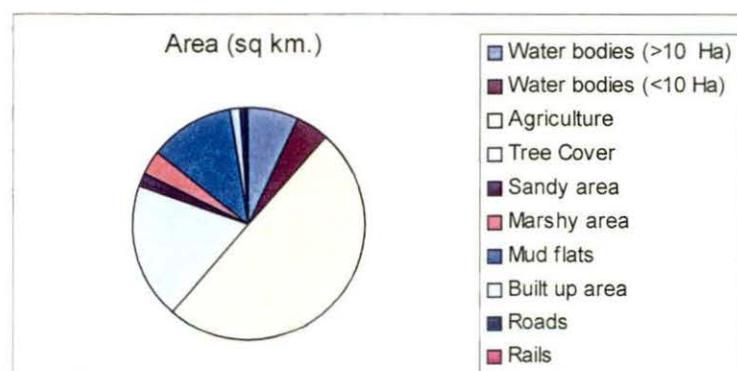
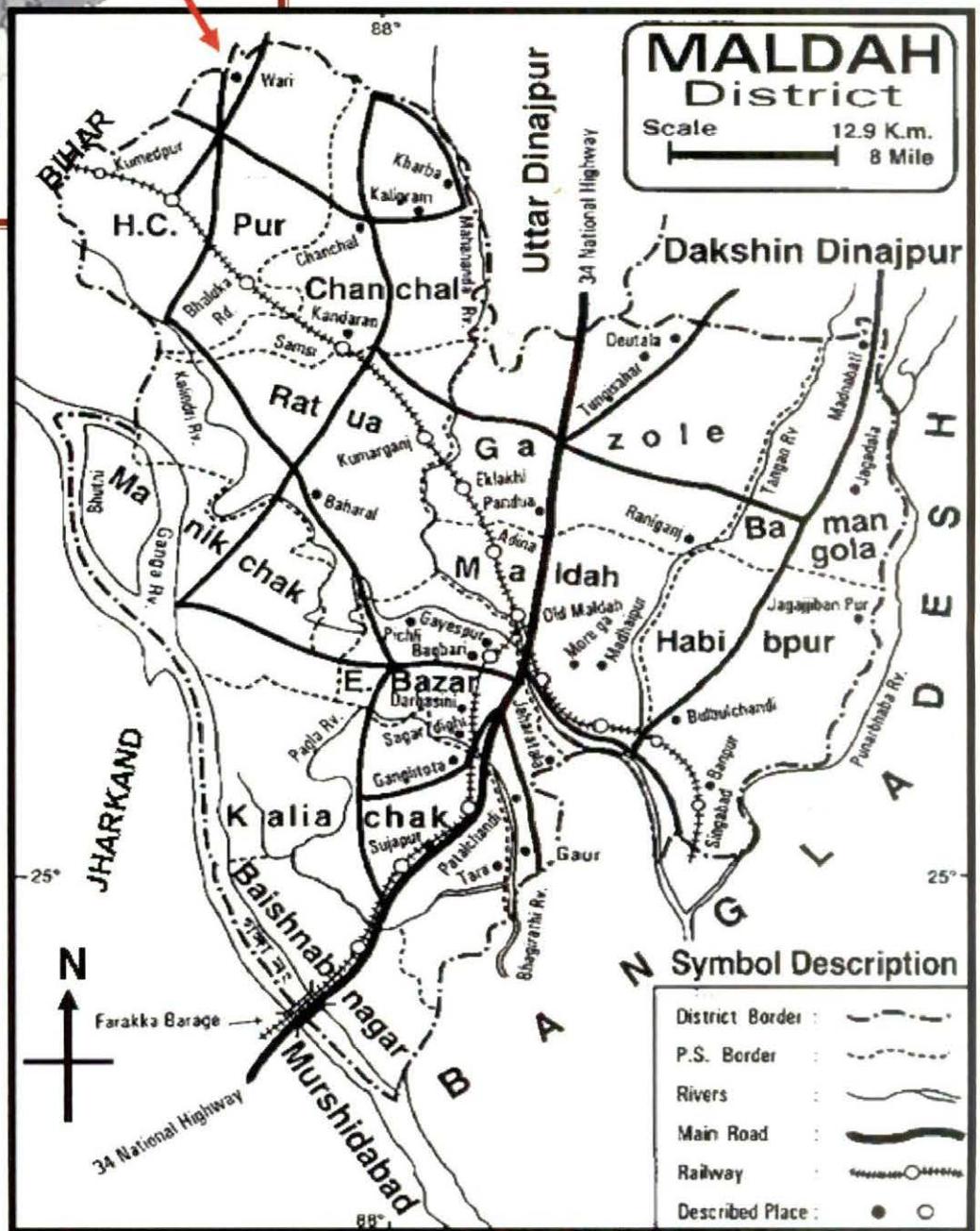
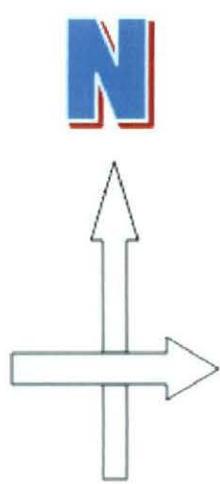


Fig 2.1 : Land distribution of Maldah District

2.4. Climate

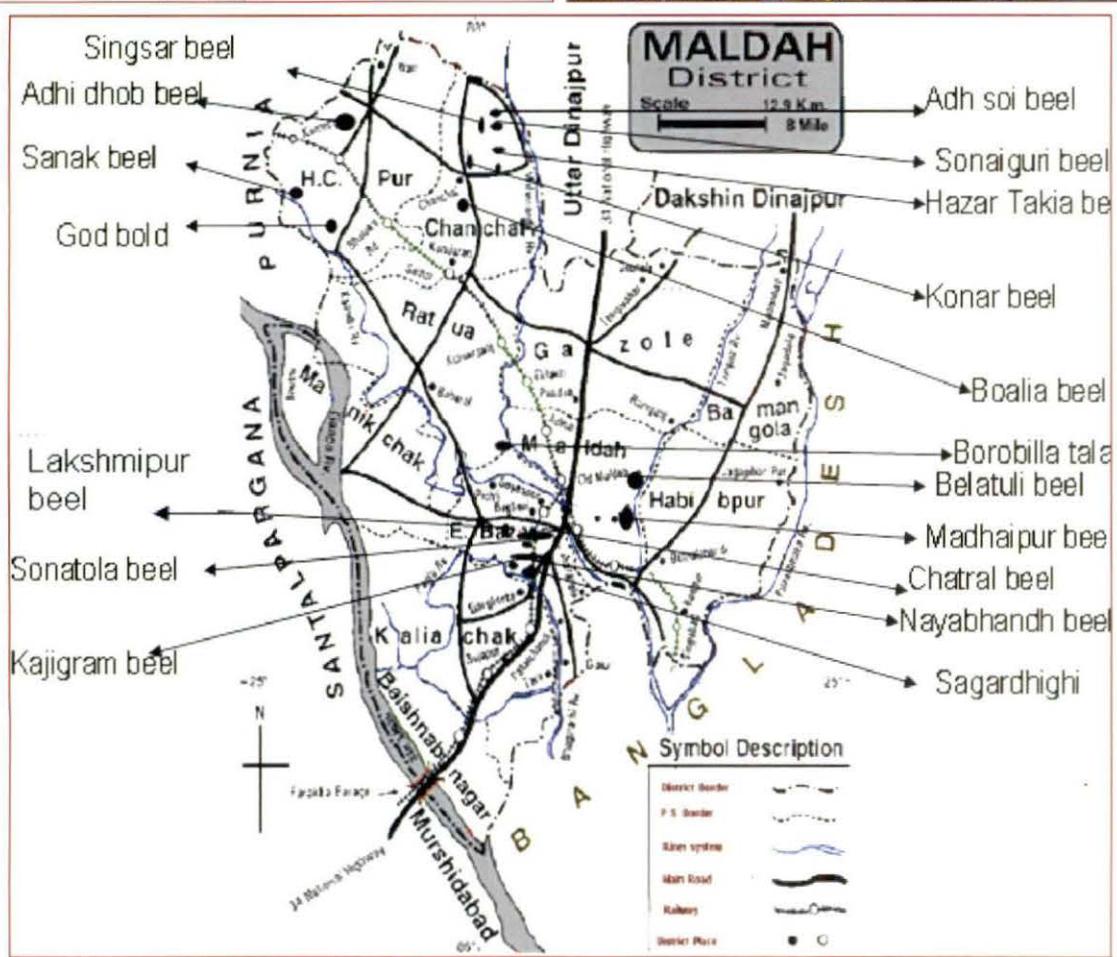
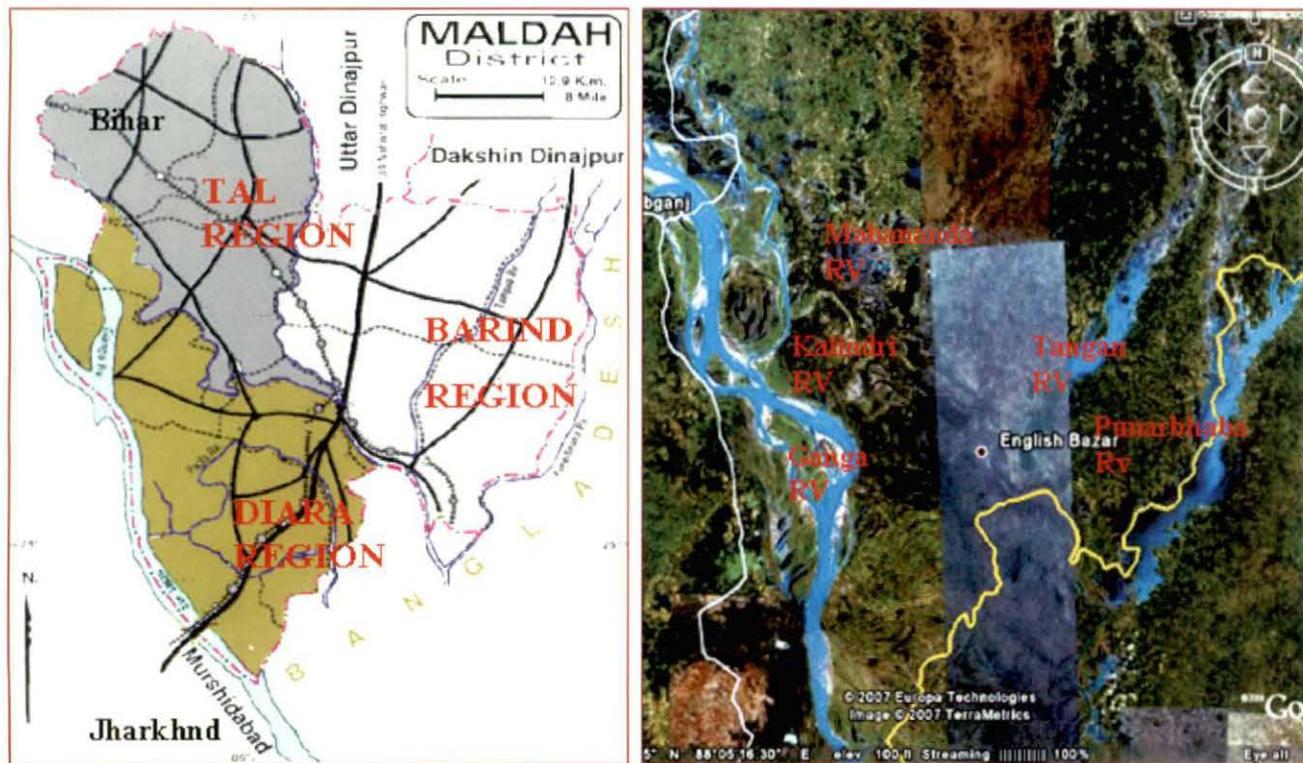
The weather of this district remains extreme round the year. Three predominant seasons namely summer, rainy season or monsoon and winter are recognized in the area. The summer starts from first week of March and extended up to the middle of August. The April, May and June are the extremely hot

Plate: III



Map of Maldah District

Plate: IV



1. District Topography, 2. Aerial Photograph, and 3. Major Wetland locations.

months when sometimes day temperature cross the 40°C. From the middle of August to the middle of October is the rainy season and from middle of October to the end of February is recognized as winter. The winter in Maldah is also severe, when sometimes, temperature fall down to 3°–4°C. During summer, mainly during April – May Nor'Westers, locally also called *Kalbaisakhi*, are quite common in the district. This Nor'Westers, sometimes runs over 400km/h during evening and are mostly originated from the Bay of Bengal. The bulk of climatic data presented here is collected from the meteorological department at Maldah.

2.4.1. Temperature

Due to its location in the tropics the summer is extremely hot and experiences an extreme saultry hot weather with high precipitation and quite humid air. The summer starts in March and stayed upto August. The day temperature reaches maximum during April – May. In April the mean day maximum temperature is 35.84 °C. Summer also sometimes experience hot waves coming from the nebouring state or plateau of Jharkhand. These hot waves are locally known as “*Loo*”. This time temperature rises up to 43°C and makes the life unbearable in afternoon for man as well as for his domestic animals. Daily maximum temperature recorded during April when the mean highest temperature is 35.85°C and mean lowest temperature is 23.02°C followed by May and June when daily mean maximum temperature are 35.50°C and 34.19°C with mean daily minimum temperature 24.89° C and 26.56° C. With the arrival of monsoon in the first week of July the daily temperature decreases slowly. Temperature starts decreasing from the middle of September. However, the winter is recognized for the period October to February the winter period is stayed. The winter is severe in the district during December to February. The mean daily minimum temperature of December, January and February is 14.08°C, 12.20°C and 15.07°C respectively. The month wise maximum and minimum temperature of last few years is given in table: 2.1 and table: 2.2.

Table 2.1 : Month wise Average Maximum Temperature

Year	1992 (°C)	1993 (°C)	1994 (°C)	1995 (°C)	1996 (°C)	1997 (°C)	1998 (°C)	1999 (°C)	2001 (°C)	2002 (°C)	Monthly Mean (°C)
January	22.3	22.3	23.6	24	23.5	24.4	21.9	25	24.3	25	23.63
February	24.9	28.7	24.7	28	28.1	27.3	28.3	30.7	28.4	28.7	27.78
March	32	32.3	33.3	33.1	34.3	33.3	31.4	35.4	33.9	32.8	33.18
April	36.7	35	37.4	38.4	37.9	32.9	33.3	37.2	37.1	32.5	35.84

May	33.4	34.4	37.8	39.5	37.8	37.2	35.1	34.5	32.6	32.7	35.5
June	34.8	33.7	33.2	32.9	33.1	36.6	36.6	34.4	32.9	33.7	34.19
July	32	32.7	32.5	31.9	32.2	33.1	33	32.1	33.4	33	32.59
August	32.1	31.6	32.5	31.7	31.7	33.3	32.7	31.8	34	32.8	32.42
September	32.1	30.9	32	31.5	32.3	32.4	32.8	31.2	32.9	33.1	32.12
October	31.1	30.7	30.8	31.2	31.7	32.6	32.8	32.1	32	32.2	31.72
November	28.5	27.5	28.2	27.7	30.5	30.5	30.3	30.6	30.5	29.7	29.4
December	24	25.3	25.2	24.4	26.8	24.4	27.7	27.5	24.2	25.6	23.63

Table 2.2: Month wise Average Minimum Temperature

Year	1992 (°C)	1993 (°C)	1994 (°C)	1995 (°C)	1996 (°C)	1997 (°C)	1998 (°C)	1999 (°C)	2001 (°C)	2002 (°C)	Monthly mean (°C)
January	10.1	11.8	14.3	12	13.5	11.8	11	12.3	11.4	13.8	12.2
February	11.4	16.5	15	14.9	16	13.9	15.6	16.5	15.3	15.6	15.07
March	17.2	18.8	19.9	19.5	21.5	20.1	18.1	20.3	19.7	19.8	19.49
April	20.8	22.2	23.4	23.9	23.7	21.5	22.8	25.8	23.7	22.4	23.02
May	22.8	24.4	24.2	27.3	26.3	25.1	25.5	25.2	24	24.1	24.89
June	25.8	26.2	26.7	27.3	26.2	26.7	28	26.8	26.4	25.5	26.56
July	25.1	27.1	27.2	26.7	27	26.9	27	26.7	27.2	26	26.69
August	25.8	27	27.2	26.8	26.8	26.7	27.4	26.4	27.7	25.8	26.76
September	25	26	25.9	26.2	27	25.8	26.7	26	26.9	25	26.05
October	21.9	24.3	23.5	25.1	23.9	22.9	25.5	24.9	25.1	22.6	23.97
November	15.7	19.7	19.3	20.2	18.5	19.5	20.9	19.5	21	18.3	19.26
December	10.8	15.5	14.5	14.9	13.4	14.1	15	15.5	13.9	13.2	14.08

2.4.2. Rainfall

In general, Maldah receives extreme rain in alternate years those cause devastating flood and that, inturn, cause the river erosion. The major river *Ganga* becomes badly affected by erosion within the District. Several villages get lost in the river. The erosion prone areas include Panchanandapur, Khaskol and Manikchak. The average mean yearly rainfall of the district is 1453.1mm as it was reported by Bachhwat in 1992. The same is 1672.95 mm during 1992 to 2002. As much as 78% of annual precipitation is received during monsoon. The rains start with arrival South-East monsoon from last week of June and extended up to the last week of September. July and August are the months with heavy rainfall and shares around 60-65% of total annual rainfall. During the 35 years, the maximum

annual rainfall was recorded 2236.3 mm in the year 1999, which is followed by 1998 (2153.6 mm), 1995 (1856.30 mm) and 1997 (1733.70).

Rainfall generally decreases during the month of September. Sometime heavy rain occurs in the month of October due the depression on Bay of Bengal that often reaches the district and cause heavy rain.

During winter season rainfall decreases sharply. January and February generally receives very small amount rain occasionally. The month wise annual rainfall data of Maldah given below in the table: 2.3. Yearly mean Temperature and rainfall of the district of last few years is presented in the Fig. 2.2.

Table 2.3: Month wise rainfall in last few year

Year	1993	1994	1995	1996	1997	1998	1999	2001	2002
January	21.6	27.7	3.5	18.1	19.2	4.9	0	0.7	9.5
February	0.8	37.2	5.9	19.8	15.8	5.9	0	0	1
March	7.3	0	1.2	0	13.7	99.5	1.1	0.8	5.7
April	67.9	15.7	4.9	26.1	60.5	41.1	6.8	4	116.9
May	55.8	27.9	70.4	13.6	39.3	124.4	127.6	206.8	101.8
June	198.3	293.4	252	222.5	210.9	186.3	334.3	295.7	124.7
July	182.5	100.3	327.5	363.8	343	643.9	384.4	276.9	244.1
August	345.2	171.4	417.8	396.7	668.3	370.8	705.9	179.3	400.5
September	438.8	195	659.8	522.1	329.7	384.6	536.8	184.2	485
October	61.4	89.9	16.3	39.3	8.8	265.5	137.9	323.8	69.3
November	72.7	0	90.4	0	2.5	26.7	1.5	0	13.2
December	0	0	6.6	0	22	0	0	0	0
Yearly rainfall	1452.30	958.50	1856.30	1622.00	1733.70	2153.60	2236.30	1472.20	1571.70

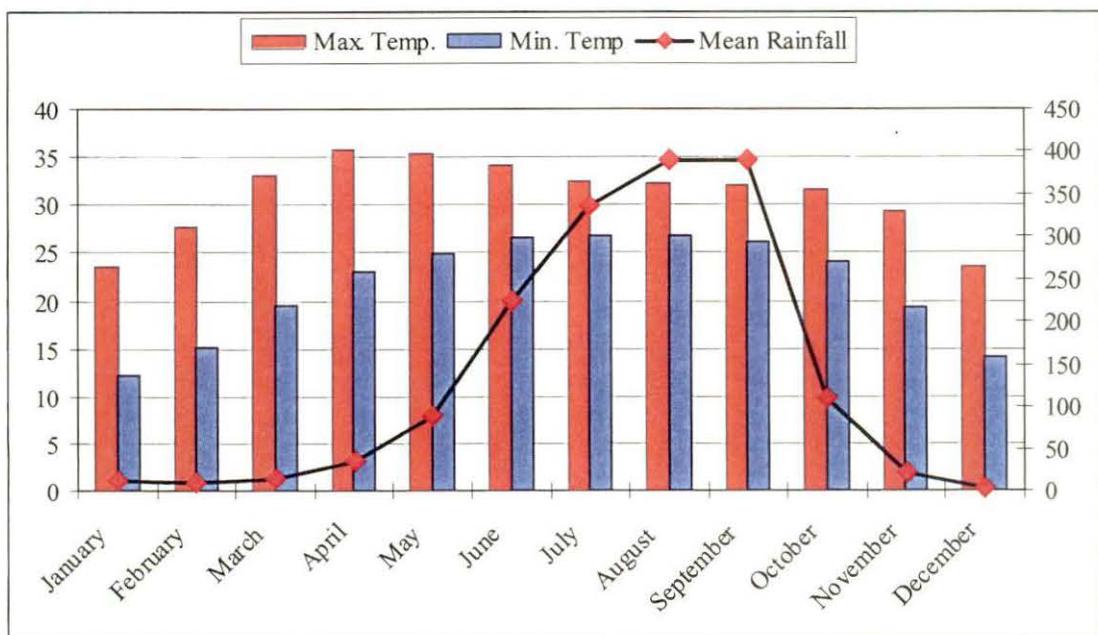


Fig. 2.2: Yearly mean Temperature and rainfall of The District

2.4.3. Relative Humidity

The humidity means water content of the air. Relative humidity of the district is remaining in peak throughout the year. The high relative humidity generally starts from summer i.e. March and it gradually rises up till September. During early summer at morning the relative humidity lies between 70-80% and at evening between 50-60%. The last 10 years annual relative humidity data shows that March and April maintain comparatively low Relative Humidity than remaining period of the year. The reading for Relative Humidity was recorded after every 3 hours interval. The month wise maximum and minimum relative humidity is given in table: 2.4 and table: 2.5.

Table 2.4: Maximum Relative Humidity (%)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2001	2002	Mean RH
January	95	83	86	77	83	79	87	77	77	81	82.5
February	93	74	79	74	76	69	72	67	70	71	74.5
March	74	61	67	59	65	59	62	47	55	65	61.4
April	77	69	67	56	60	67	70	71	61	77	67.5
May	89	80	72	73	76	65	74	75	75	80	75.9
June	89	84	87	87	84	73	77	80	83	82	82.6
July	95	86	85	88	88	83	87	85	81	86	86.4
August	93	88	87	89	89	84	85	88	81	83	86.7
September	94	89	86	89	86	82	81	85	82	81	85.5
October	95	85	83	81	75	71	78	79	82	74	80.3
November	94	83	79	79	70	75	74	71	77	72	77.4
December	98	77	79	81	72	85	74	74	82	76	79.8

Table 2.5: Minimum Relative Humidity (%)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2001	2002	Mean RH
January	52	66	67	56	63	63	72	66	62	69	63.6
February	37	52	58	48	54	54	56	53	54	54	52
March	27	40	44	36	43	44	53	38	40	49	41.4

April	27	52	48	36	45	57	62	53	48	69	49.7
May	53	67	53	53	55	55	66	70	68	70	61
June	57	73	78	78	73	66	71	74	75	74	71.9
July	77	77	74	82	81	80	84	81	75	79	79
August	73	83	80	81	82	81	82	84	77	77	80
September	68	85	78	87	81	83	80	83	81	77	80.3
October	62	77	74	73	73	68	81	78	79	74	73.9
November	47	72	66	70	67	69	75	69	71	71	67.7
December	52	64	62	69	65	77	71	70	76	75	68.1

2.5. Drainage system

The Maldah district is blessed by the several river systems. The peoples of this district again created large number of small and long canals for irrigation. These are also locally called *Khal* or *Dar* which generally connect one river to another river. Quite a number of rivers are passing through this district, among them *Ganga* is the main. Other rivers are presently recognized as *Mahananda*, *Kalindri*, *Tangan*, *Punarbhava*, *Pagla*, *Bhagirathi*, and *Fulahar*. Apart from the river system there are so many wetlands and are very important parts of the district's drainage system.

There are several small rivers connecting different main rivers. The river *Chitola* a small stream originated from river *Kalindri* and meeting *Mahananda* after flowing over the block Ratua II. Similarly, river *Sati* another small stream originated from river *Tangan* is meeting *Mahananda* after flowing over the old Maldah block and river *Pagla* a small stream originated from river *Ganga* and flowing into the *Mahananda* passing through the blocks Manikchak, Kaliachak I, II & III. So, all the rivers of Maldah district are connected with each other.

2.5.1. Origin of Wetlands

Several hundred wetlands are located within the boundary of the district. All the wetlands, except few, are natural in their origin. These are originated from the river system in earlier period during their regular sifting and are regularly feeding during monsoon by different rivers. The regular recurrence of flood is mainly due to excessive rise of water level in the river *Ganga* and is responsible for creating large number of major and minor wetlands in the district (Sengupta, 1969). The district got its name "MALDAHA" from wetlands. The "MAL" meaning wealth (in Arabic) and "DAHA" means low laying land.

2.5.2. Types of Wetlands

According to Ramsar classification criteria out of five, three types of wetlands are generally found in this district. These are *Palustrine* among which only marshes, seasonal waterlogged, swamps and floodplains are found in Maldah. Other two types are *Lacustrine* and *Riverine*, which means lakes and river wetland respectively. These three types are mainly fresh water wetlands.

These wetlands are also divided into several category based on their water cycle. Almost 60% of these wetlands are perennial i.e., wetlands holding water throughout the year and rest 40% are seasonal and flood created.

2.5.2.A. Riverine Wetlands

This district is flood prone area for which all the major river system sifting their course and creating several lager water bodies called Wetlands. These wetlands are still receiving water every year. Few oxbow wetlands are developed due to river sifting but most of those are still attached with the main river as they receive water during monsoon, but are slowly getting. These semi-circular wetlands are locally called as *Moranadi*. Such riverine wetlands of the district includes *Mora Tangan* (Part of river *Tangan*), *Mora Mahananda* (Part of river *Mahananda*), *Mora Kalindri* (Part of river *Kalindri*) etc. However, very old oxbow lakes are now completely separated from their mother river and are difficult to trace back their ancestry.

2.5.2.B. Lacustrine Wetlands

Except natural wetlands man-created numerous lakes and ponds for pisciculture, irrigation and for domestic use are situated in the district. Few lakes and ponds are 400 to 2000 years old and their number is also very high, nearly 19000 of approximately 29000 of such water bodies in the district (Som, 2006).

Lakes of the district are locally called as *Dighi*. Many of such *Dighies* are very large and old with varying shapes like oval, rectangular, semi-circular and elongated. These are generally perennial and are now mostly used for fish-culture. Some of the lakes are more than 60 hectares in size.

The ponds of different size are also found in the district in large amount and are called as *Pukur* or *Doba* by local people. 20000 ponds are present in *Barind* area. While few ponds are seasonal, most of those retain water round the year.

2.5.2.C. Palustrine Wetlands

The major wetland system of district is mainly fresh water littoral *Palustrine* that includes perennial and seasonal wetlands. These are the mainly low laying fresh water marsh, narrow water bodies locally called *Khal* and fresh water swamps and floodplains. The depths of these wetlands are up to 4 m in case

of seasonal wetlands whereas 1 to 6 m in perennial wetlands. As per report of the Fishery Department of Maldah (1998) “*Beel & Bours*”, type of wetlands cover 6508.54 hectares areas of the total district out of which *khal* or narrow water canals also covering an area of 1087.49 hectares. Whereas marsh and low laying areas covering 5421.05 hectares of which some parts are vested. Private and vested areas are 856.14, 605.07 and 3959.84 hectares respectively.

These types of wetlands are widely distributed throughout the district but most of those are concentrated in Chanchal I and II, Harischandrapur I and II, Gajol, Ratua II, Old Maldah, Habibpur and English Bazaar blocks.

There are so many water bodies along the roadside are found in the district which are mostly ephemeral wetlands and connected to district drainage system.

2.6. Wetlands under study

The 11 larger wetlands and some smaller wetland and/or smaller water bodies have been studied during this work. The larger wetlands are not composed of single water body but contain many smaller water bodies. So, for better representation instead of naming numerous small connected wetlands, as ‘wetland complex’ has been considered and named after its most important part, for the convenience of proper reference. Mainly the larger wetland of the district has been studied. For presenting the total scenario of lowland or wetlands of the district are studied based on their topographic distribution. Study areas are selected from all three zones of the district giving more importance to the degree of concentration of wetlands. The *Tal* region is very much influenced by river (*Ganga, Mahananda, Kalindri* etc.) sifting and ten large wetlands have been selected from this part of the district. These wetlands are *Adh soi Beel, Gour Adhi Dob Beel, Sanak Beel, Gold bold Beel, Singsar Beel, Barbilla Beel, Boalia Beel* and *Hazar Takia Beel*. *Madhaipur beel* and *Belatuli beel*, are larger wetlands of *Barind* region. Where as *Gabgachhi-chatal Beel complex, Nayagram Beel* and *Lakshmipur Beel* from *Diara* region. The soil of wetlands in *Tal* and *Diara* region are mainly blackish muddy with much of humus whereas sandy, reddish and dry soil is dominating in *Barind* wetlands. Their distribution pattern and connection with other non-recognized wetland, location and status are presented in Table 2.1. Except 16 larger and important wetlands; several other large and small wetlands also have been studied for many aspects, except the phytosociology. The list of extra wetlands is provided in Table 2.2. To understand the location and nature of wetland possible maps and satellite imageries of different wetlands are also provided (**Plate- V & VI**). The aerial photogram and satellite image collected from three important websites [www. Google. Earth. Com](http://www.google.com), [www. Wikimapia. Org](http://www.wikimapia.org) and [www. Barkley/India/map. Org](http://www.Barkley/India/map.org). The available maps and satellite imageries studied properly and the final maps are prepared.

Table 2.5: Wetlands under detailed study

Sl. no.	Name	Type	Approximate Area (ha)	Global position
01.	<i>Adhi dob beel</i>	Palustrine	280	N25°25'40. 1" E087°53'21. 8"
02.	<i>Adh soi beel</i>	Palustrine	120	N25°31'45. 16" E087°57'36. 77"
03.	<i>Hazar takia beel</i>	Palustrine	140	N25°27'49. 50" E087°58'46.10"
04.	<i>Konar beel</i>	Palustrine	240	N25°25'46.70" E087°57'24.20"
05.	<i>Singsar beel</i>	Palustrine	120	N25°29'06. 89" E087°56'49. 87"
06.	<i>Sanak beel</i>	Palustrine	200	N25°25'02. 06" E087°51'26. 97"
07.	<i>Sonaiguri beel</i>	Palustrine	150	N25°29'27. 72" E087°59'27. 34"
08.	<i>Belatuli beel</i>	Palustrine	120	N25°02'46. 63" E088°12'24. 66"
09.	<i>Madhaipur beel</i>	Palustrine	200	N25°00'49. 10" E088°12'02. 10"
10.	<i>Barbilla beel</i>	Palustrine	120	N24°14'26.60" E087°51.04.90"
11.	<i>Boalia beel</i>	Palustrine	120	N25°21'06.31" E087°59'36.15"
12.	<i>Gabgachi-chatral beel complex</i>	Palustrine	2400	N24°53'06" E088°11'42.35"
13.	<i>Sagar Dighi</i>	Lacustrine	105	N24°58'10.23" E088°05'55.62"
14.	<i>Nayagram beel</i>	Palustrine	160	N24°58'52.45" E088°06'11.84"
15.	<i>Lakshmpur beel</i>	Palustrine	120	N24°00'37.37" E088°05'56.00"
16.	<i>Gold bold beel</i>	Palustrine	120	N25°19'47.88" E087°53'17.89"

2.6.1. Tal Region

i. Adh Soi Beel

[Plate-V (3) & Plate-VII (2 & 3)]

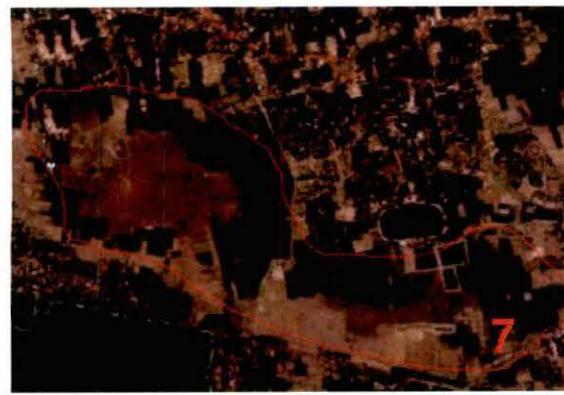
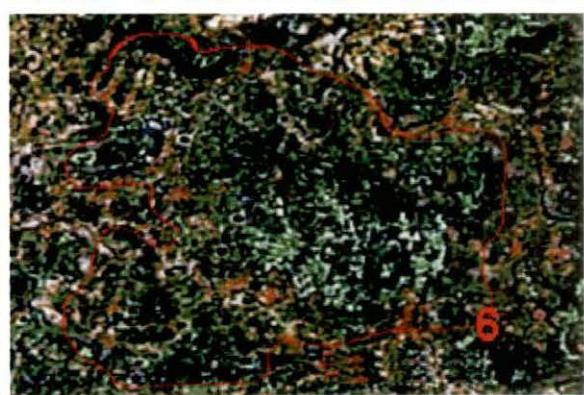
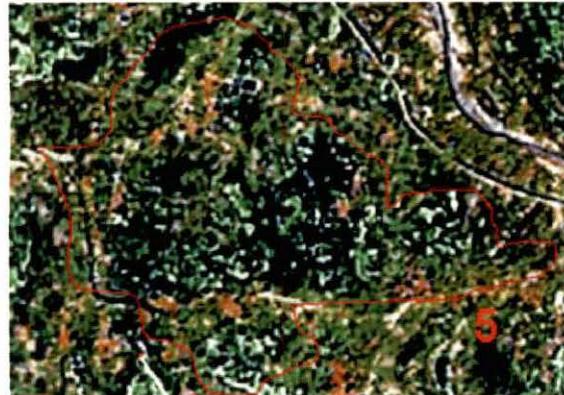
It is an irregular shaped seasonally flooded wetland complex with average depth of 7-8 m in monsoon and 1-2.5 meters in summer. This wetland complex is composed of several large and small wetlands. During monsoon all wetlands are connected to form a huge water body. Its total size is approximately

Plate: V
Satellite and Aerial imageries



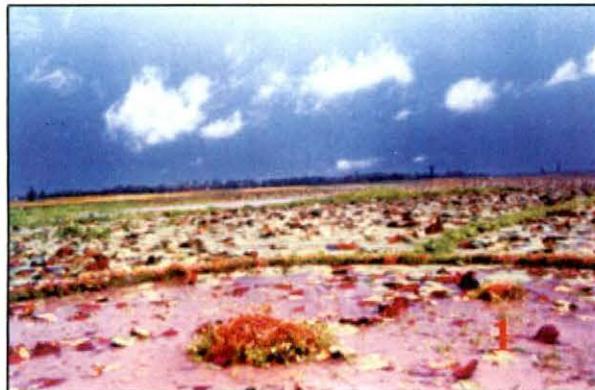
1. Sanak Beel, 2. Gold bold beel, 3. Adh soi beel 4. Boalia beel, 5. Belatuli beel, 6. Madhaipur beel, 7. Konar beel and 8. Hazar Takia beel

Plate: VI
Satellite and Aerial imageries



1. Sagardighi
2. Gabgachi-chatral beel complex
3. Gour adhi dob beel
4. Barbilla beel
5. Sonaiguri beel
6. Singsar beel
7. Nayagram beel
8. Lakhsmipur beel

Plate: VII
Photograph of Wetlands



1. Adhi gour dob beel, 2.,3. Adh soi beel, 4. Gold bold beel, 5 & 8. Konar beel, 6. Barbilla beel, and 7. Sagardighi,

Plate: VIII
Photograph of wetlands



1 & 4. Boalia beel, 2 & 3. Hazar Takia beel, 5. Sonaiguri beel, 6. Madhaipur beel, 7 and 8. Gabgachi-Chatral beel complex

140 hectares. During post-monsoon and pre-monsoon seasons it is completely dried out keeping only 4–6 small marshy water bodies. It is spreaded over the Mouzas Pachla of Harishchandrapur – I block of Chanchal subdivision. Surrounding villages are Pachla 1, Pachla 2, Choinpur, Jamalpur, Satrani and Barghoria.

Very few waterfowls visit this wetland probably due to excessive human interference. However, birds like jakana, stork, heron, duck are common visitors.

Exposed land is used for paddy cultivation during summer and post-monsoon seasons, whereas water bodies are generally used for Makhana (*Euryale ferox*) cultivation. During pre-monsoon jute is also cultivated, and the water bodies are used for retting jute.

ii. Adhi Gour Dob Beel

[Plate-VI (3) & Plate-VII (1)]

This wetland is situated in Harishchandrapur-I block of Chanchal sub-division. It is spreading over the Uttar Harischandrapur mouzas and is composed of four larger and few smaller water bodies. The four water bodies are *Adhi gour dob beet* (10.84 ha), *Dhamlia beet* (9.78 ha), *Beels* (6.42 ha) and *khari beet* (6.13 ha). The total area of this complex is approximately 280 ha. Surrounding villages are Kasempur, Pipla, Mahadar, Bhusi, Kalna and Harischandrapur.

Exposed land is generally used for paddy and jute cultivation and shallow water bodies for Makhana (*Euryale ferox*) cultivation and jute retting. The wetland and its water gets polluted due to the agricultural runoff and filling up due to the erosion of upland soil and degraded plant parts.

A number of waterfowl species visit these wetlands during October to April. Different types of ducks, storks, herons, pelicans and kingfishers are common.

iii. Barbilla Beel

[Plate-VI (4) & Plate-VII (6)]

This is a rectangular wetland which expended over 120 hectares Parapur mouza of Ratua block II. It is formed by three large and few small water bodies along with seasonally flooded marsh surrounding the *Barbilla* water bodies. The main water bodies are *Barbilla* (15.19 ha), *Noyacole* (11.25 ha) and *Chunakhali* (7.25 ha). During monsoon it is connected with river *Mahananda* that flows through its left.

This wetland is generally used for pisiculture and the exposed land for paddy cultivation. The water is mainly polluted by agricultural runoff.

Several bird species mainly storks, herons, pelicans, different species of duck, kingfishers are noted in this wetland during post-monsoon period.

iv. Boalia Beel

[Plate-V (4) & Plate-VIII (1 & 4)]

This is an irregular wetland, expended over 120 hector of Chanchal - I block. It is formed by two large and few smaller water bodies along with seasonally flooded marsh. The main water bodies are *Baro Kathan beel* and *Chhoto Kathan beel*. This wetland is generally used as for Makhana (*Euryale ferox*) and the exposed land as paddy cultivation. The water is mainly polluted by agricultural runoff.

Several bird species mainly Storks, Herons, Pelicans, different species of ducks, kingfishers are noted in this wetland during post-monsoon period.

v. Gold Bold Beel

[Plate-V (2) & Plate-VII (4)]

This wetland is irregular in shape and situated in Harischandrapur II block of Chanchal sub-division. It is spreading over the Mouzas likes Uttar Kumedpur and Tal Bhakuria. It is seasonally waterlogged *Palustrine* wetland in monsoon with water depth 4-5 meters and dries up during summer. It is composed of many smaller water bodies and occupying 120 hectares of land.

Exposed land is generally used for paddy cultivation and shallow water bodies for *Paniphal* or *Jalsingara* (*Trapa natans*) cultivation. The wetland and its water is polluted due to the agricultural runoff and filling up due to erosion of upland soil and degraded plant parts.

vi. Hazar Takia Beel

[Plate-V (8) & Plate-VIII (2 & 3)]

This wetland is situated in Harishchandrapur-I block of Chanchal sub-division and is spreading over the *Pirojpur* and *Dakshin Ramnagar* Mouzas. This waterlogged *Palustrine* wetland composed of two lager and few smaller wetlands. The larger two are *Hazar Takia* (19.8 ha) and *Garia* (9.66 ha) wetland. The total area of this complex is approximately 140 hectares. Surrounding villages are Mabarakpur, Kalitola, Bidanpur, Muragathi, Saldoi, Basatpur and Lianof.

Exposed land is generally used for paddy and jute cultivation and shallow water bodies for Makhana (*Euryale ferox*) cultivation and jute retting. The wetland and its water get polluted due to the agricultural runoff and filling up due to erosion of upland soil and degraded plant parts.

A number of waterfowl species visit these wetlands during October to April. Different types of ducks, stork, heron, pelicans and kingfisher are common.

vii. Konar Beel

[Plate-V (7) & Plate-VII (5 & 8)]

This wetland is marsh and floodplain wetland that lies in Chanchal II blocks of Maldah district. It is composed of several small water bodies (beel) and spreading in Mouzas like Konar, Dhigna, Kamarta, Jikandanga, Hahad, Gochia and Madhaipur. This is occupying a total area of 280 hectares and most of the areas remain dry throughout the year except monsoon. It is irregular in shape and 6-7 small water

bodies remain during summer. During monsoon it forms a large water body. The average depth of this area during monsoon is 4-5 meters and while in summer it reduces to 1-1.5 meters.

Exposed land is generally used for paddy and jute cultivation and shallow water bodies for Makhana (*Euryale ferox*) cultivation and for jute retting. The wetland and its water get polluted due to the agricultural runoff and filling up due to upland erosion of soil and degraded plant parts.

A number of waterfowl species visit these wetlands during October to April. Different types of ducks, stork, heron, pelicans, kingfisher etc. are common.

viii. Sanak Beel

[Plate-V (1) & Plate-IX (2, 3 & 4)]

It is an irregular shaped seasonally waterlogged *Palustrine* wetland complex with average depth in monsoon is 7-8 meter and is reduced to 3-3.5 meter in summer. This wetland complex is composed of several large and smaller wetlands. *Sanak beel* (12.04 ha), *Khasimari beel* (19.2 ha), *Patibona beel* (17.45 ha), *Koia beel* (10.75 ha) and *Matul beel* (8.41 ha) are the larger water bodies. During monsoon all wetlands are connected to form a larger water body. Its total size is approximately 200 hectares. It is spreading over the Mouzas like Uttar Bhakuria and Kopakati of Harischandrapur-II block of Chanchal sub-division. The *Matul* and *Khasimari* wetlands are very interesting because of their ichthiofaunal diversity. Various species of jacanas, ducks, storks, herons are visiting these wetlands in large number. Exposed land is used for paddy and mustard cultivation during summer and post-monsoon seasons. The *Khasimari*, *Matul* and *Sanak beels* are widely used for Makhana (*Euryale ferox*) cultivation.

The wetland and its water gets polluted due to the agricultural runoff and filling up due to the erosion of upland soil and degraded plant parts.

ix. Singsar Beel

[Plate-VI (6) & Plate-IX (5)]

This wetland is irregular in shape and situated in Harischandrapur I block of Chanchal sub-division. It is seasonally flooded wetland with water depth is 3-4 meters in monsoon and is reduced to 1-0 meter during summer. It is composed of many smaller water bodies and occupying a total of 120 hectares of land. Surrounding villages are Chandipur, Dakhsin Saldoi, Paschim Saldoi, Mollabari, Kotol, Khosalpur, Maradighi, Birua and Mankibari. During summer the entire wetland dried up leaving behind only one small pond inside the wetland and that too is for paddy cultivation.

x. Sonaiguri Beel

[Plate-VI (5) & Plate-VIII (5)]

This wetland is irregular in shape and situated in Harischandrapur I block of Chanchal sub-division. It is seasonally flooded wetland with water depth in monsoon is 3-4 meter and is reduced to 1-0 meter during summer. It is composed of many smaller water bodies and occupying around 200 hectares of land.

During summer the entire wetland dried up leaving behind only one small pond inside the wetland and that too is used for paddy cultivation.

2.6.2. Diara Region

i. Gabgachi - chatral Beel complex

[Plate-VI (2) & Plate-VIII (7 & 8)]

It is an irregularly rectangular area seasonally or permanently waterlogged *Palustrine* wetland complex with average depth in monsoon is 7-8 meter and that reduced to 3-3.5 meter in summer. This wetland complex is composed of several large and small water bodies. *Gabgachi I* (32.52 ha), *Gabgachi II* (31.28 ha), *Sonatola beel* (6.9 ha), *Abhirampur* (30.20 ha), *Nander beel* (26.85 ha) etc. are the larger waterbodies. During monsoon all wetlands are connected to form a large water body. Its total size is approximately 2400 hectares. It is spreading on the English Bazaar block of Maldah Sadar sub-division. It is running into the Bangladesh and there it is connected to Bhatia Beel.

The *Sonatola*, *Abhirampur*, *Chatral* and *Moselempur* wetland is very interesting because of their ichthiofaunal diversity. Jacanas, ducks, storks, herons and pelicans are visiting these wetlands in large number.

Exposed land is used for paddy, jute and mustard cultivation during summer and post- monsoon season. The *Chatral*, *Abhirampur*, *Moslempur* beels are used for Makhana (*Euryale ferox*) cultivation. Water gets polluted due to the agricultural runoff, sewage from urban areas and filling up of due to the erosion upland soil and degraded plant parts.

ii. Nayagram Beel

[Plate-VI (7) & Plate-IX (8)]

It is an irregular or rectangular area, seasonally waterlogged *Palustrine* wetland with average depth is 4-5 meter in monsoon and that is reduced to 1-0.5 meter in summer. This is a single continuous large water body with total size is approximately 4 sq. km. It is spreaded on the English Bazaar block of Maldah Sadar sub-division.

The wetland is interesting because of its ichthiofaunal diversity. Jakana, ducks, storks, herons, pelicans etc are visiting these wetlands in large number.

Exposed land is used for only paddy cultivation during summer and post-monsoon period.

Wetland water is getting polluted due to the agricultural runoff, and filling up due to the erosion of upland soil and degraded plant parts.

iii. Lakshmipur Beel

[Plate-VI (8) & Plate-IX (7)]

It is an irregular or rectangular shaped seasonally waterlogged *Palustrine* wetland with average depth is 4-5 meter in monsoon and is reduce to 1-0.5 meter in summer season. It is a single continuous large water body with approximately 100 hectors area. It is spreading over the English Bazaar block of Maldah sadar sub-division.

The wetland is very interesting because of their ichthiofaunal diversity. Different species of Jacana, ducks, storks, herons and pelicans are visiting these wetlands in large number.

Exposed land is used for only paddy cultivation during summer and post-monsoon period.

Its water is getting polluted due to the agricultural runoff and filling up due to the erosion of upland soil and degraded plant parts.

iv. Sagar Dighi

[Plate-VI (1) & Plate-VII (7)]

This wetland is manmade and situated in the English bazaar block covering an area of approximately 105 hectors. This deepwater lake is looked after by Government of West Bengal for pisiculture. It is the largest single water body in the district. This lake maintained nicely and free from anthropological pressure except pisiculture. Only degrading factor is soil run off from its surrounding upland.

Availability of good amount of fish attracts different types of waterfowl throughout the year but reaches its maximum during October to April. Different types of storks, herons, kingfishers and different species of ducks are the common visitors. Resident birds are common throughout year and they are nesting in different trees of surrounding mango orchard. Few aquatic birds are also nesting in different bushes surrounding the lakes.

2.6.3. Barind region

i. Belatuli Beel

[Plate-V (5) & Plate-IX (1 & 6)]

This is a seasonally flooded wetland situated in old Maldah block and covering an area of approximately 176.5 hectors. This wetland is spreading in the Mouzas of Koar, Jatradanga and Kaluary under Old Maldah block. It is composed of several wetlands like *Koar beel*, *Motikata beel* and few very smaller wetlands. Among these wetlands, *Kaluary beel* (59.32 ha), *Koar beel* (59.32 ha) and *Belatuli beel* (8.75 ha) are larger.

During summer it dried out completely except very small water bodies with average depth 1-2 meters. But during monsoon it forms a large water bodies with average depth of 7-8 meters. This wetland complex is generally used for paddy cultivation during summer and post-monsoon season and its water is polluted by agricultural runoff only.

A number of waterfowl species visit this wetland during October to April. Different types of ducks, stork, heron, pelicans, kingfisher etc. are common.

ii. Madhaipur Beel

[Plate-V (6) & Plate-VIII (6)]

This wetland complex is situated just behind the Belatuli beel and spreading over the Mouzas of Jalkar Bithan and Mobarakpur with covering 343.05 hectares area. This wetland complex is composed of three major and few smaller wetlands under Old Maldah block. The majors ones are *Madhaipur beel* (100 ha), *Jalkar Bithan* (144.3 ha) and *Putul beel* (22.68 ha). It is also a seasonally waterlogged *Palustrine* wetland and during dry period used as paddy cultivation. During monsoon it form a large water body with average depth of 7-8 meters whereas in summer it is dried up leaving behind few smaller water bodies with average depth of 1-1.2 meters.

A number of waterfowl species visit this wetland during October to April. Different types of stork, heron and kingfisher are quite common.

Table 2.6: List of smaller wetlands studied (except phytosociological work)

Sl. No.	Name of wetlands	Block	Region
01.	<i>Amriti beel, Kajigram beel, Maliha beel, Mahananda river valley</i>	English Bazar	Diara
02.	<i>Halna beel complex, Motikata beel, Chatral beel</i>	Old Malda	Barind
03.	<i>Chandrasahi beel complex, Domaipur beel complex</i>	Chanchal I	Tal
04.	<i>Chapra beel</i>	Chanchal II	Tal
05.	<i>Baromasia-Teljanna-Kabutara-Klindri river valley, Dhekul beel, Manna beel</i>	Harishchandrapur II	Tal
06.	<i>Kapaichandi beel complex, Chang and Kendra beel complex</i>	Harischandrapur I	Tal
07.	<i>Golbaka beel complex</i>	Ratua II	Tal
08.	<i>Chota Ajguba beel</i>	Kaliachak I	Diara
09.	<i>Boro Ajguba beel, Babla beel</i>	Kaliachak II	Diara
10.	<i>Kanchan beel, Prajapoti beel, Basu beel complex, Kanchan beel complex, Purba beel complex, Altar beel complex</i>	Gajol	Barind

2.7. Vegetation

The district of Maldah is falling within the tropics and is exhibiting a typical tropical climatic set up. The flora of the region is known to be quite rich (Acharya, 1998). The district is also famous of its mango orchards. The total tree cover of the district is 718.35 sq km of which 1694.392-hectar is

occupied by forests. In terms of forest, district forest area is very less i.e. only 16.94 sq km areas which cover only 0.49% of its geographical area. These forests are classified into reserve forests, protected forests and unclassified state forests with the area 773.773, 396.268 and 524.351 hectares respectively. But, wide areas of the district covered with mango orchard, paddy field, mulberry plantation, wetland vegetation etc. For better understanding, vegetation of the district is classified into the following categories:

2.7.1. Forests

At present, there is no any natural forest within the boundary of Maldah district, but the plantation forests covers 1694.392 hectares (16.94 sq km) that only 0.49% area of the of district of the forested areas, 773.773 ha covers reserved forest; protected forest area is 396.298 ha and unclassified state forest covers 524.351 ha only. According to Champion and Seth (1964) forest type of this district fall under the tract of Northern Tropical deciduous forest, group-3, type-c. However, these areas can not be considered as now natural forests are missing from the area. The Forest Departments in Maldah classify the forested area of Maldah into **i. high land forest and ii. Low land forest.** There are some small forests areas in the district among those Adina forest is largest one which covering 69.365 hectares land. Except that few other small forests are situated in old Maldah, Harischandrapur II, and Gajol blocks. These areas are generally dominated by tree like *Shorea robusta* A. DC., *Dalbergia sissoo* Miq., *Lannea coromandelica* (Houtt.) Merrill, *Lagerstroemia reginae* Roxb., *Phoenix sylvestris* Roxb., *Borassus flabellifer* L., *Anthocephalus chinensis* Hassk., *Azadirachta indica* A. Juss., *Delonix regia* Rafin., *Albizia lebbek* Benth., *Terminalia arjuna* Wight & Arn., *T. chebula* Retz., *Butea monosperma* Kuntze, *Madhuca indica* J.F.Gmel., *Tectona grandis* L.f., *Cassia nodosa* Buch-Ham. ex Roxb., *Cassia fistula* Herbb. ex Oliver and *Barringtonia acutangula* Blume. Some shrub species like *Calamus strictus* Miq., *Polyalthia suberosa* Benth.-Hook.f. ex Hook.f., *Capparis zeylanica* L., *Murraya koenigii* Spreng, *Flacourzia indica* Merrill, *Lantana camara* L., *Zizyphus mauritiana* Lam., etc. are dominated. Climbing species includes *Smilax zeylanica* Blume, *Tinospora cordifolia* Miers., *Vitis trifolia* L., *Paederia foetida* L., *Stephania japonica* Miers. *Hemidesmus* sp, etc. and ground covers herbs includes *Emilia sonchifolia* (L.) DC., *Vernonia cinerea* (L.) Less., *Clerodendrum indicum* (L.) O. Kuntze, *Rungia pectinata* (L.) Nees, *Oxalis corniculata* L.. etc are dominated. Except the angiosperm, quite a few species of pteridophytes like *Diplazium esculentum* (Retz.) Sw., *Pteris vittata* L., *Marselia minuta* L., *Ophioglossum reticulatum* L., *Helminthostachys zeylanica* (L.) Hook., *Ceratopteris thalictroides* (L.) Brongn., *Adiantum caudatum* L., *Lygodium flexuosum* (L.) Sw., *Salvinia cucullata* Roxb. ex Bory, *Azolla pinnata* R. Br. etc are common.

2.7.2. Mango orchards

The District Maldah is also called as mango city for its mango production with good quality and quantity. The mango of this region is exported in entire country as well as in few foreign countries from last three year. A good number of mango orchards are distributed in different block of the district covering an area of 32000 hector. The mango orchards are mainly concentrated in Manikchak, Kaliachak I, II and III, English Bazaar, Old Malda and Gajol blocks. The mango orchards of Maldah are generally very old and the orchard-floors support many herbaceous species like *Evolvulus nummularius* L., *Oxalis corniculata* L., etc. Few climbing species like *Wattakaka volubilis* Stapf., *Vitis trifolia* L., *Raphidophora* sp etc. are also common. There are so many parasitic (species of *Dendrophoe* and *Viscum*) and epiphytic species (mainly Pteridophytes like species *Lepisorus* sp, *Vittaria* sp etc.) are growing on the mango trees. Very few orchard- floors support the growth of Pteridophytes like *Diplazium esculentum* (Retz.) Sw., *Pteris vittata* L., *Ophioglossum reticulatum* L., *Adiantum caudatum* L., *Lygodium flexuosum* (L.) Sw. etc.

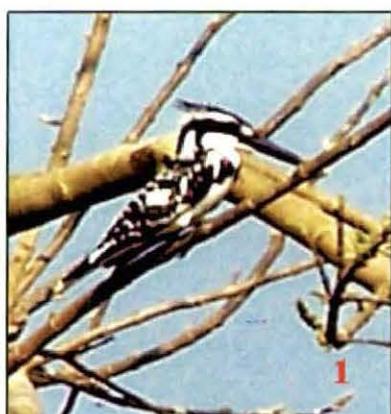
2.7.3. Grasslands

Many parts of the district shows several uplands mainly in *Barind* region, and are covered with various species of grasses and few species of other herbs. The dominating species of grasses include *Saccharum spontaneum* L., *S. arundinaceum* Retz., *Arundo donax* Goergi, *Imperata cylindrica* Beauv., *Cynodon dactylon* Pers., *Oplismenus burmannii* Beauv. etc. with few hidden herbs and shrubs like *Lippia javanica* Spreng., *Phyla nudiflora* Greene etc.

2.7.4. Muralic vegetation

The history of the Maldah district is quite old and for some time it was the capital of Bengal. So many Muslims and Hindu kings rules over the Bengal from the area. So there are so many ancient archeological monuments (*Gour* and *Adina*) of 200-300 years old are present in the area. These old and broken monuments are often habitat to so many interesting plants. The trees species like *Ficus benghalensis* L., *Ficus religiosa* Forsk., *Lannea coromandelica* (Houtt.) Merill., *Pongamia pinnata* Merill, *Azadirachta indica* A. Juss., etc. are found. Shrubs and herb includes *Youngia japonica* DC., *Centella asiatica* (L.) Urban, *Lantana camara* L., *Blumea lacera* DC., *Oxalis corniculata* L., *Leucas indica*, *Croton bonplandianus* Baill, *Scoparia dulcis* L., *Lindenbergia indica*, *Sonchus oleraceus* L., *Clerodendrum viscosum* Moldenki etc. Some climbers like *Capparis zeylanica* L., *Paederia foetida* L., etc are also recorded.

Plate: X



1. *Ceryle rudis*, 2. *Bubulcus ibis*, 3. *Halcyon pileata*, 4. *Phalacrocorax carbo*, 5. *Anastomus osciyanus*, 6. *Mesophoyx intermedia*, 7. Crab, 8. *Casmerodius albus*, 9. Duckls, 10 & 11 Different molluscas, 12. *Phalacrocorax fuscicollis*, and 13. *Nycticorax nycticorax*,

2.7.5. Aquatic Vegetation

The wide spreading water bodies including rivers support various species of aquatic plants. The marsh and seasonally flooded wetlands of Maldah are very rich in flora like other wetlands of the world. The algae and fungi are also growing here in good number. Few species of pteridophytes and bryophytes are also found to grow in these wetlands.

Various types of fresh water wetlands of Maldah, support different kind of aquatic plants and those can be classified into following habit groups:

- 1. Free floating:** This type of plants float over the water surface freely. e.g. *Pistia stratiotes* L., *Eichhornia crassipes* (Martius) Solms., *Azolla pinnata*, *Lemna perpusilla* Torrey, *Spirodela polyrrhiza* (L.) Schleid etc.
- 2. Submerged plants:** Plants of this group mainly lies in submerged condition in the water rooted at the bottom soil of water bodies. e.g. *Vallisneria spiralis* L. var. *denseserrulata* Mikino, *Nechamandra alternifolia* (Roxburgh ex Wight) Thwaites, *Hydrilla verticillata* (L.f.) Royel, *Najas graminea* Delile, *Potamogeton crispus*, *Aponogeton natans* (L.) Engl. & Krause, *Aponogeton crispum* Thunberg etc.
- 3. Rooted with floating leaved:** Plants of this group mainly rooted with bottom soil but leaves with long petioles are floating on water surface. e.g. *Nymphaea nouchali* Burman f., *Nymphaea pubescens* Willdenow, *Nelumbo nucifera* Gaertner, *Nymphaea hydrophylla* (Loureiro) Kuntze etc.
- 4. Suspended:** These groups of plants are without root and remain in freely suspended condition inside the water. e.g. *Ceratophyllum demersum* L., *Utricularia aurea* Loureiro, *Utricularia gibbosa* L. ssp. *exoleta* (R. Brown) P. Taylor etc.
- 5. Amphibians:** The plants of this group generally grown on marshland and they are able to survive in water and in dry soil for some period. e.g. *Sagittaria guayanensis* Humboldt, Bonpland & Kunth, *Sagittaria sagittifolia* L., *Ammannia baccifera* L., *Ammannia multiflora* Roxburgh, *Bergia ammannioides* Roxburgh, *Monochoria hastata* (L.) Solms, *Monochoria vaginalis* (Burm.f.) C. Presl ex Kunth etc.

2.8. Fauna

The Faunal diversity in the district is not properly known. Probably, this is due to the lack of wild forests in the area. But the small reserved forests, rivers, wetlands etc. provide home to some wild faunal elements (**Plate: X**).

Bird diversity of the district is somehow interesting specially the wetlands birds. During post-monsoon period almost all the wetlands suddenly becomes the house of different birds for their food and breeding. Several migratory and domicile water birds are visited those areas mainly during post-monsoon and summer period. These birds include Ducks, Kingfisher, Stork, Heron etc. Except waterfowl various species of fish are found in such wetlands that also attract the waterfowls. The wetlands of *Barind* region, situated with *Tangon* and *Punarbhava* Rivers are the favourite places for different species of Ducks. Wetlands of *Tal* and *Diara* region which situated along with *Ganga*, *Mahananda* and *Kalindri* rivers are interesting for larger birds like Pelican, Adjvant, Heron, Stork, Kingfisher and some species of ducks. Few identified common avifauna include *Aythya fuligula* (Tufted Duck), *Anas acuta* (Northern pintail), *Anas clypeata* (Northerm shoveler), *Anas strepera* (Gadwall), *Anas anser*, *Ardeola grayii*, *Ardea cinerea* (Indian Pond heron), *Phalacrocorax niger*, *Phalacrocorax carbo*, *Leptoptilos javanicus*, *Leptoptilos dubius*, *Anastomus osciyanus* (Asian openbill), *Helcyon capensis* (Stork billed kingfisher), *Alcedo atthis*, *Alcedo meninting*, *Ergetta garzetta* etc. are common in different wetlands. Except these, many unidentified waterfowl also visit different wetlands of this part of the country.

The fish fauna of different river and wetlands are also very interesting. Several fish species are common in different wetlands. These includes *Catla catla*, *Labeo rohita*, *Chana punctata*, *Clarias batrachus*, *Heteropneustes fossilis*, *Oreochromis mossambicus*, *Trichogastes fasciatus*, *Puntius sarana*, *Channa striatus*, *Burbus tinto* (titputi), *Puntius ticto*, *Anabas testudineus*, *Collisa fasciulata* (Khalisa) etc.

Apart from these several species of molluscs, reptiles, insects are available in those wetlands. Some wild mammals like *Vulpes benghalensis*, monkeys are very common in this region. Among the reptiles lizards like *Calotes jerdoni*, *Chamaeleon zeylenica*, *Mabuya carinata*, *Varanus benghalensis* (Go Sap), *V. salvator* whereas, snakes like *Xenochrophis piscator* (Jaldhora), *Athaetulla nasuta* (lawdoga), *Naja naja* (Gokhro), *Ophiophagus hannah* etc. are very common in this region.

Production of raw silk yarn is an important and old practice in this district. This district produces 85% raw silk of total output of West Bengal. The value of such raw silk is around 4 crores. The people Kaliachak I,II,III and English Bazaar block are very involve in silk production and it marketing.