

Chapter **2**
STUDY AREA

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Sub-Himalayan West Bengal, consisting of Terai and Duars are spreading through the districts of Jalpaiguri, Alipurduar and plains of Darjeeling are taken as study area for the present dissertation. A belt of moist forests passes along the study areas, at the foot of the majestic Himalayas.

The undulating *Terai* and *Duars* landforms and temporary or permanent virgin elaborate wetland systems are forming a mosaic of tall grasslands, savannas, evergreen and deciduous forests. The slope of the study area is gentle from north to south and located at 25° 57' to 26° 36' N latitude and 89° 54' to 88° 47' E longitude (Terai) & 26° .16' to 27° .0' N latitude and 88° .4' to 89° .53' E longitude (Duars) with altitudinal range varying from 80 to 100 m above mean sea level. The entire region is made up of sand, gravel and pebbles laid down by major and minor river and/or stream (*Khola* or *Jhora*) systems like *Teesta*, *Torsa*, *Jarda*, *Raidak*, *Jaldhaka*, *Sankosh* and several other small rivulets coming from the Darjeeling and Sikkim Himalayas and also from the neighboring countries Nepal and Bhutan. The river Teesta has divided this entire area into two parts and the western part is referred as *Terai* whereas the eastern part is named as *Duars* or *Dooars*. Based on forest types and nature of soil formation the *Duars* region can be further subdivided into the small parts, like Siliguri area as *Western Duars*, the middle or Jalpaiguri part as *Central Duars* and the easternmost end part of Alipurduar is referred as *Eastern Duars*.

The word '*Terai*' meaning dampness and the word '*Duar*' has been derived from the word 'doors', Duars or Dooars acts as a gateway to mountain kingdom of Bhutan and the North-Eastern states of India. The *Terai-Duars* area (Fig. 2.1) is a land with dense tropical evergreen forests interspersed with numerous marshy areas. It represents a transitional belt between lower hills of the Himalayas and plains and the rolling flat plain of North Bengal.

2.1. TERAI

The western bank of river Teesta is generally known as *Terai* with very rich and diversified evergreen forested system. It is a belt of marshy grassland, savannas and forests at the foot of the Himalayan range stretching southwards to about 38 km. Above the *Terai* belt, a forested belt of rock, gravel, and eroded soil covered Himalayan areas are referred as *Bhabhar*. The *Terai* zone is composed of alternate layers of clay and sand, with a high water table that created many springs and wetlands.

2.2. DUARS

Duars, a land of unending beauty, lies in the sub-Himalayan foothills in Jalpaiguri and Alipurduar districts in the Northern part of the state of West Bengal. The area is starting from the eastern bank of river *Teesta* in the Jalpaiguri district and stretching up to the western bank of the river *Sankosh* in Alipurduar district and is spreading over a span of 130 km of which 40 km area is running along the Himalayan foothills.

Duars with a vast texture of dense forests teeming with wildlife, unending tea gardens, babbling rivers, interspersed with small ethnic settlements, constitute a fascinating tourist destination in this part of

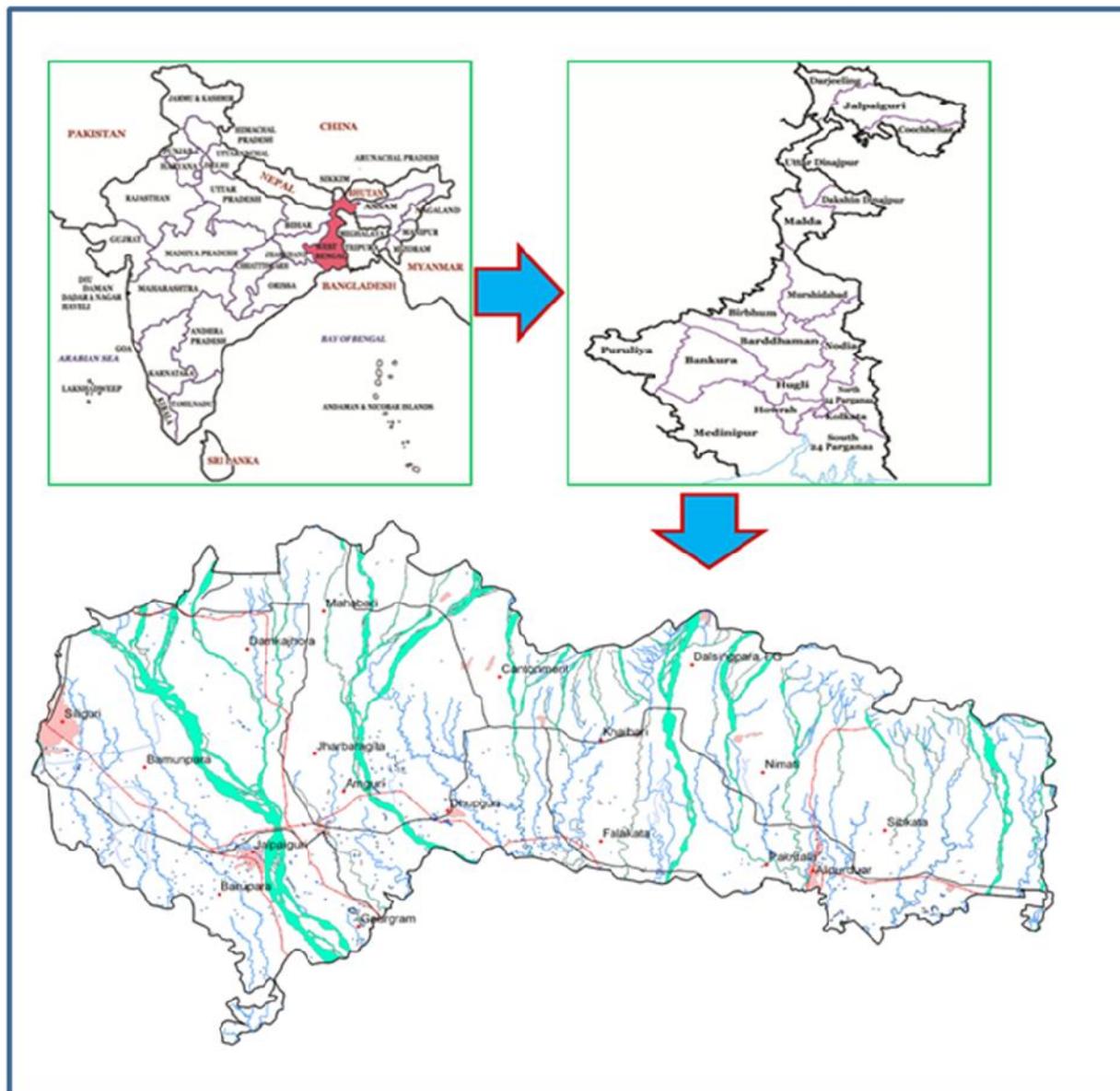


Fig. 2.1. Map showing the areas of Terai and Duars [Source: www.jalpaiguri.gov.in]

the country. *Duars* offers some magical landscape with fascinating view of river valleys and hills and this beautiful landscape is still unknown to the large section of tourists.

The Duars area is specially noted for its Protected Areas in IUCN guideline and includes Gorumara National Park, Buxa Tiger Reserve, Buxa National Park, Jaldapara National Park, Chapramari wildlife Sanctuary etc. These in-situ conservatories are harbouring a rich and fascinating diversity of flora, fauna and microbes including several endemic rare and threatened species. The vast texture of massive trees sheltering varieties of orchids, other epiphytes and climbers and the forests resounded with songs of birds and call of wild animals make it a veritable paradise for nature lovers and eco-tourism.

2.3. LOCATION

Terai [25° 57' to 26° 36' N latitude and 89° 54' to 88° 47' E longitude] and Duars [26°.16' to 27°.0' N latitude and 88°.4' to 89°.53' E longitude]

2.4. TOPOGRAPHY

Terai and *Duars* region is extended upto the river *Sankosh* in the East and is spreading over an area of 6227 sq km. The major geographic facial appearance of this area are the numerous rivers and streams which are intersecting with each other in every direction, and large tracts of Sal forests, tall grasses and reeds, growing along the banks of rivers and their rivulets throughout the entire region interrupted with patches of crop fields, tea gardens and large patches of reserved or plantation forests.

2.5. DRAINAGE SYSTEM

The foothills of *Terai* and *Duars* are intersecting by a good number of perennial rivers/ streams coming down from the Himalayan glaciers. The major such rivers are *Mahananda*, *Balason*, *Mechi*, *Karotoa*, *Sahu*, *Panga* etc along with several small streams are continuously proving the life support to greenery of *Terai* regions. *Duars* regions are also blessed with several big and small rives like *Teesta*, *Torsa*, *Karala*, *Jaldhaka* and *Diana* and their rivulets makes the area paradise of biodiversity. All these rivers originated from Himalayan hills, flow from North-east to South-West and are rain fed, except *Teesta* which has its origin from the Jemu glaciers in North Sikkim. Though they are tame, shallow and nearly dry during summer, but generally overflow during monsoon sometime causing heavy floods. The numerous low laying areas holds good volume of rain water and saves terrestrial areas from inundation.

2.6. SOIL

Soil of the study area is basically porous in nature, deep, light textured, highly acidic, with moderate organic matter, low Phosphate, Potassium, and micronutrient contents (Monda *et al.*, 2002); (Status Report, 1993). Soil consists of soft sands of different sizes and is interspersed with humus along with variable sized gravels and boulders. The soils are brought down by rivers coming down from hills and their tributaries those are bringing materials from a height of about 3048 m of Himalayan ranges and are deposited layer by layer in the form of soil all over the study area. The greater part of the region is covered with alluvial soils, ranging from pure sand to clay, but mainly sandy loam in nature. In the upland of the north of the *Duars*, the soil is ferruginous clay and is particularly well-suited to the growth of the tea plants (Sarkar, 2011). The *Western Duars* has numerous old and/or dead river beds which have been left over by the streams. Near the hills soils are composed of more stones and boulders while lower down they contain gravel and in the plain they contain more sand with humus.

2.7. CLIMATE

The weather conditions of the study area are more or less remains pleasant throughout the year. Three predominant seasons namely pre-monsoon, monsoon and post-monsoon are quite prominently recognizable in these areas. The pre-monsoon starts from the 1st week of February and extended up to the middle of May, whereas, monsoon starts from the last week of May and extended up to end of September. The post-monsoon season begins from the 3rd week of November and extended up to last week of January. Climatic data for the study area is collected from Central Tobacco Research Institute at Dinhat and Hydromet division, India Meteorological Department, Kolkata.

2.7.1. Temperature

The study area is basically located in sub-tropical region and facing the heavier rainfall during summer and monsoon seasons and the temperature is rarely excessive. November, to February is recorded as the driest months of the year. The temperature of this region fluctuates from 37.5° C during summer to about 6° C in winter. In December, January and February it is colder, and from the end of March it begins to get warmer, and from May to September is rather hot when the monsoon prevails in the region (Fig. 2.2).

2.7.2. Precipitation

Precipitation occurs all over the study area mainly in the form of rain. However, formation of dense fog, sometimes almost with zero visibility, also adds some amount of moisture and becomes much useful for the vegetation for sustenance during the dry spell of the climate. The dense fogs also substantially reduce the loss of soil moisture by reducing the evaporation of soil-water and also the rate of transpiration by plants.

Rainfall mainly occurs due to south–western monsoon and usually begins from the month of April and continues till the 2nd week of October. In consequence of the heavy and wide-spread rainfall, the region never presents a dry appearance, and always remains green and the growth of vegetation is also with the growth of the ever-green elements. In April the average rainfall is around 177.14 mm and the rains are usually very heavy between June and September, when the humidity becomes very high. The average maximum rainfall *i.e.*, 933.28 mm is recorded in the month of July (Fig. 2.3).

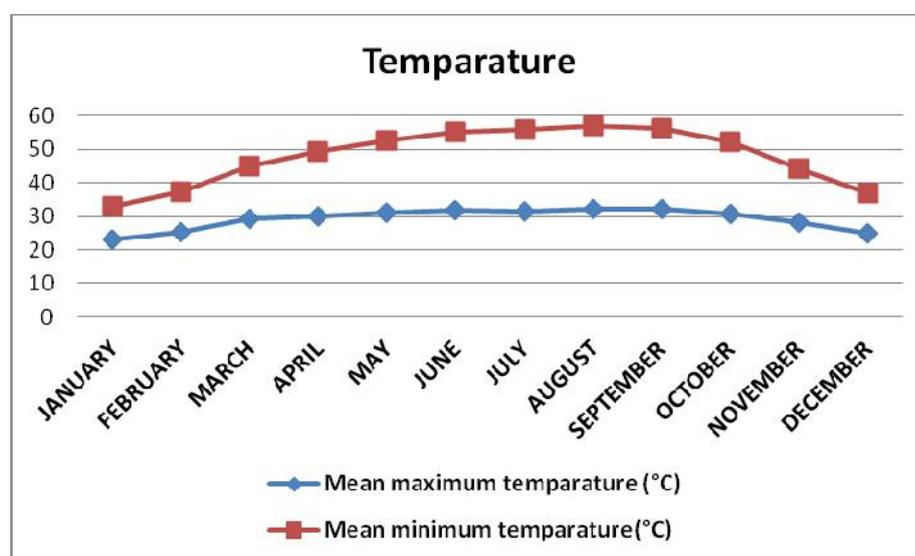


Fig. 2.2. Graphical representation of annual temperature in Study area [Source: Meteorological Department, Jalpaiguri, India]

2.7.3. Relative Humidity

The atmospheric humidity refers to the average water content of the air. Relative Humidity of the study area is remaining in maximum almost 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 Relative Humidity annual data for the last 10 years 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 (Fig. 2.4).

2.8. Origin of Wetlands

The study area is covered with several small and large, annual and perennial, littoral and sub-littoral wetland systems with diversified biota. It is found that a good number of wetlands are situated at international border or in no-mens-land areas of Indo-Bhutan and Indo-Bangladesh line of controls. Most of the wetlands of these areas are fed by the water which comes down from the Great Himalayan regions.

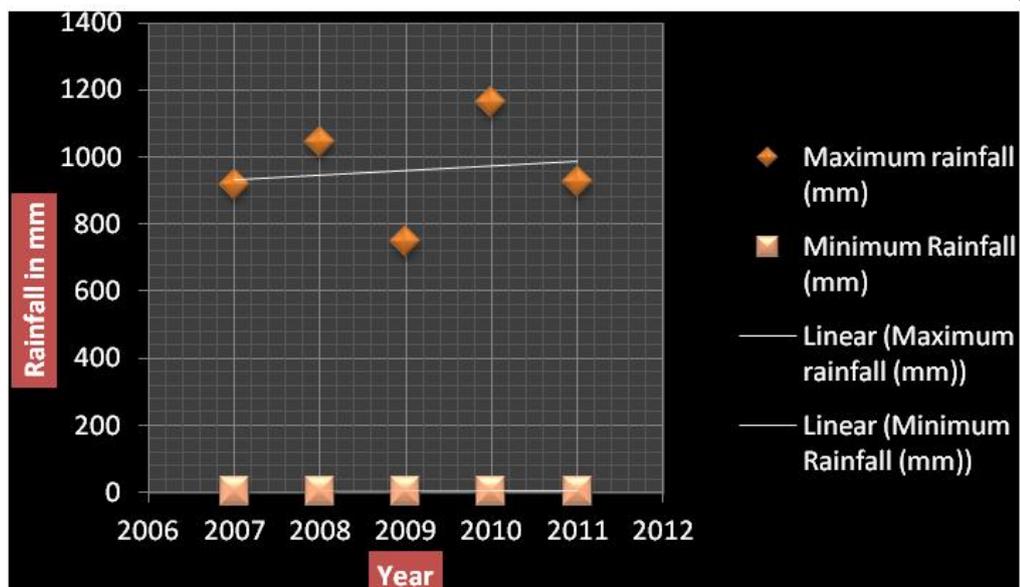


Fig. 2.3. Graphical representation of annual rainfall in Study area during 2007 – 2011 [Source: Meteorological department, Jalpaiguri, India]

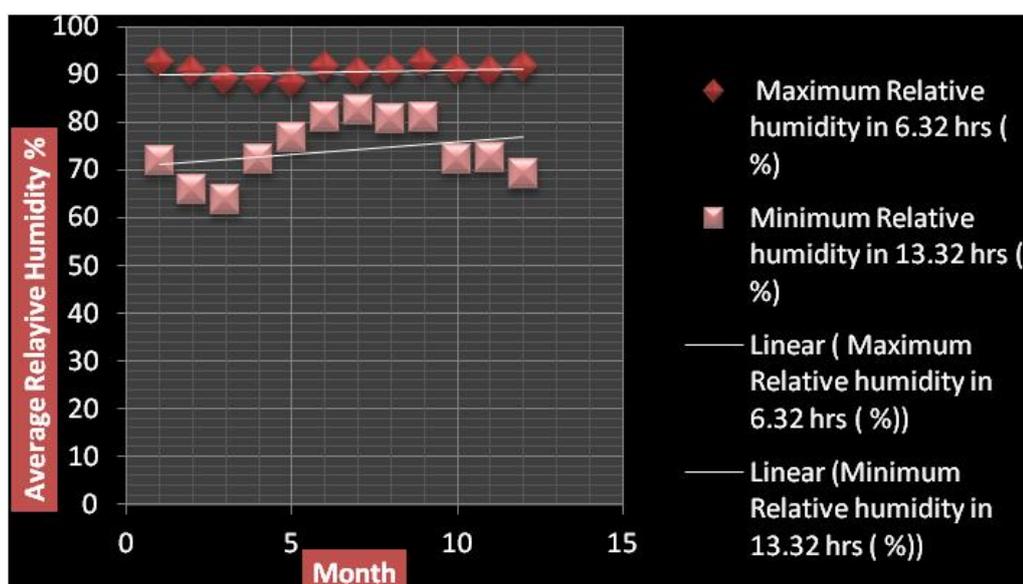


Fig. 2.4. The graphical presentation of annual relative humidity in Study area [Source: Meteorological department, Jalpaiguri, India]

Of the whole wetland systems in the study area, 65 % wetlands are perennial and the rest 35 % are seasonal or ephemeral.

However, three types of wetlands, namely *Riverine*, *Palustrine* and *Lakustrine* are mainly located in this region. Few beels are regularly feeding during the period of monsoon by different fast or slow flowing *riverine* wetland systems. The study area is rich with other wetlands like *lakustrine* i.e. large or small lakes, ponds etc. and *palustrine* including ephemerals seasonally waterlogged areas, beels etc.

2.8.1. Riverine Wetlands

The study area is mainly flood floated. Numerous rivers are flowing through different peats of the study area. Several ox-bow lakes were formed in these regions during the random shifting of rivers. These cut off wetlands are always fed by rivers and flood water during monsoon. Depth and water current of some small narrow fast flowing rivers (*Karala, Jarda, Panga* etc.) gradually decreases every year during summer and these are locally referred as 'Mara-nadi' (dead-rivers). Some large rivers such as Balason, Mahananda, Teesta, Jaldhaka etc. creates devastating situations during monsoon when the water level increases beyond the danger level.

2.8.2. Lakustrine Wetlands

Human beings created numerous wetlands for aquaculture, pisciculture, agriculture, tourism and for various domestic uses. *Lakustrine* wetlands are lakes and ponds and some of these are very old and approximately 200 to 2000 years old. Lakes are locally called as *Dighi*. These are generally perennial and are now mostly used for aquaculture. Numerous ponds are present in the study area, those locally known as *Pukur*.

2.8.3. Palustrine Wetlands

The one of the major wetland system of the study areas is *Palustrine* that includes both perennial and seasonal wetlands. These are mainly low laying fresh water marshes, narrow slow flowing water bodies locally called *Nala* or *Khaal* and fresh water swamps and floodplain areas. Many small and big ditches and ephemeral water bodies are also quite common along the road sides in study area. In seasonal wetlands water depth is 2 – 4 m whereas it is 1 to 6 m in perennial wetlands.

2.9. Wetlands under study

In the study area numerous large, medium and small wetlands are present. Among these, some wetlands are situated inside different Protected Areas like National Parks, Wildlife sanctuaries and Reserve forests. The 15 larger wetlands and many smaller wetlands including roadside ditches and paddy field have been studied for the present dissertation. The larger wetlands are composed of a group of small fragmented water bodies. So, today's larger wetlands should be treated as wetland complexes. Some of these wetlands are: *Mahananda Reservoir, Aambari Reservoir, Domahoni Beel, Gajoldoba Beel, Kathambari Beel, Nijiarap Beel, Gosshaihat Beel* (in Moraghat Reserve Forest), *Jaulapara Beel, Kuchi-Daineer Beel, Garati Beel* (in Gorumara National Park) *Ramsai Beel* (in Gorumara National Park), *Chukchuki Beel* (in Gorumara National Park), *Sursuti Beel* (in Lataguri Reserve Forest), *Rajbari Dighi* (Jalpaiguri), irrigation canals, Municipality drains and numerous social ponds, road side ditches, paddy fields etc (Table 2.1).

Table 2.1. Some major study areas along with types, GPS location and Administrative locations

Wetlands	Types	GPS location of study site	Administrative Location
Mechi River	Large, Natural, seasonally flooded	26°32 09.90 N 88°04 33.97 E	Ind -Nepal transboundary region Darjeeling, Panitanki (Terai)
Hulia River	Natural, narrow, slow flowing	26°41 31.24 N 88°17 16.28 E	Bengdubi forest, Darjeeling (Terai)
Ponta-bari River	Natural, narrow, slow flowing	26°41 09.23 N 88°15 28.41 E	Naxal-bari, Darjeeling (Terai)
Buri-Balason River	Large, Natural, seasonally flooded	26°41 56.07 N 88°19 52.33 E	Bagdogra, Darjeeling (Terai)
Bounivita River	Natural, narrow, slow flowing	26°41 19.86 N 88°15 34.41 E	Bounivita, Darjeeling (Terai)

Wetlands	Types	GPS location of study site	Administrative Location
Lachka River	Natural, narrow, slow flowing	26°43 02.23 N 88°20 27.10 E	Outside of N.B.U. campus, Darjeeling (Terai)
Magurmari River	Natural, narrow, slow flowing	26°42 26.97 N 88°21 34.85 E	N.B.U. campus, Darjeeling (Terai)
Chamta River	Natural, narrow, slow flowing	26°43 22.95 N 88°23 31.61 E	Lexicon, Darjeeling (Terai)
Mahananda River	Large, natural, seasonally flooded	26°41 20.51 N 88°24 31.13 E	Siliguri, Darjeeling (Terai)
Sahu River	Large, Natural and seasonally flooded	26°37 21.43 N 88°27 27.36 E	Radha Bari, Jalpaiguri (Terai)
Karatoa River	Large, Natural, seasonally flooded	26°38 43.74 N 88°30 01.36 E	Aam Bari, Jalpaiguri (Terai)
Panga River	Large, Natural, seasonally flooded	26°35 37.60 N 88°29 50.86 E	Talma, Jalpaiguri, (Terai)
Karala River	Natural, narrow, slow flowing	26°32 18.57 N 88°42 39.94 E	Jalpaiguri town, Jalpaiguri, (Terai)
Gadadhar tributaries	Natural, narrow, slow flowing	26°30 28.05 N 88°43 27.27 E	Kather bridge, Jalpaiguri, (Terai)
Rukruka Tributaries	Natural, narrow, slow flowing	26°32 47.51 N 88°42 35.30 E	Gosala more, Jalpaiguri (Terai)
Dhardhara tributaries	Natural, narrow, slow flowing	26°34 10.30 N 88°47 36.46 E	Sadar Hospitals Babupara, Jalpaiguri, (Duars)
Nathuar char	Natural, but degraded	26°34 05.38 N 88°39 06.87 E	Bodaganj, Jalpaiguri (Terai)
Teesta River	Large, Natural, seasonally flooded	26°30 41.14 N 88°44 02.67 E	Daspara, Jalpaiguri (Terai)
Jarda River	Natural, narrow, slow flowing	26°35 55.85 N 88°49 30.59 E	Maynaguri Jalpaiguri (Duars)
Raidak River	Large, natural, seasonally flooded	26°26 34.66 N 89°41 59.91 E	Jalpaiguri (Terai)
Shankosh River	Large, natural, seasonally flooded	26°22 55.71 N 89°48 02.23 E	Jalpaiguri (Duars)
Mansai River	Large, natural, seasonally flooded	26°11 51.46 N 89°18 00.66 E	Jalpaiguri (Duars)
Torsa River	Large, natural, seasonally flooded	26°36 59.35 N 89°23 01.63 E	Jalpaiguri (Duars)
Jaldhaka River	Large, natural, seasonally flooded	26°34 19.51 N 88°56 33.25 E	Jalpaiguri (Duars)
Kaljani River	Large, natural, seasonally flooded	26°36 39.14 N 89°29 07.46 E	Jalpaiguri (Duars)
Murti River	Large, natural, seasonally flooded	26°49 04.36 N 88°49 40.21 E	Jalpaiguri (Duars)
Aam-bari Barrage	Artificially created	26°38 25.49 N 88°30 04.78 E	Aambari, Jalpaiguri (Terai)
Gajol Doba	Naturally created near Teesta Barrage	26°44 57.46 N 88°34 22.34 E	Gajol Doba, Jalpaiguri (Duars)
Mahananda Barrage	Artificially created	26°39 20.46 N 88°24 34.65 E	Ranidanga, Rajganj Jalpaiguri, (Terai)
Reservoir I	Artificially created	26°41 34.93 N 88°24 29.64 E	Jalpaiguri, (Terai)
Reservoir II	Artificially created	26°41 28.11 N 88°24 32.30 E	Jalpaiguri, (Terai)

Wetlands	Types	GPS location of study site	Administrative Location
Reservoir III	Artificially created	26°41 10.65 N 88°24 45.25 E	Jalpaiguri, (Terai)
Reservoir 4	Artificially created	26°50 02.00 N 89°17 56.14 E	Totopara, Madarihat, Jalpaiguri, (Duars)
Nijiarap Beel	Natural	26°20 16.03 N 88°20 05.14 E	Baxiganj, Haldibari (Terai)
Domohani Beel	Natural	26°35 32.61 N 88°46 03.17 E	Domohani, Maynaguri, (Duars)
Rajbari dighi	Artificial lake	26°32 12.87 N 88°43 16.20 E	Jalpaiguri (Terai)
Jalpesh pond	Artificial	26°31 29.68 N 88°51 58.03 E	Jalpesh, Jalpaiguri (Duars)
Goshaihat Beel	Natural	26°41 41.01 N 88°59 23.12 E	Gayerkata, Jalpaiguri (Duars)
Kuci dainer Beel	Natural	26°41 36.09 N 88°59 21.14 E	Gayerkata, Jalpaiguri (Duars)
Garati Beel	Natural	26°43 16.01 N 88°40 26.82 E	Gorumara, Lataguri, (Duars)
Chukchukia Beel	Natural	26°43 26.11 N 88°41 25.68 E	Gorumara (Duars)
Ramsai Beel	Natural	26°43 38.71 N 88°51 19.32 E	Lataguri, Jalpaiguri (Duars)
Katham Bari Beel	Natural	24°48 55.22 N 88°35 41.50 E	Kathambari, Jalpaiguri (Duars)
Sursuti Beel	Semi-natural,	26°47 03.81 N 88°46 36.82 E	Lataguri (Duars)
Sova Bari old brick field	Artificial, big, now used as reservoir	26°33 15.07 N 88°39 29.04 E	Sova Bari, Jalpaiguri (Duars)
Jaulapara Beel	Artificial, large, used for fishery	25°57 57.53 N 88°59 58.58 E	Madarihat, Jalpaiguri (Duars)
Social Pond 4	Big, used for fishery	26°31 14.65 N 88°42 38.96 E	4 no. Ghumti, Jalpaiguri (Duars)
Roadside ditches	Water source for agricultural activities	26°39 04.30 N 88°30 27.82 E	Aambari, Jalpaiguri (Duars)
Social Pond 7	Big, used for fishery	26°32 18.03 N 88°43 06.73 E	Rajbari, Jalpaiguri (Terai)
Social Pond 8	Big, used for fishery	26°38 43.74 N 89°43 30.97 E	Near Jalpaiguri rail station (Terai)
Roadside ditches, near Teesta bridge	Water source for agricultural activities and fishery	26°34 17.26 N 88°45 43.59 E	Vivekananda Pally, Jalpaiguri (Terai)
Social Pond 10	Big, used for fishery	26°31 03.96 N 88°41 47.59 E	Haldibari More, Jalpaiguri (Duars)
Social Pond 11	Big, used for fishery	26°30 18.73 N 88°42 40.36 E	Mohitnagar, Jalpaiguri (Duars)

2.10. Survey areas for Ethnobotany

The following villages and localities/settlements: *Bengdubi Tea garden, Munda Basti (Assam-more, Jalpaiguri), Banabasti (Lataguri), Nagrakata, Paschim Satali, Satali Eastate, Lachu Bhita, Purba Madati, Jhavaguri Chhat, Baragharia, Dakshin Barajhar, Uttar Paitkapara, Uttar Dhalkor, Samuktala, Baniapara, Latabari, Sibkata, Khoardanga, Panbari, Sankosh Tea Garden, Raidak*

Tea Garden, Raja Bhatkhawa, Dalgaon, Totopara, Ghoramara, Salkumar and Mahakalguri etc. were selected and surveyed for the ethnobotanical studies and the purpose of the study was to record the traditional knowledge of the *Rabha, Toto, Munda, Mech, Santal, Oraon* and *Malpahari* people, who commonly use wetland vascular plants in different purposes.

2.11. Vegetation

Terai and *Duars*, the two contiguous sub-Himalayan regions of West Bengal and the adjacent part of Assam are very rich in its floristic diversity. The dense growth of diverse type of floristic elements here is primarily due to the local physiography, climatic conditions as also courses of the turbulent tributaries of the study area and its soil texture. The forest and vegetation of this area is similar to the mixed plain forest of Darjeeling and has various kinds of vegetation formation including very tall Savannah type of grasslands. Two famous Wildlife Sanctuaries [Mahananda Wildlife Sanctuary and Chapramari Wildlife Sanctuary] and three National Parks [Gorumara National Park, Jaldapara National Park and Buxa National Park (including Buxa Tiger Reserve)] are situated in this region. After declaration of Buxa Duar as a tiger reserve in Jalpaiguri, the flora of North Bengal gained special attention to maintain the forest habitat for proper conservation. Mukherjee (1965) worked on the vegetation of Jalpaiguri and prepared a sketch of forest types of Jalpaiguri and described its main floristic composition.

2.12. Faunal diversity

The Faunal diversity of this area is not properly known. But, the study area provides ample opportunity for food and shelter to wild faunal elements. Bird diversity of this area is somehow interesting, especially for the wetlands birds. During post-monsoon period almost all the wetlands suddenly becomes the happy home for different birds and these areas provides them food, shelter and favourable breeding environment. A large number of migratory birds (migrating from the different parts of the World) are visited these areas mainly during post-monsoon and stayed up to 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. Few identified common avifauna includes *Aythya fuligula* (Tufted Duck), *Anas acuta* (Northern pintail), *Anas clypeata* (Northern 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.

The fish fauna of different river and wetlands are also very interesting and some those are *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 fasclata* (Khalisa) etc.

Apart from the fishes and birds, several species of mollusks, reptiles, insects are available in those wetlands. Among the reptiles some important lizards are *Calotes jerdoni*, *Chamaeleon zeylenica*, *Mabuya carinata*, *Varanus benghalensis* (Go Sap), *V. salvator* etc. and important snakes are *Xenochrophis piscator* (Jaldhora), *Athaetulla nasuta* (lawdoga), *Naja naja* (Gokhro), *Ophiophagus hannah* etc. are very common in this region.



PLATE 2.1. Figs. 1 – 6. Study sites: 1. Mahananda Barrage I; 2. Sova-Bari Beel; 3. Katham-Bari Beel; 4. Raj Bari Dighi; 5. Doumohani Beel; 6. Balapara Beel



PLATE 2.2. Figs. 7 – 12. Study sites: 7. Sahu river bed; **8.** NH-31 Road-side ditches; **9.** Baikunthapur forest wetland; **10.** Fishery pond at Daspara; **11.** Karala River bed; **12.** Gadadhar canal- I

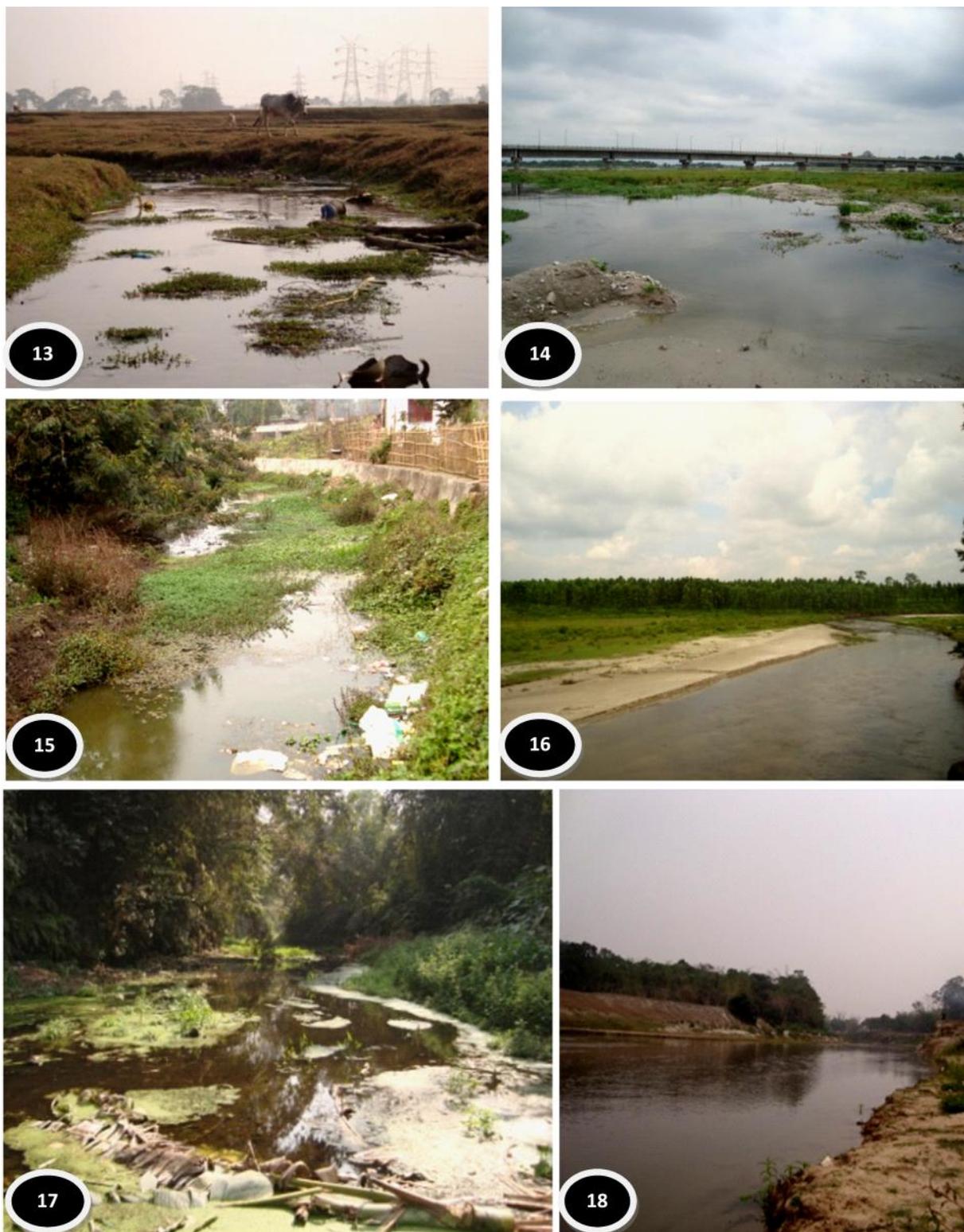


PLATE 2.3. Figs. 13 – 18. Study sites: 13. Lachka River; 14. Balason River; 15. Gadadhar canal-II; 16. Karotoa River; 17. Rukruka River; 18. Panga River



PLATE 2.4. Figs. 19 – 24. Study sites: 19. Dhardhara canal; 20. Pond of Totopara, 21-22. Social pond, 23. Gossaihaat Beel, 24. Kathambari Beel



PLATE 2.5. Figs. 25 – 30. Study sites: 25. Irrigation canal [Jalpaiguri]; **26.** Gajoldoba [Jalpiguri]; **27.** Forest wetland [Suruti forest, Lataguri]; **28.** Teesta Barrage; **29.** Garati Beel; **30.** Chukchuki Beel

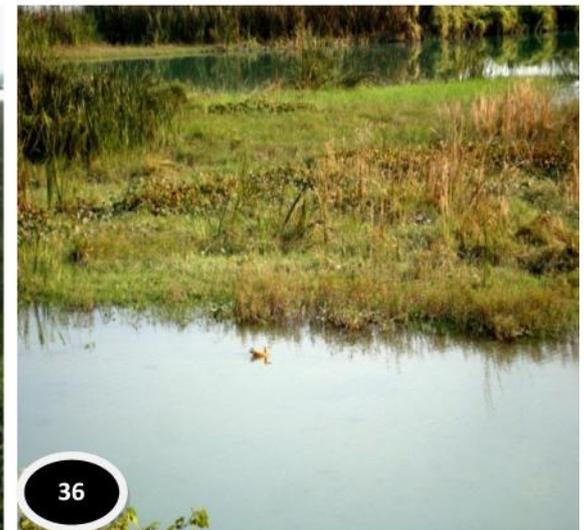
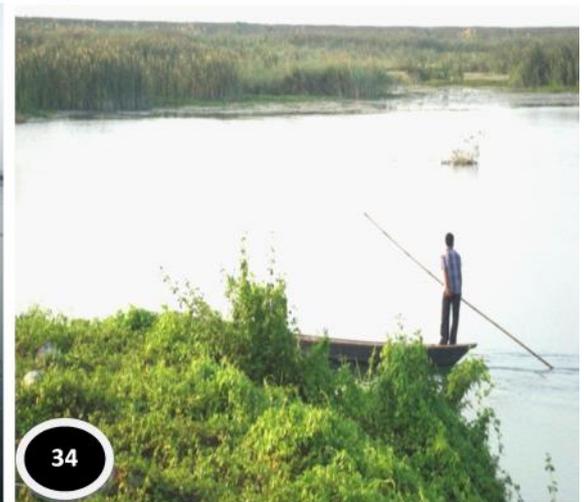
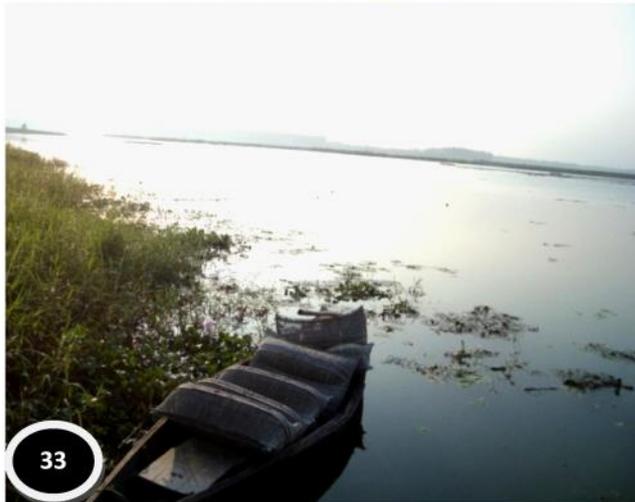


PLATE: 2.6. Figs. 31 – 36. Study sites: 31. Fatapukur Pond; 32. Aambari Barrage; 33. Rajbari Dighi; 34. Kuchi-dainer Beel; 35. Mahananda Barrage; 36. Nathuar Beel