

## STUDY AREA – 2

### 2.1. Introduction

West Bengal is 13<sup>th</sup> largest state in India connecting the entire North eastern part with the rest part of India. The Eastern Himalayan regions of Darjeeling and Kalimpong districts lies in the North of the state West Bengal and the Bay of Bengal is at the south. In between them, the main river Ganga flows eastwards along with its main tributaries. The Hooghly River flows south to arrive at the Bay of Bengal. In 1947, the state of West Bengal was created with 14 districts, now the state divided into 23 districts. At present 341 blocks, 66 sub-divisions, 6 municipal corporation and 121 municipalities present in West Bengal.

### 2.2. Location and Geography

The State lies between 21° 45' – 27° 16' N latitude and 85° 55' – 89° 56' E longitude, covering a geographical area of about 88,752 sq. km. It is bounded on the north by Sikkim and Bhutan, on the east by Assam and Bangladesh, on the south by Bay of Bengal on the west by Bihar, Jharkhand and Orissa and on the North West by Nepal. The periphery of West Bengal is bounded by Sikkim and Bhutan, and on the East by Assam and Bangladesh, the Bay of Bengal forms the southern boundary and on the Western part bounded by Orissa, Bihar and Nepal. The state has 23 administrative districts grouped under three divisions. The districts Bankura, Birbhum, Hoogly and Midnapore came under Bardhaman Division, where as Calcutta, Howrah, Cooch Behar, Darjeeling, Jalpaiguri, West Dinajpur and Malda were kept under Jalpaiguri Division. In order to facilitate administrative control the district 24 Parganas with high density of population and having an international boundary with Bangladesh has been divided into two more districts as North and South 24 Parganas during recent years and in 1992 West Dinajpur has been further divided into South and North with their respective headquarters at Balurghat and Raiganj. Due to an increase of density of population with more than 400/ sq. km the state is under a severe threat of land use pattern and eventually human habitation and related activities. It is, therefore, obvious that due to such intense biotic factors good deals of natural habitats for plants are getting extinct. But still some National parks and Wildlife Sanctuaries play vital role in preserving flora and fauna.

### 2.3. Soil

Different types of soil were recorded from various topography of West Bengal. In order to differentiate the main recognizable soil types of the overall area of the state were grouped as (i) Alluvial soil (ii) Laterite (iii) Red earth and (iv) Tidal nature (Singh 1971). Quality of the soil of Bengal have been studied in detail by Chatterjee (1940) where stress has been given on the general character of the soil while Champion and Seth (1968) performed details study on soil types of forest of West Bengal. Beside this general soil types of the state have also been outlined by Basak and Guha Bakshi (1977) while performing the floristic survey of West Bengal.

Ganga alluvium soil which is the most fertile and forms due to the activities of the river Ganga and its tributaries from past geological history covering the largest area of the plain of West Bengal (28.921.3 sq. km) popularly known as Gangetic flood plains. The alluvial soil is remarkably fertile due to richness in mineral contains and organic matter and have been found to be most suitable for agriculture activities. Soil in the narrow alluvial strips bordering the laterite and red soil bed of the parts of Murshidabad. Soil of the district of Bankura, Bardhaman, Hoogly and Midnapur are very much different in texture and quality. The bulk of this soil type constitutes the riverine track of the *Damodar* and *Kansai* River and their tributaries bringing silt from the western plateau and laterite deposits. Such soil profiles are characterized by alternating sand beds and irregular stratification.

The other important type of soil is representing by laterite which occupy an area next to alluvial. Laterite soils are poor in water holding capacity and are mainly spread along the undulating stretches of well drained land of the western districts (Purulia, Bankura, Birbhum) bordering in the northern part of the state.

The kinds of soil transported from the laterites towards the eastern flanks of the districts under Bardhaman Division, excluding Howrah and Hoogly, are known as Red Earth or Red Soil and are physically laterite alluvium in nature. Considerable area under Rath Plain and the Barined tract of Malda and West Dinajpur has deposition of Red Earth. The soil of the nonspecific composition deposited at the foothills of Darjeeling-Kalimpong Himalaya particularly Tahsil and Jalpaiguri district are classified as Terai Soils. This kind of soil is acidic in nature and plant nutrients and organic matter. The physical feature of Western part of Rarh Plain in the districts of Midnapore, Purulia,

Bankura, Bardhaman and Birbhum show undulated rocky terrain of Archaen Gnesis and other metamorphic rocks as well as coal belts of Gondwana specially in Bardhaman district. Laterite soil together with red alluvium and gravels get interspered due to penetration of the spurs of the Chhotanagpur Plateau and low hilly areas bring a marked change of the topographical view in the districts of Purulia and Bankura. Laterite fringe and laterite debris are also noticed at the Hoogly district (Basak and Guha Bakshi 1977). The plains of Northern half of 24-Parganas and Howrah mark the formation of *matured delta* and *active sections* constitute the South Sundarbans and new islands amidst the creeks. Great thickness of alluvium in most of the plain districts of West Bengal has also been mentioned by others Randhawa *et al.*, 1964.

#### **2.4. Drainage System**

West Bengal is blessed by various perennial big and small river systems coming from Sikkim, Bhutan Himalaya and Chhotanagpur plateau which finally meets with Bay of Bengal. The state has gradual slope from the north to the south and also from western side to east. The lowest height of the western boundary is marked by the point of entry of river Ganga after rounding the Rajmahal hills between Murshidabad and Malda districts after bifurcating near Dhulian in Murshidabad, one turns to the South as Bhagirathi and the other flows to Bangladesh.

The *Bhagirathi* river after demarcating the two main divisions *viz.* Bardhaman and Presidency divisions of West Bengal, finally confluences at Bay of Bengal under the name Hoogly. The origins of plain along the course of *Bhagirathi* are associated with a long history of geological events and have been variously interpreted (Spate 1957; Anderson 1959). The lowland lying in the South of Midnapur that stretching towards West of the river *Bhagirathi-Hoogly* though not a part of delta proper is also flat (Chatterjee 1940) with a gentle elevation towards the west. The major part of the plain covering the lower Ganga plain in West Bengal can be broadly divided under: i) The Northern peradelta of the *Ganga* and *Barind* tract in West Dinajpur and Malda districts. ii) The western part of state consisting mostly laterite plain and of Red Earth (the Rarh areas) and the Contai Coastal strip of the land. The latter along the sea coast is characterized by frequent sand dunes and salt marshes mingled with each other (Ghosh 1976). The marshes were formed behind well developed sand bars; shifting sand dunes of great dimensions have a tendency to blow landwards with high velocity wind and

encroach upon the lands under cultivation. It is not uncommon also to witness the coastline being eroded by the action of sea waves. iii) The extensive plains of the proper Ganga delta having a span of 40-80 km on both sides of the river Bhagirathi further subdivided into *Meribund* area of Murshidabad, Nadia, Hoogly and Howrah.

The entire land area to the west of the Bhagirathi being gradually elevated towards west all the rivers in Bardhaman divisions have a course of their flow from west to east or south-east, where as all the rivers east of the *Bhagirathi* flow north to south with a minor slant towards the east except the Jalangi and Churni in Nadia which have their flow westwards into the Bhagirathi Basin. The western region of the state is flanked by the coalesced fans of seasonal flashy torrent tributaries of the *Ajay*, *Damodar*, *Mayurakshi*, *Kangsabati*, *Rupnarayan* and *Haldi*, all of which fall to a dead delta zone along the Hoogly river bank (Singh 1971; Basak and Guha Bakshi 1977). The physiography of the changing rivers like the Ganga, Damodar and others, explains the mode of formation of the surface of the plain in the southern part of West Bengal (Sen 1968). The rivers in the north of the state have their origin from the Himalayas which after flowing through a short distance within the districts north of Bhagirathi-Padma enter Bangladesh. The *Teesta*, *Jaldhaka*, *Mahananda*, *Nagar*, *Torsa*, *Atrai*, *Punarbhaba*, *Hulia*, *Sahu*, *Shankosh*, *Garati beel*, *Katham bari beel*, *Sursuti beel*, *Jaulapara beel*, *Domohani beel*, *Magurmari*, *Santragachi jheel*, *East Kolkata wetlands*, *Jhilimili lake* of Bankura etc. are some of the notable rivers and water bodies that drain out massive water during rainy season from their catchment in the Himalayas causing devastating floods in Jalpaiguri, Cooch Behar, Malda and West Dinajpur districts. Many dry riverbeds with boulders, pebbles and sand is a common feature in the northern part carrying thin flow of water in dry summer and which come into spate during monsoon. Indication of the remnants of old river beds is not uncommon in some of the districts of central West Bengal which form long stretches of marshes and small lakes. These are commonly known as *Jheels* and *Beels* and most of them are gradually utilized for temporary seasonal cultivation. Tributaries of the old river system occurring in the district of South 24-Parganas have converted the famous part of Sundarbans into an intricate network of tidal water system towards the sea. However, the salinity in the Hoogly River has been considerably reduced since the Bhagirathi is being fed by freshwater after constructing a barrage at Farakka between Murshidabad and Malda.

## 2.5. Agro Climatic zones

The climate of West Bengal is principally tropical type. Tropic of Cancer passes through the northern part of the districts of Purulia, Bankura and Nadia due to which hot summer prevails in major parts of the state. Except for a short duration of 3–4 months from late November to the end of February, winter is very mild and pleasant in the state. However, the mountain region in the northern districts of Darjeeling and Kalimpong are cold throughout the year due to high altitude locations. But on account of high percentage of atmospheric humidity feeling of cold is more in hilly regions. According to classical traditions the state of West Bengal enjoys following seasonal variations Summer, Rainy, Autumn. Mild winter, severe Winter and Spring. Practically only for clearly well marked seasons with a brief pause of Spring are observed namely the Hot season (April to June), the Rainy season (July to August), the post Monsoon season (September to November) corresponding to Autumn and Winter season (December to March). In West Bengal though broadly four seasons have been taken into consideration as major climate periods (Ghosh 1947) the Spring is remarkably pronounced with onset of Southern Wind from the Bay of Bengal. The flow of wind is very strong near coastal region during hot summer that causes the formation of shifting sand dunes. Following such hot spell, the water laden monsoon clouds reach the state generally by the second week of June. The hot season continues from March to June with the day temperature fluctuating from 38° C to 45° C in different parts of the state. The highest temperature with comparatively low humidity is recorded in the fringes of the plateau extended within West Bengal particularly in Purulia, Bankura and the Durgapur-Asansol industrial belt which is also extremely dry due to complete deforestation for developmental activities. The nights, however, bring pleasant relief with the cool sea breeze flowing with moisture from the Bay of Bengal. As a result of high temperature often troughs of low pressure and formed on the plains causing sudden and forceful storms accompanied by lightning and thunder showers and are locally named as Kalbaisakhi, which often cause damage to the ripening fruits during the months of May to July. Though such storms brings heavy loss but at the same time they are beneficial to agricultural operations and also help the summer fruits to receive adequate sap the better development. The rains also help in ploughing land in preparation for the main monsoon crop of paddy and June and also in ripening of the early paddy crop. The Darjeeling and Kalimpong districts due to its altitude (Ave. 1900

m) are comfortably cool during summer. The higher reaches however, often get enveloped in dense fog and help in the growth of luxuriant and rich temperate flora of the district.

The monsoon in West Bengal approaches with gorgeous preparation accompanied by cohorts of dense blue-black clouds generally by the middle of June. However, flash rains, pouring flooding water before the onset of monsoon are also experienced. The short spells rain start arriving before the major break of monsoon rains about a fortnight ahead and brings down the heat of summer with a pleasant break. The rains in West Bengal are solely caused by the current of South West Wind which brings the moisture laden clouds from the Bay of Bengal. The rain bearing clouds after moving northward gets obstruct by the barrier of Himalayas and pour down heavily on the mountains and the foothill areas of Duars. As such the average rainfall in the state being about 125 cm during the year. The mountains receive more than 1780 mm. The seasonal rainfall in Darjeeling area is generally above 3500 mm where as Duars receives about 3000 mm. In the western plateau the rainfall is less than 1500 mm per year. Particularly during winter months the atmospheric humidity (Fig. 9 &12) in these districts also comes down to very low and extreme dryness prevails from November to March when rainfall is only 1.0 mm to 25 mm. Particularly the districts of Bankura and Purulia are in a permanent state of extreme drought condition and the way of improving the agricultural crop is through irrigation. Monsoon in West Bengal sometimes shows some interesting features of variability and sudden breaks in rainfall is not uncommon and flooding heavy downpour is also experienced during the end of the monsoon. The states bordering the northern part of the Bay of Bengal, including Bangladesh, are prone to worst and devastating cyclonic conditions during September to November. Very often the low pressures created in the Bay of Bengal during those months develops into furious cyclonic storms accompanied by heavy rains and slashes the life and property of the coastal states including the districts in the southern part of the state.

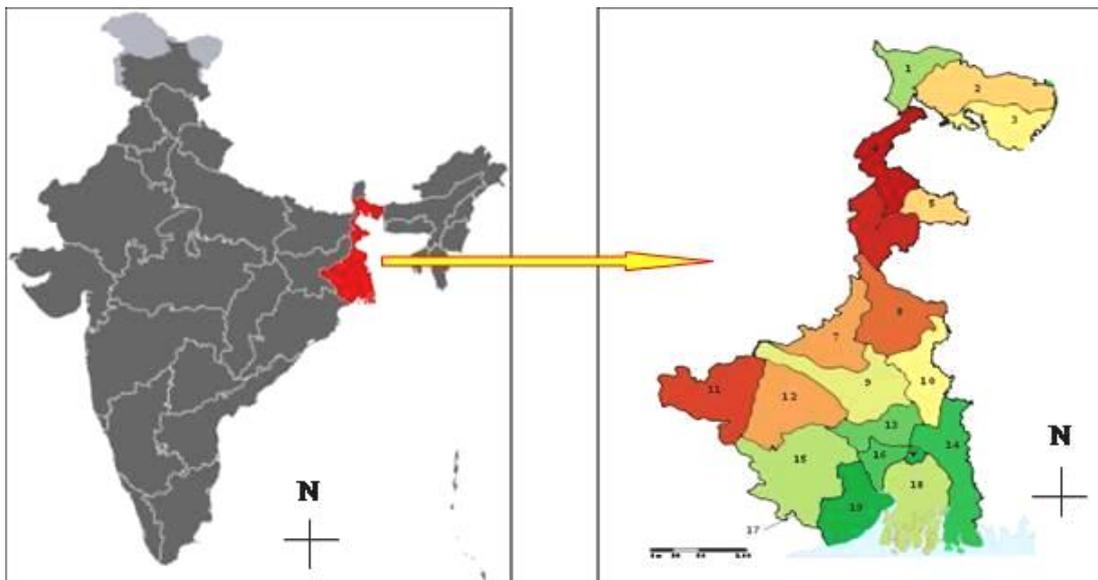
The winter is mild over the plains and lasts for about three months when average temperature does not drop below 15°C (Table 5). The season is accompanied by a cold and northern wind which appreciably causes lowering of the humidity (Fig. 12 & 15) level. However, short spell of smart rains with cloudy days are experienced during the end of December and in the 1<sup>st</sup> week of January due to incursion of the western monsoon coming all the way from the Arabian Sea. The weather becomes warmer by

the middle of February which marks the welcome arrival of a short period of spring in the state and fresh greenery with new foliage proclaims in this period. Most remarkable flowers noticed in these regions are *Bombax* (Mather), *Crataeva nurvula* (Barun) etc. Sweet smell of blooming *Magnifera indica* (Aam), *Citrus* sp., *Michelia champaka* (Champa), *Jasminum* spp., abounds under cultivation in the gardens and forests. But the mellow season is too short and summer heat sets in from April, and seasonal cycle rolls once again. A summarized normal climatic data during 2013-2018 as recorded by the Meteorological Department at Alipore observatory is diagrammatically represented from four climatic regional stations of West Bengal.

The state (Map 5) is divided into the following five broad geographical regions:

1. The Darjeeling Himalaya
2. Terai – Duars region
3. Western undulating highland and plateau
4. North and South Bengal plains
5. Gangetic Delta

Palms in nature appear in multifarious forms and structures. Numerous structural features change in Palms during its growth till flowering and fruiting.



**Map 5:** Location of West Bengal (source: [www.google.co.in](http://www.google.co.in))

The exotic palms after introduction in the new environment also show some changes in their phenological behavior, for example palms of equatorial regions after their

introduction in the higher latitudes and grown for a longer period of time and their off springs raised from the acclimatized seeds show change in their seasonal production of leaves and inflorescence and development of flowers and fruits. Till date, no importance was given on recording these very important phenological changes in the introduced palm species. A study on their taxonomy, ecology and ethnobotany is considered a very important and pertinent subject. A detail inventory is therefore necessary dealing with taxonomy, ecology, phenological peculiarities of some interesting palm species and economic aspects of palms on one hand, and the threat posed to certain species of indigenous palms by over exploitation and habitat changes on the other. The humidity, temperature and rainfall graph patterns of West Bengal (Map. 5) of five broad geographical regions mentioned above are described below.

### 2.5.1. Darjeeling-Kalimpong Himalaya

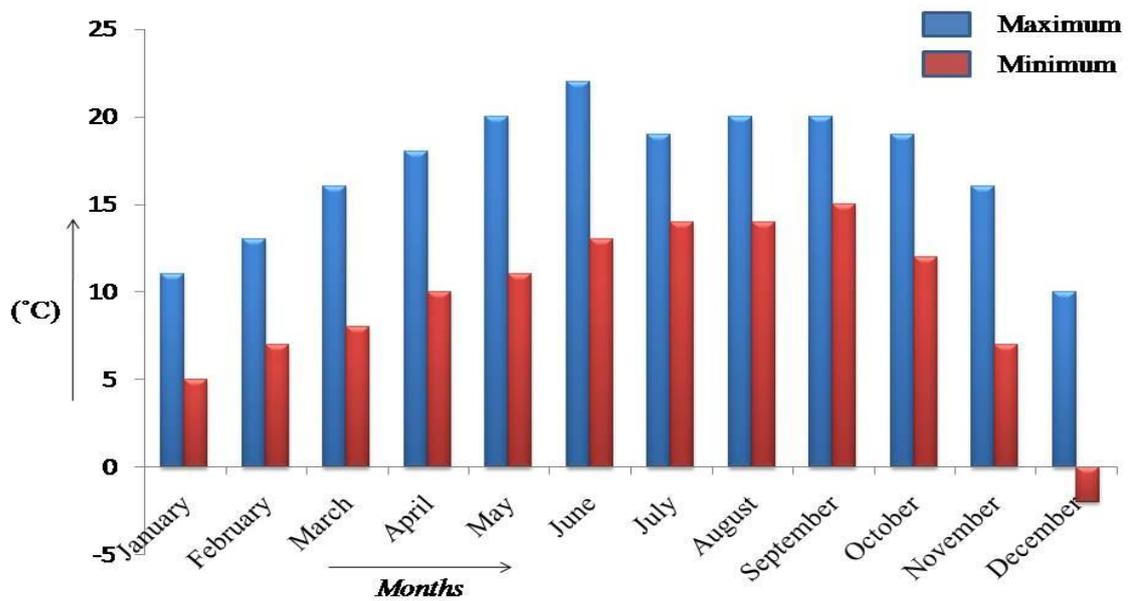
The Darjeeling – Kalimpong Himalaya region lies on the extreme northern boundary of West Bengal and includes two districts 1. Darjeeling district with four sub-divisions (Map. 6) *i.e.*, Darjeeling Sadar, Kurseong, Mirik and Siliguri subdivision and 2. Kalimpong district with three blocks *i.e.*, Kalimpong – I, Kalimpong – II and Gorubathan. A number of mountain ranges and deep river valleys are the unique features in this region. Geographically, it is located between 26°31'05" N 129°21'24.2"E latitude and 87°59'30"N to 88°53'24"E longitude. *Teesta, Rangeet, Mechi, Balason, Mahananda, Lish, Gish, Chel* etc. are the important rivers and rivulets of the district. The rainfall of Darjeeling-Kalimpong Himalaya was recorded higher in July (781mm) 2012 and lowest rainfall in December (7mm) 2017 and temperature was recorded higher in June (22 °C) 2011 and lowest in December (-4 °C) 2017 (Table 3 & 4 and Fig. 13 & 14).



**Map 6:** Darjeeling-Kalimpong Himalaya (source: <https://earth.google.com>.)

**Table 3:** Temperature of Darjeeling-Kalimpong Himalaya throughout the year 2006–2017

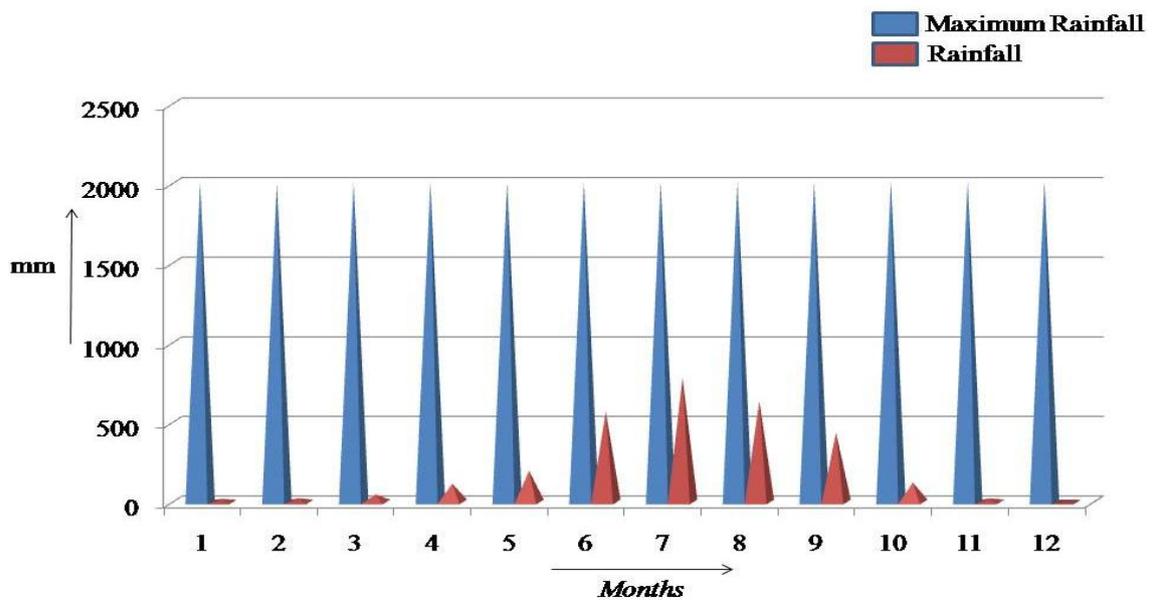
Month	Year	Mean maximum average temperature(°C)	Mean minimum temperature (°C)
January	2006	11	5
February	2007	13	7
March	2008	16	8
April	2009	18	10
May	2010	20	11
June	2011	22	13
July	2012	19	14
August	2013	20	14
September	2014	20	15
October	2015	19	12
November	2016	16	7
December	2017	10	-4
<b>Annual average</b>		14.9	9.33



**Fig.13:** Annual temperature of Darjeeling-Kalimpong Himalaya region (2006–2017)

**Table 4:** Rainfall of Darjeeling-Kalimpong Himalaya throughout the year 2006–2017

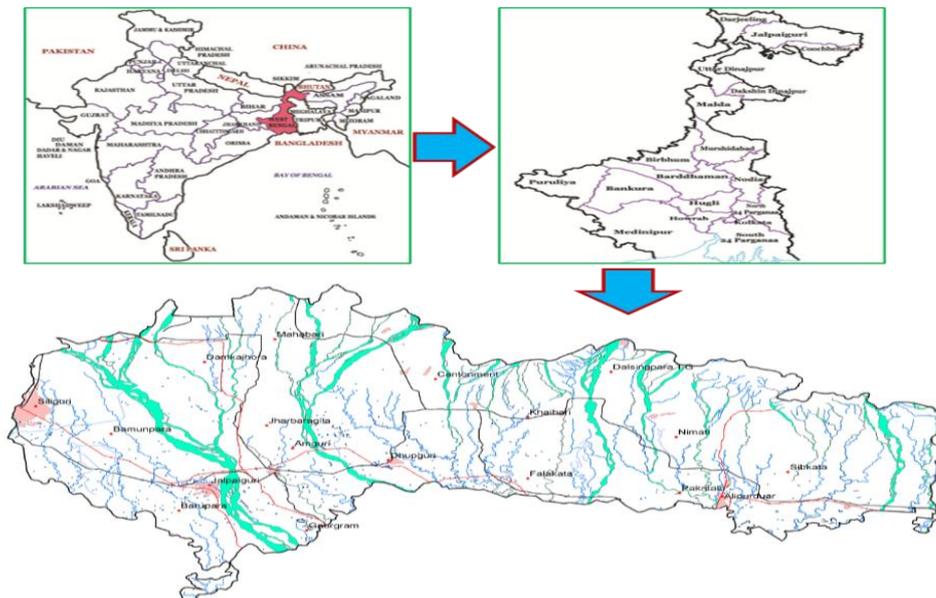
Month	Year	Average Rainfall (mm)
January	2006	19.7
February	2007	24.1
March	2008	47.7
April	2009	115.8
May	2010	197.2
June	2011	570
July	2012	781.7
August	2013	635.3
September	2014	437.3
October	2015	122.5
November	2016	23.5
December	2017	7
<b>Annual rainfall</b>		<b>248.48</b>



**Fig.14:** Rainfall (mm) of Darjeeling-Kalimpong Himalaya (2006–2017)

### 2.5.2. Terai – Duars region

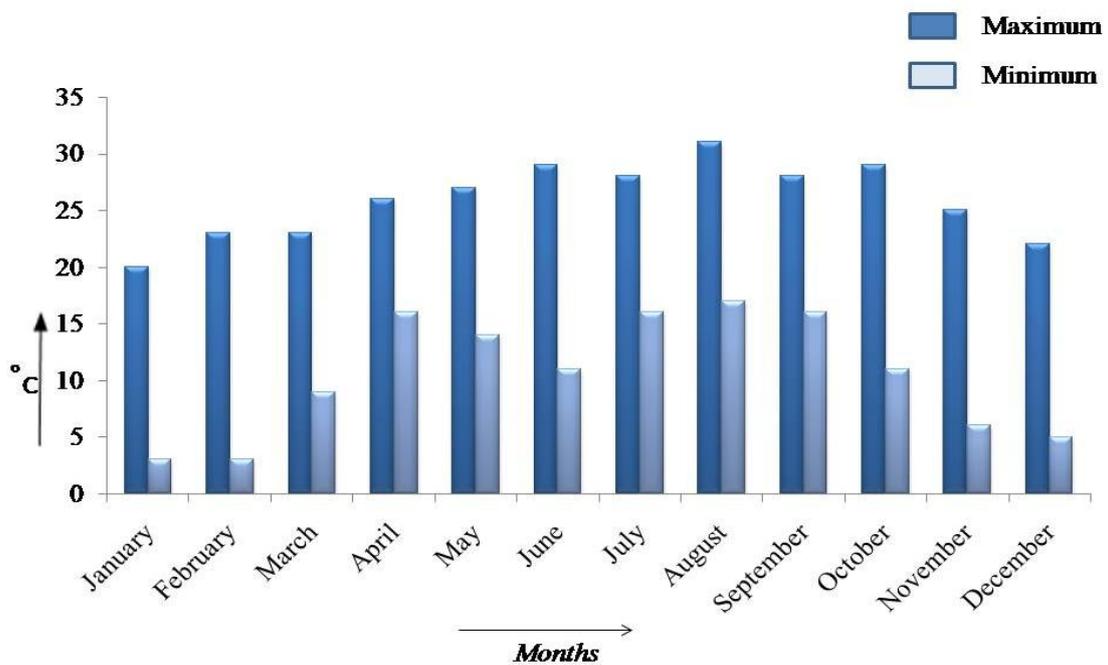
Terai and Duars are spreading through the districts of Jalpaiguri, Alipurduar and plains of Darjeeling are taken as study area for the present dissertation. A belt of moist forests passes along the study areas, at the foot of the majestic Himalayas. The undulating *Terai* and *Duars* (Map 7) landforms 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) and 26°.16' to 27°.00' N latitude and 88°.04' 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.



**Map7:** Terai and Duars (Source: [www.jalpaiguri.gov.in](http://www.jalpaiguri.gov.in))

**Table 5:** Annual temperature in Terai-Duars region (Source: meteorological Department, Jalpaiguri, India)

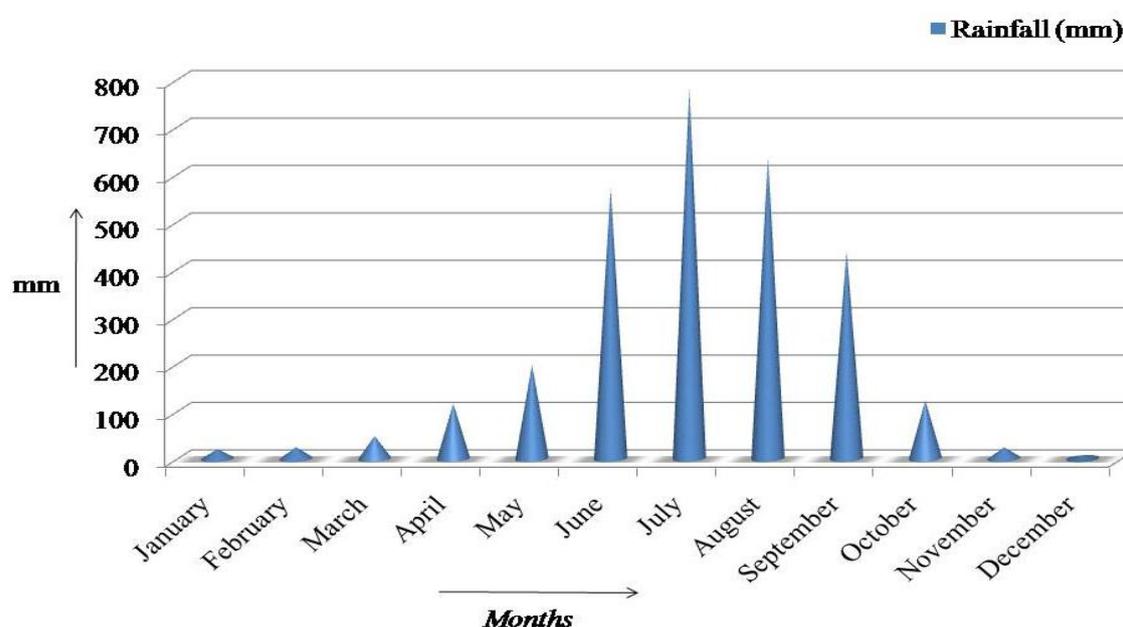
Month	Year	Mean maximum	Mean minimum
		Ave. temperature ( $^{\circ}$ C)	Ave. temperature ( $^{\circ}$ C)
January	2006	20	3
February	2007	23	3
March	2008	23	9
April	2009	26	16
May	2010	27	14
June	2011	29	11
July	2012	28	16
August	2013	31	17
September	2014	28	16
October	2015	29	11
November	2016	25	6
December	2017	22	5
<b>Annual average</b>		<b>25.91</b>	<b>10.58</b>



**Fig. 15:** Annual temperature of Terai-Duars region (2006–2017)

**Table 6:** Annual rainfall in Terai-Duars region during 2006 – 2017 (Source: Meteorological department, Jalpaiguri, India)

Month	Year	Average Rainfall (mm)
January	2006	19.7
February	2007	24.1
March	2008	47.7
April	2009	115.8
May	2010	197.2
June	2011	570
July	2012	781.7
August	2013	635.3
September	2014	437.3
October	2015	122.5
November	2016	23.5
December	2017	7
<b>Annual rainfall</b>		<b>248.48</b>

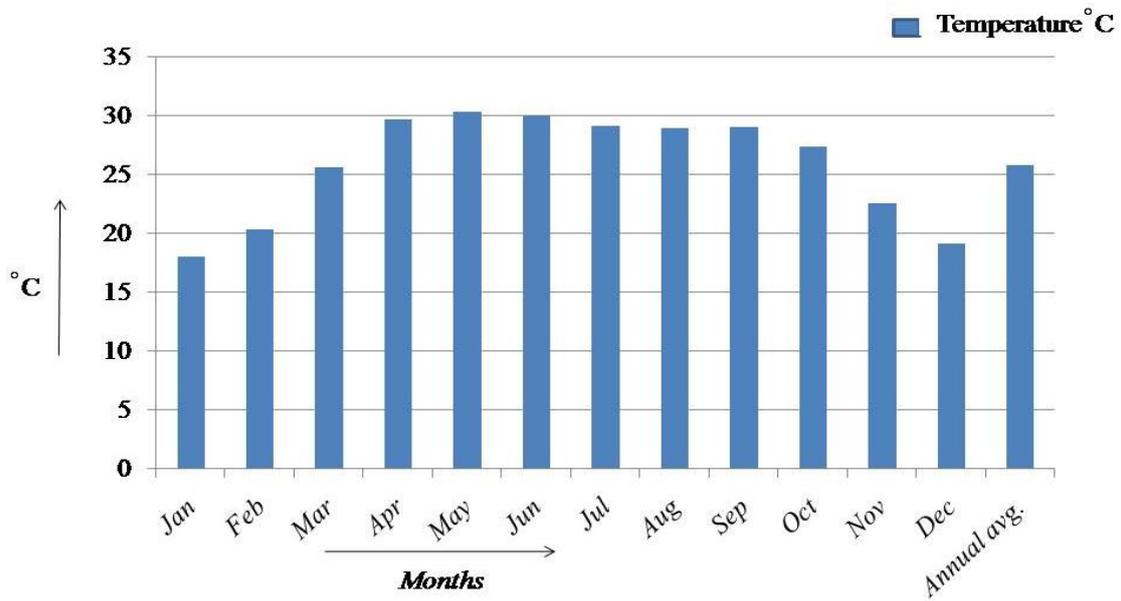


**Fig.16:** Annual rainfall of Terai Duars region (2006–2017)

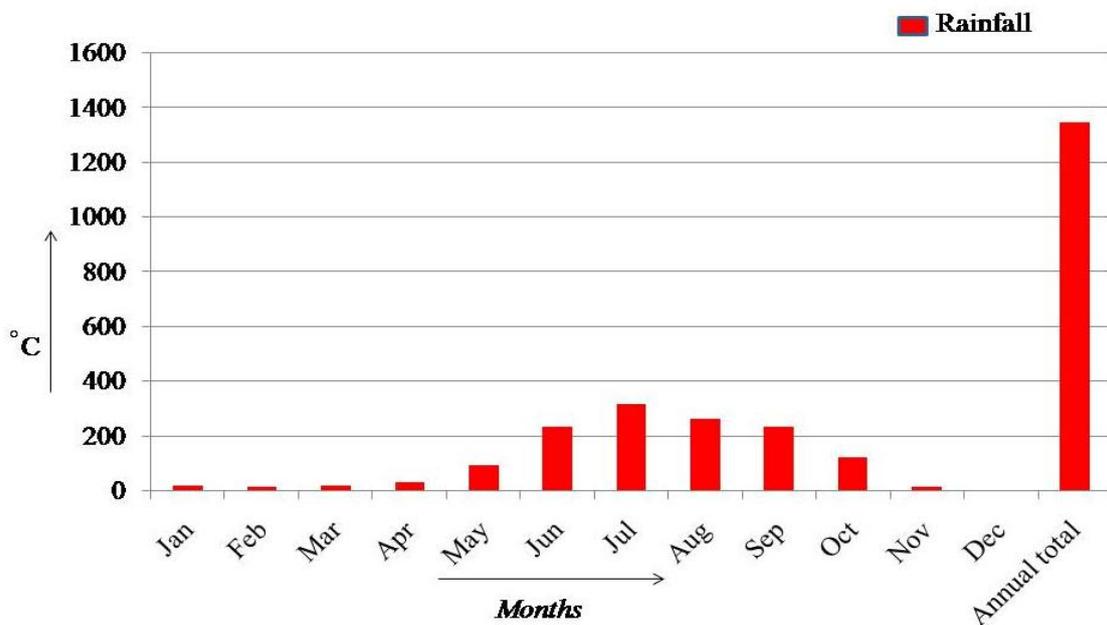
### 2.5.3. Western undulating highland and plateau

The entire Purulia district and western part of Bardhaman, Bankura and East and West Medinipur districts constitute the western undulating uplands and plateaus. This area is the extension of Chotonagpur plateau. Among the hills rising above the general level of plateau *Ayodhya*, *Panchet*, *Bagmundi* of Purulia district and *Susunia* and *Biharinath* of Bankura district are worth mentioning. *Gargaburu* of *Ayodhya* hills is the highest peak

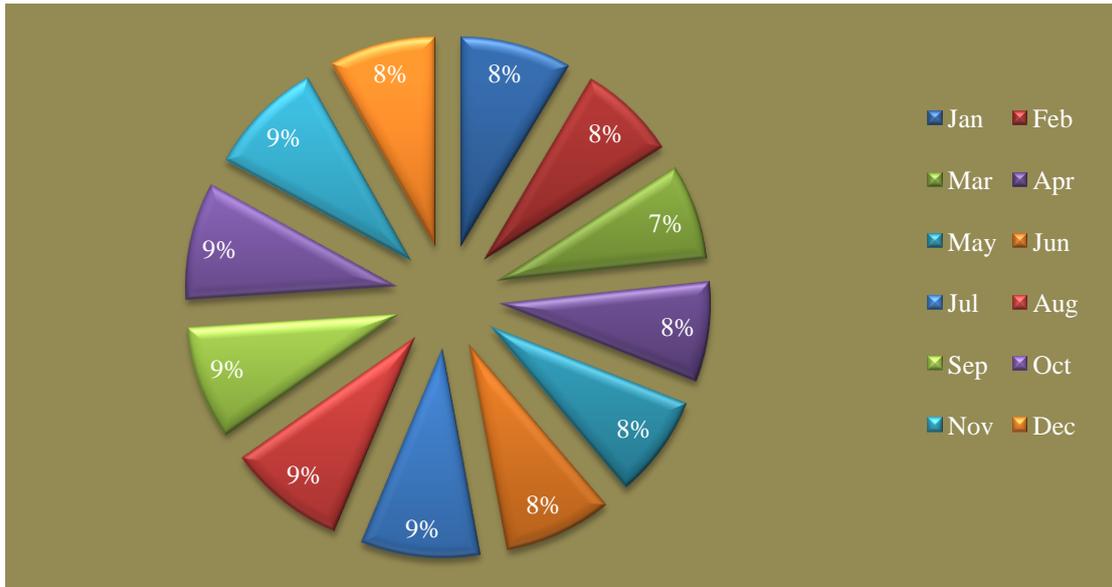
(677 m) of this region. The dominating soil type of this area is basically red-lateritic. The average daily temperature during summer varies between 26–39° C. Sometimes temperature raises upto 48° C and in winter average temperature remains 13° C which sometimes drops down to 5° C (Fig. 17) and rainfall ranges between 16.5 mm to 315.5 mm (Fig. 18).



**Fig. 17:** Annual temperature of Western undulating highland and plateau (2006–2017)



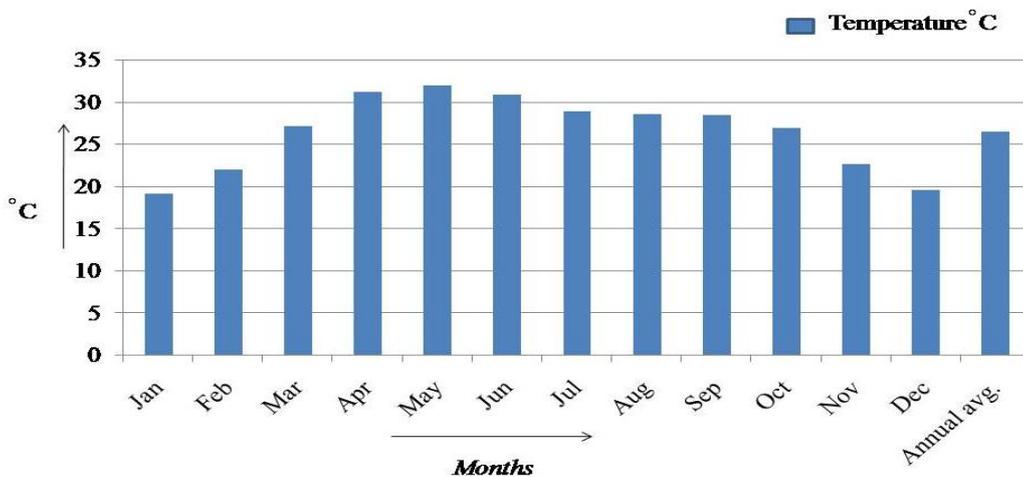
**Fig.18:** Annual rainfall of Western undulating highland and plateau



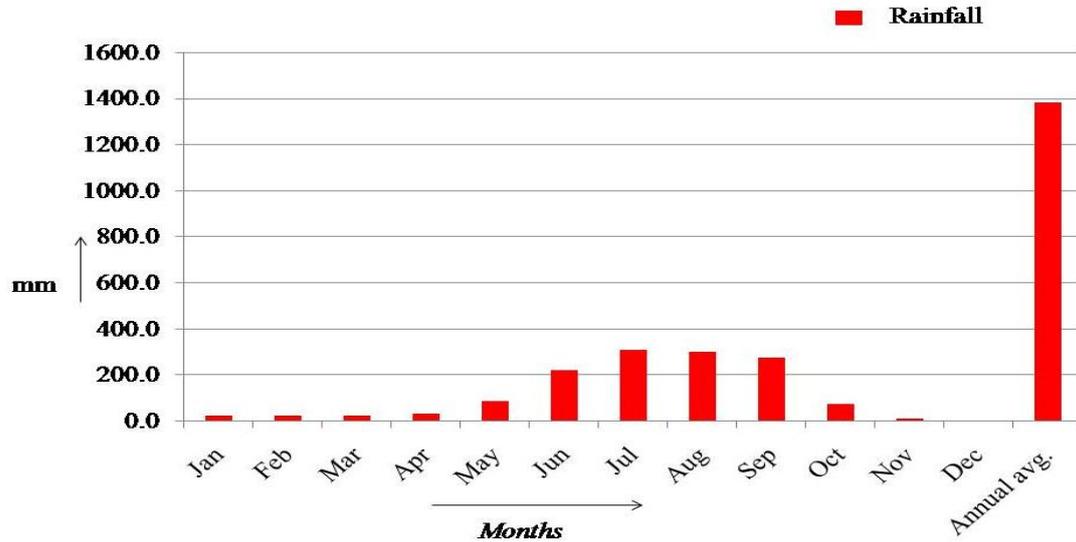
**Fig. 19:** Humidity of Western undulating highland and plateau

#### 2.5.4. North and South Bengal plains

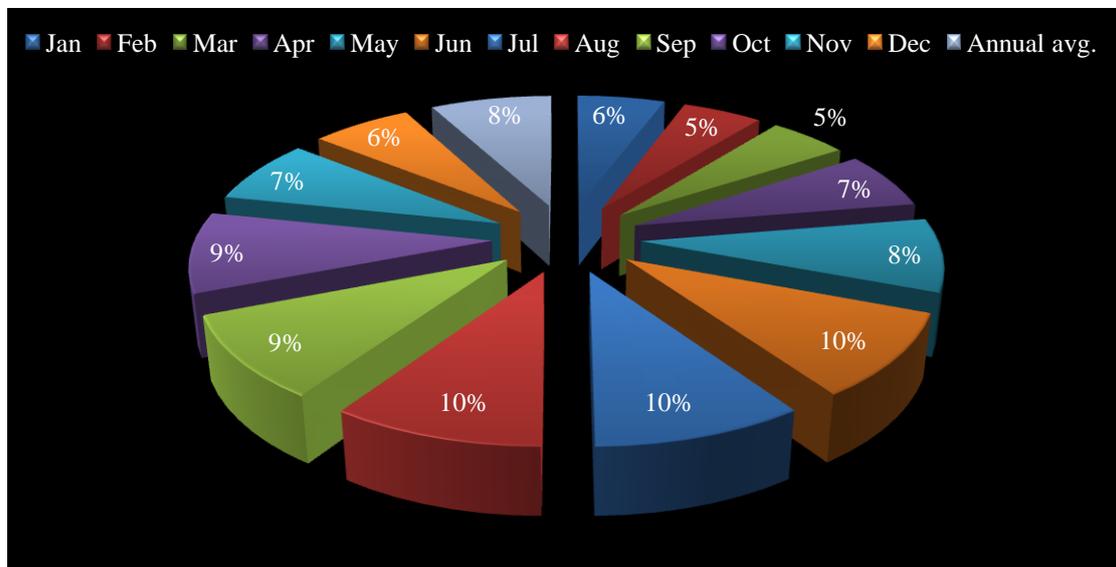
The river Ganga divides the West Bengal plain into North and South Bengal plains. North Bengal plains include Coochbehar, Alipurduar, Jalpaiguri, Uttar and Dakshin Dinajpur and Malda districts. On the other hand, South Bengal plains include Murshidabad, Nadia, Birbhum, Hooghly, Howrah and some parts of Bardhaman, Bankura, E and W Medinipur, North and South 24–Parganas districts. Soil of this region is generally alluvial. Lateritic soil also occurs in some areas. The average summer temperature remains between 36–38° C and average winter temperature is 15°C (Fig. 10). The average rainfall is 250 cm in North Bengal plains and ranges from 150–200 mm in the plains of South Bengal (Fig. 11).



**Fig.20:** Annual temperature of North and South Bengal Plains (2006–2017)



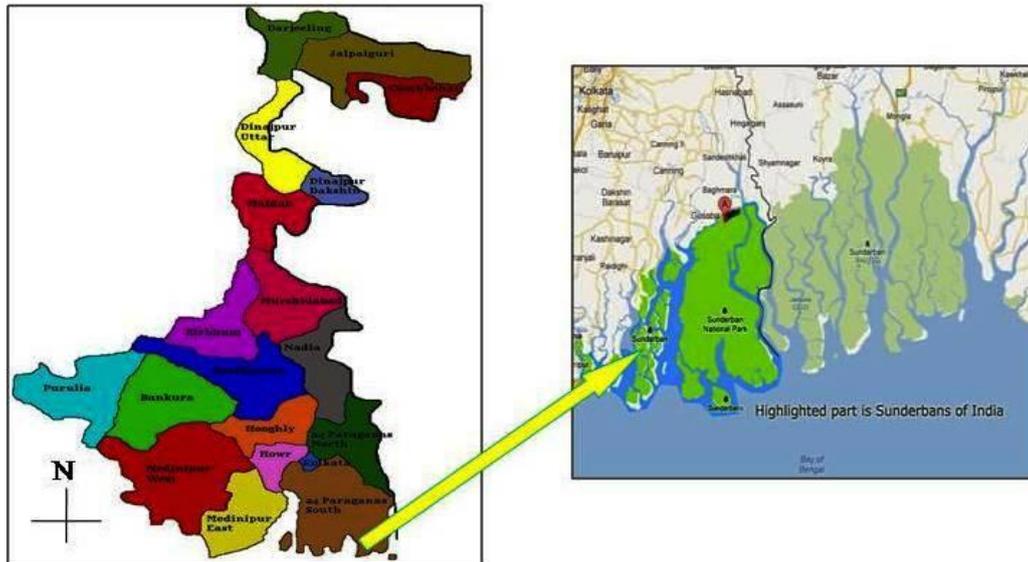
**Fig.21:** Rainfall of South Bengal Plains (2006–2007)



**Fig.22:** Humidity of North and South Bengal Plains

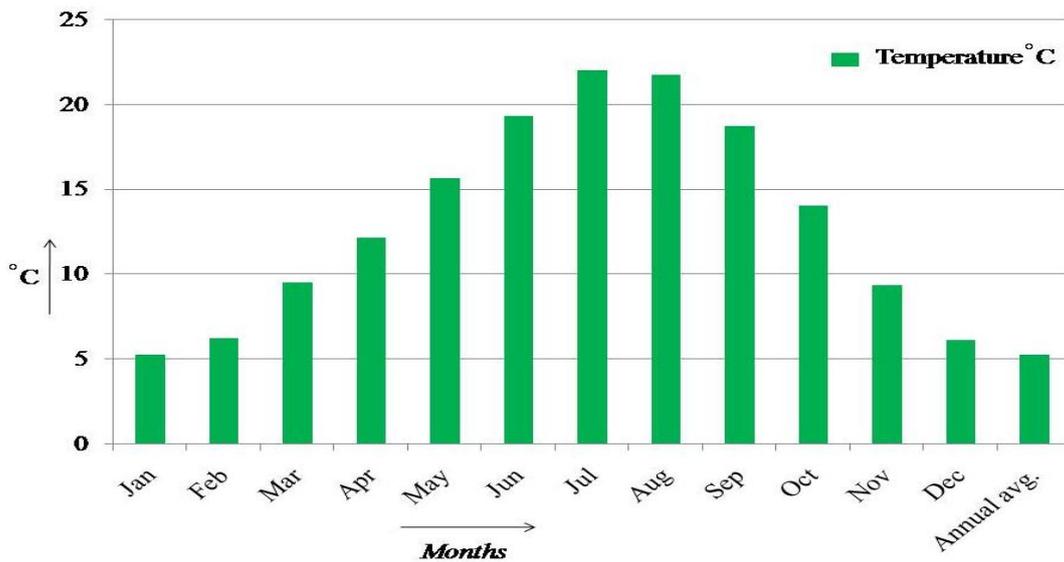
### 2.5.5. Gangetic delta

The Gangetic delta includes Sundarban area in South 24 Parganas district. The area has many creeks and tracts of lowland, marshy places and wide river openings. Soil is usually saline. Sandy soil predominates on islands, river beds and on the bay coast. The climate is hot and very humid. The average temperature is 20° C in winter and 28° C in summer (Fig. 23). Annual rainfall varies between 180–200 mm (Fig. 24).

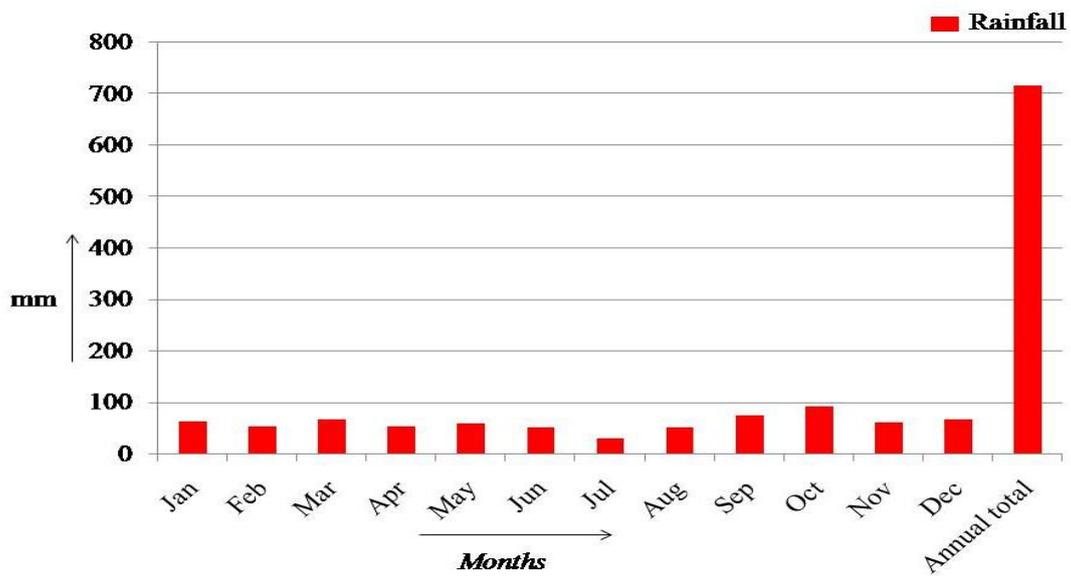


**Map 8:** Gangetic Delta (source: <https://earth.google.com>.)

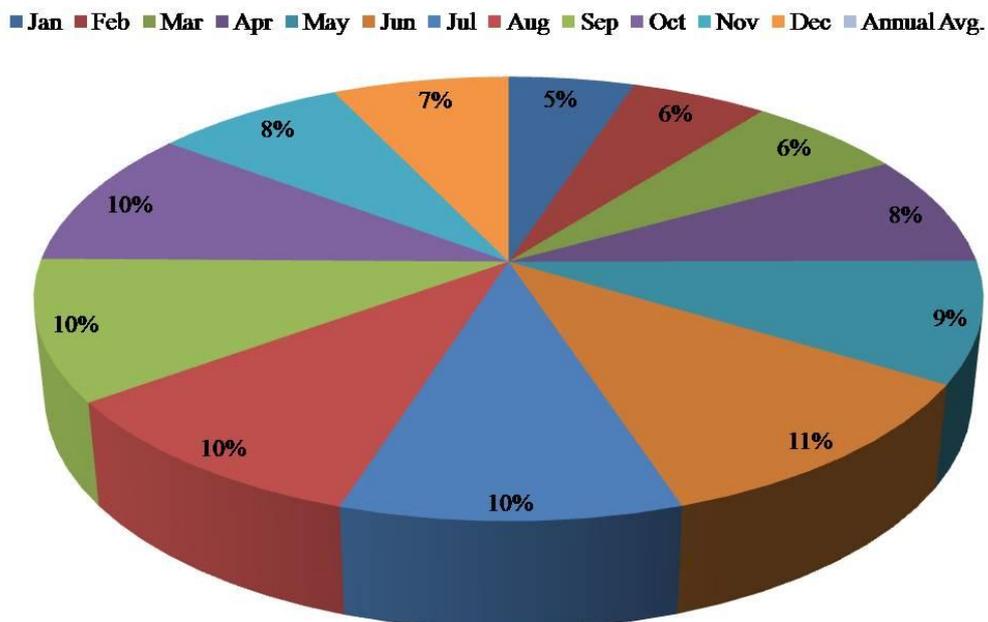
The West Bengal is unique in having a complete physiographic ecological continuum between the tropical, subtropical and temperate forest zones with the most interesting floristic diversity from the coastal mangrove to high altitude sub-alpine areas.



**Fig.23:** Annual temperature (°C) of Gangetic Delta (2006–2017)



**Fig.24:** Annual rainfall (mm) of Gangetic Delta (2006–2017)



**Fig.25:** Humidity of Gangetic Delta (2006–2017)

## 2.6. Survey areas for Ethnobotany

Ethnobotany is the study of a native plant and their daily life uses through the traditional knowledge of ethnic communities. The good number of potential villages and localities / settlements namely *Tamkule*, *Dhajea Busty*, *Moonda kothe*, *Salim Bong*, *Tukvar Tea Garden*, *Lebong Tea Garden*, *Ging Tea Garden* of Darjeeling Himalaya and *Bengdubi Tea garden*, *Munda Basti* (Assam-more, Jalpaiguri), *Banabasti*

(Lataguri), *Nagrakata, Paschim Satali, Satali Tea estate, 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.* of Terai and Duars and *Jarkhali, moukhali, Hinchakhali, Nikarighata, Pathan Khali, Kamarpara, Daria, Uttar Aungodbaria, korakathi* of Sundarban area and *Ballabhpur, baradiha, galundi, Angora, balishwar, Barasat etc.* of Western undulating high land and plateau and some tribal villages of Central Bengal were selected and surveyed carefully. The ethno-botanical studies and the purpose of the study was to recorded the traditional knowledge of the indigenous ethnic communities like *Rabha, Toto, Munda, Mech, Santal, Oraon, Murmu, Mahato, Munda, Lepcha, Sherpa, Khas, Manger, Sundar, Newar, Kami, Damai, Darji, Kirat Dukpa Tamang, Chettri, and Malpahari* are the inhabitant in those villages were seriously interviewed and noted the shared information about the palms and canes utility.

## **2.7. Vegetation Outline of West Bengal**

The main landmass of West Bengal plains (excluding the northern Himalaya and Sub-Himalaya tract and the drier projections of the Bihar plateau in the western boundary) and the southern estuarine forests of the Sundarbans are derived from the Gangetic Delta and alluvial deposits of the tributaries of the Ganga and Brahmaputra where cultivated lands dotted with villages having varieties of plantations form the main feature of the vegetation.

In recent years several district floras and floristic accounts have contributed significant aspects of this vegetation and the constituent elements of the vegetation and their controlling factors are narrated as under.

## **2.8. Vegetation and Forest Types of West Bengal**

The varied and unique physical features in the state gives rise to 5 well defined phyto-ecological zones to support corresponding typical vegetations, these are **1.** Darjeeling Himalayan region, **2.** Terai and Duars region and the adjacent plains, **3.** Vast alluvial (North and South Bengal) plain on both sides of the Bhagirathi and its northern and western tributaries, **4.** The Western undulating highland and plateau and **5.** Mangrove

forest (Gangetic Delta) of Sundarbans mainly restricted to South 24-Parganas. In the broad outline of the areas mentioned above certain subdivisions of forest types and vegetation patterns have been further classified after critical analysis by the ecologist and plant sociologists (Champion and Seth 1968; Naskar and Guha Bakshi 1987; Malick and Gamble 1875). However, the present picture of the vegetation pattern and forest types in the entire state is not the same as in the past and has undergone considerable modification due to continuous stress of intense bio-edaphic factors (Basak and Guha Bakshi, 1977) which have been operative markedly during the last 50 to 60 years. Apart from those mentioned above the other typical plant groups belonging to the aquatic members, weed elements horticulture and cereal crops along with components of forestry development also have markedly changed the vegetation in terms of quality and quantity and the details are treated under separate headings.

The vegetation pattern of West Bengal particularly that of the Lower Ganga Plains has been worked out and shows quite interesting features (Chaudhuri *et al.* 1962). Anatomical studies of the excavated wood from deep core have indicated the existence of a dominating mangrove forest which at present has migrated only to the southern part of the 24- Parganas (Ghosh 1941; Ghosh and Neogi 1958).

## **2.8.1 Vegetation of Darjeeling Himalaya and Terai-Duars**

### **2.8.1.a. Temperate forest**

The temperate forest zone of Darjeeling Himalaya shows also a characteristic distribution of scrub forest communities. In this zone the common plants like *Pinus griffithii* or sapling of *Quercus lamellose*, *Lithocarpus pachyphylla*, *Quercuss lineate* etc. are available. Among the temperate forest there are several forest includes savana type indicate several plants and grasses like *Saccharum spontaneum*, *S. procerum*, *S. bengalensis*, *Cynodon dactylon*, *Leerseae hexandra* etc. and other mixed plain forest types with flora like *Sorea robusta*, *Acacia ferruginea*, *A. intsia*, *Litsea lacta*, *Pueraria tuberosa*, *Bauhinia anguinea*, *B. malabarica*, *B. purpurea*, *Calamus sp.*, *Daemonorops sp.*, *Plecotocomia sp.*, *Dalbergia foliosa*, *D. motorium*, *D. pulchellum* etc.

### **2.8.2. Vegetation of North Bengal**

Out of the five vegetational zones of West Bengal mentioned earlier, the forest types and floristic composition of the mountainous Darjeeling including its plain areas being

greatly influenced by the Himalayan elements, its vegetation has been dealt with separately in the preceding part of this chapter, though it is situated in North Bengal.

The works mentioned above also created interest in subsequent workers like Sikdar (1984) published an account on the Baikunthapur forest division of Jalpaiguri district. Based on the composition and distribution of the floristic elements of North Bengal, he described forests into five categories and their typical components are as under:

**2.8.2.a. Semi- evergreen forests:** Common species like *Alstonia scholaris*, *Bauhinia variegata*, *Castanopsis tribuloides*, *Cinnamomum obtusifolium*, *Eugenia formosa*, *Litsea salicifolia*, *Meliosma simplifolia*, *Syzygium cumuni* etc. Forests of such types are found in small patches near the rivers or streams.

**2.8.2.b. Moist deciduous forest:** This kind of forests are described under moist tropical forest type and categorized under Sub-Himalayan secondary wet mixed forest. The principal genera found in these forests are *Elaeocarpus*, *Eugenia*, *Dysoxylum*, *Litsea*, *Machilus* etc. Extensively growing climbers of Vitaceae are frequently found to grow on those trees and make an entangled lattice of climbers. Some of the well represented trees and other associated shrubby elements are *Alphanamixis polystachya*, *Callicarpa arborea*, *Casaria vareca*, *Phlogacanthus thyrsiflorus*, *Aporosa roxburghii*, *Maesa indica*, *Styrax serrulatum* etc.

**2.8.2.c. Dry deciduous forests:** The vegetation in this forest type according to Champion and Seth (1968) is recognized as East Himalayan moist mixed deciduous forest where *Shorea robusta* is frequently found growing along with various other trees and shrubby elements and the floor is densely covered with grasses following burning of ground cover. Along with dominating *Shorea robusta* other commonly growing species are *Lagerstroemia parviflora*, *Stereopermum personatum*, *Wrightia tomentosa*, *Sterculia villosa*, *Malotus philippensis*, *Erythrina stricta*, *Bridelia stipularis*, *Ziziphus rugosa* and straggling shrubs like *Holmskiodia sanguine*, *Celastrus paniculatus* etc.

**2.8.2.d. Sal forest:** The forest of *Shorea robusta* in the aforesaid division and in general are in plantation by the state forest department and found in most of the

forest ranges. Common associates of this type of forests are *Lagerstroemia parviflora*, *Sterculia villosa*, *Morinda angustifolia*, *Maesa indica*, *Terminalia bellirica*, *Schima wallichii*, *Aphanamixis sp.*, *Earnthemum splendens*, *Strobilanthes capitatus* and others.

**2.8.2.e. Grass lands:** Impressive grassy terrains are found mainly along the river banks where in presence of moist habitat in low lying areas support luxuriant and thick grasses like *Saccharum spontaneum*, *S. procerum*, *Phragmites karka*, *Agrostis ravennae* etc.

### **2.8.3. Vegetation of the Western Periphery of West Bengal**

Due to extension of the floristically rich hilly plateau of Bihar and Orissa along the western boundary of West Bengal the vegetation in these areas of the bordering districts viz. Birbhum, Bardhaman, Bankura, Purulia and Midnapur represents a distinct type of flora related to the adjoining drier areas of the two States. Moreover, the undulated stretch of sub-montane topography drained by the distribution and establishment of plants uncommon for the Lower Ganga Plains. Many species of Peninsular and Terai Himalayan distribution occurring in this strip have rendered the vegetation quite interesting for the phytomigratory influence on the distribution of species in the marginal areas. The eastern and south-eastern parts of land of the districts with a gentle slope have gradually merged in the Gangetic Plain of alluvium and here the flora is similar to the plain of West Bengal.

### **2.8.4. Vegetation of the Mangrove Forests of the Sundarbans**

The most impressive and interesting forest vegetation with which West Bengal has been endowed is the Mangrove vegetation of Sundarbans. This fascinating area which the state is retaining at present is only about one-tenth of the gorgeous forest occupying the estuarine creeks and islands of the world's largest delta of erstwhile Bengal. Some of the most ideal conditions have rendered this forest a congenial habitat for harnessing the world fame Royal Bengal Tiger in the forest and a Tiger Reserve has been declared by the Govt. for protecting this race in the Sajnakhali Block of the Sundarbans.

The flora of this wonderful forest was prepared by Heining (1896) who made thorough a collection of specimens of the mangrove to facilitate the task of publication of the

'*Flora of Sundarbans*' by David Prain (1930b). Apart from his rich gatherings Heining also studied about the vegetational cover and aspects of topography and ecological factors operative in this region. The vegetation of Sundarbans further divided into two categories:

**2.8.4.a. Swampy mangroves:** Swampy Mangrove are coastal wetlands flora in tropical and subtropical regions of Sundarbans. Where trees, shrubs and other plants growing in brackish to saline tidal waters, some common plants in these region *i.e.* *Aegialitis rotundifolia*, *Aegiceras corniculatum*, *Amoora cucullata*, *Phoenix paludosa*, *Nypa fruticans*, *Heritiera fomes*, *Kandelia candel*, *Rhizophora apiculata*, *R. mucronata*, etc.

**2.8.4.b. Tidal mangrove:** The changing level of water regulates helophytic mangrove forest of Sundarbans and the biological diversity, lifeline for the whole tidal eco–system some common palnts like *Acanthus ilicifolius*, *A.volubilis*, *Caesalpinia crista*, *Clerodendrum inerme*, *Dalbergia spinosa*, *Derris scandens*, *Tamarix dioica* etc. mainly found in tidal regions of mangrove region.