

# Climatic Variations of North Bengal in India: A Regional Analysis

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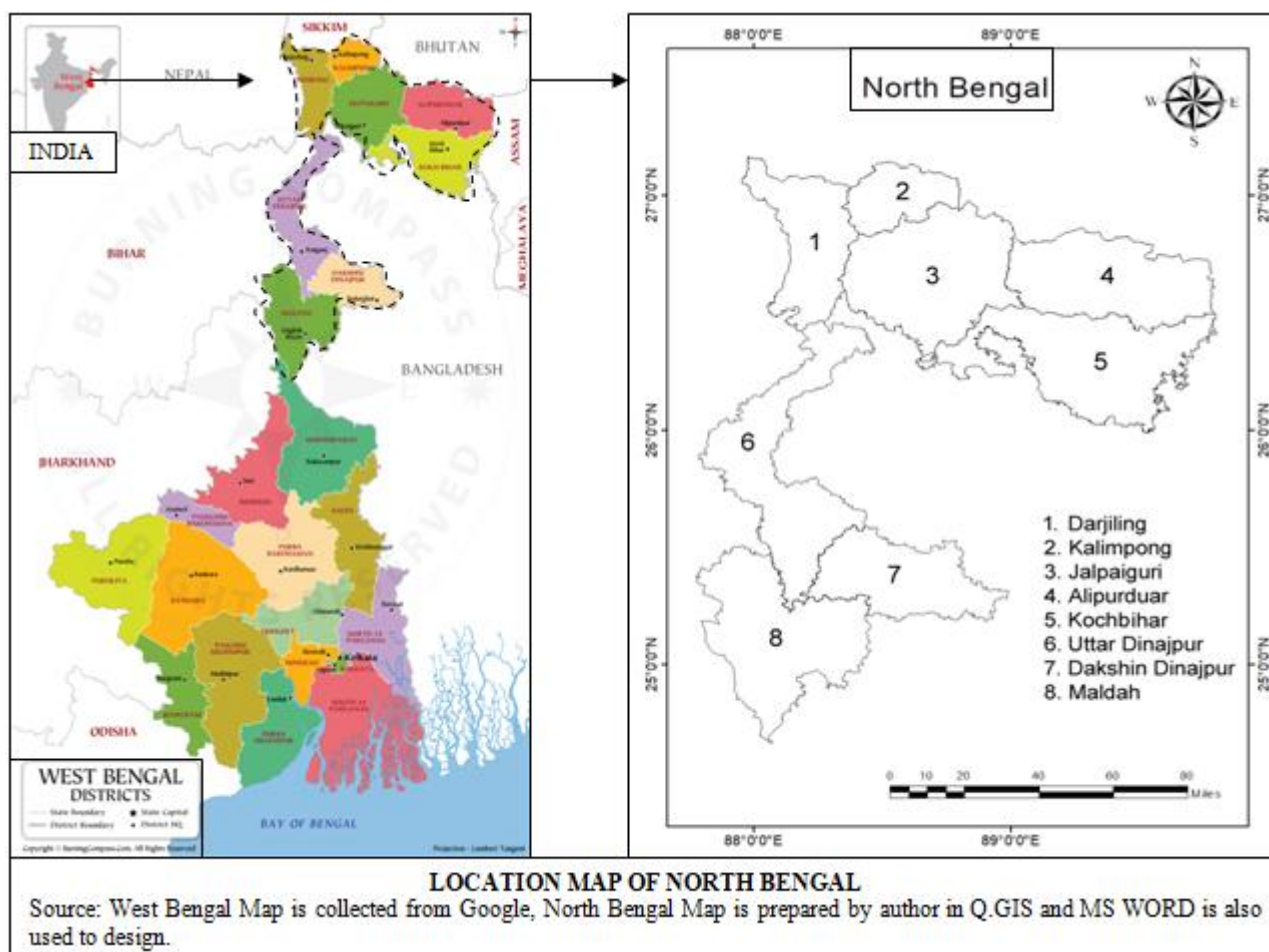
**Abstract:** Physiographically, North Bengal is a diverse region and a complex area. Climatic variations are particularly noticeable with the diversified physiographic of North Bengal. Climate is defined as the average weather pattern of a particular place. Here we will discuss about the two most effective climatic factors such as temperature and rainfall to analyse the regional and seasonal climatic variations of the study area. Plain areas are characterized by tropical monsoon but the mountainous areas are characterized by tropical temperate climate. Basically in tropical climate, summer is warm & wet and winter is dry and cool, but the climate of the mountainous region is tropical in type but temperate in nature, because the climate of these regions is very mild and pleasant. Occasional snowfalls are also occurred on the hilly areas.

**Keywords:** Physiographic Divisions, Regional Analysis, Seasonal Variations.

## 1. Introduction

North Bengal refers the northern part of West Bengal in India. It consists of eight districts i.e., Coochbehar, Jalpaiguri, Alipurduar, Kalimpong, Darjeeling, North

Dinajpur, South Dinajpur and Malda in West Bengal. North Bengal has a much diversified physiographic divisions and as a result, climatic nature changes when the physiographic divisions changes.



Because parts of few districts are under mountainous region, part of some districts is under Dooars region, and rest is under plains regions. The climate of the study area is characterized by hot, humid and heavy rainfall although in

the northern hilly areas a cool climate prevails. To analyze this diversification of climatic trend over the region based on rainfall and temperature the present topic has been selected.

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### Location of the Study Area

North Bengal extends approximately from 24° 45' N to 27° 20' N and from 87° 45' E to 89°50' E. The total area of the region is about 21859 sq. km (26322 sq. km). Geographically, the region is located in the Teesta-Torsha-Mahananda basin in between Darjeeling and the Himalayas in the north and the Gangetic plains in the south.

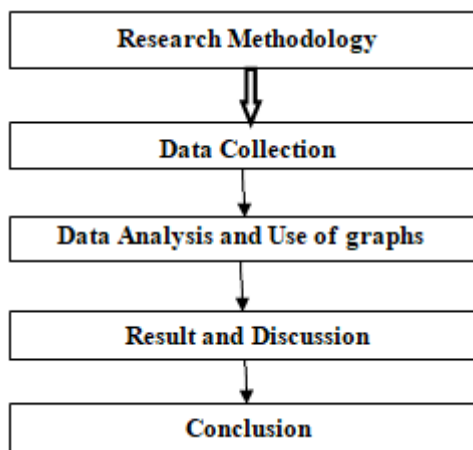
North Bengal is bounded on the north by Sikkim and Bhutan; on the east by Assam and the Rangpur and Rahsahi divisions of Bangladesh; on the south by the Presidency division of West Bengal; and on the west by Bihar and Nepal. The Ganges separates North Bengal from South Bengal.

**Objectives:** These objectives have been taken for describing the present topic-

- 1) To find out the regional climatic variability, geographical divisions and district wise climate has been described;
- 2) To explore the climatic condition of North Bengal, seasonal variability high lightened.

## 2. Methodology

The study is based on secondary sources, such as research paper, journal, internet access, Wikipedia, different books, and many reports etc. The location map has been prepared in Q.GIS software, Microsoft Excel and Word is also used for preparing Graphs. The whole methodology is represented by the following chart-



## 3. Result and Discussion

### 3.1 Climatic Variations in North Bengal - A. Physiographic divisions:

**a) The Darjeeling Himalaya Mountainous region** is located on the north-eastern border of West Bengal, above the eastern Himalayan mountain range. With the exception of Siliguri subdivision, the entire Darjeeling district belongs to the hilly region, has suddenly risen steeply from the Terai plain. The mountainous region in the north is cold on account of its altitude but their humidity is high. The Himalayan Mountain extends along the northern boundary of the State and occupies almost 70% of the total area of

Darjeeling and a little less than 10% of Jalpaiguri district. The mountain range affects the pattern of air circulation to a considerable extent by preventing the severe cold air from the north to penetrate southwards into the areas of West Bengal. Thus, the Himalayas act as a major climatic barrier between very severe climatic environment of the north and the tropical humid environment of the south of the range. It is also the cause of formation of a large number of local winds; the upper-air flow pattern is also affected to a considerable degree.

**b) The Terai-Duars regions** is formed in the lowlands of the foothills of the Himalaya by the accumulation of silt, sand and gravel, such as the river Mahananda, Jaldhaka, Torsa, Raydak etc., flowing from the hilly lands of the eastern Himalaya.

Based on the Koppen-Geiger climate classification system, the Nepal Terai experiences a tropical savanna climate type with dry winters and hot summers, a mean annual temperature of 20-28°C, a mean annual rainfall of 2500-3000 mm in the east. The Terai-Duars region politically constitutes the plains of Darjeeling district, whole of Jalpaiguri and Alipurduar district and upper region of Cooch Behar district in West Bengal. The Teesta has divided the area into two parts- the western part is known as the Terai whereas the eastern part is known as the Dooars or Duars. The Dooars regions can be further subdivided into the Siliguri or Western Dooars, the middle or Jalpaiguri Dooars and the eastern or Alipur Dooars. The average rainfall of the duars region is about 3500 mm. monsoon generally starts from the middle of May and continues till the end of September. Winters are cold with foggy mornings and nights. Summer is mild and constitutes a very short period of the year.

**c) North Bengal plain** starts from the south of the Terai region and continues up to the left bank of the Ganges. The southern parts of the district Jalpaiguri, North Dinajpur baring some extreme northern regions, south Dinajpur, Malda, Alipurduar and southern part of Koch Behar districts constitute this geographical region.

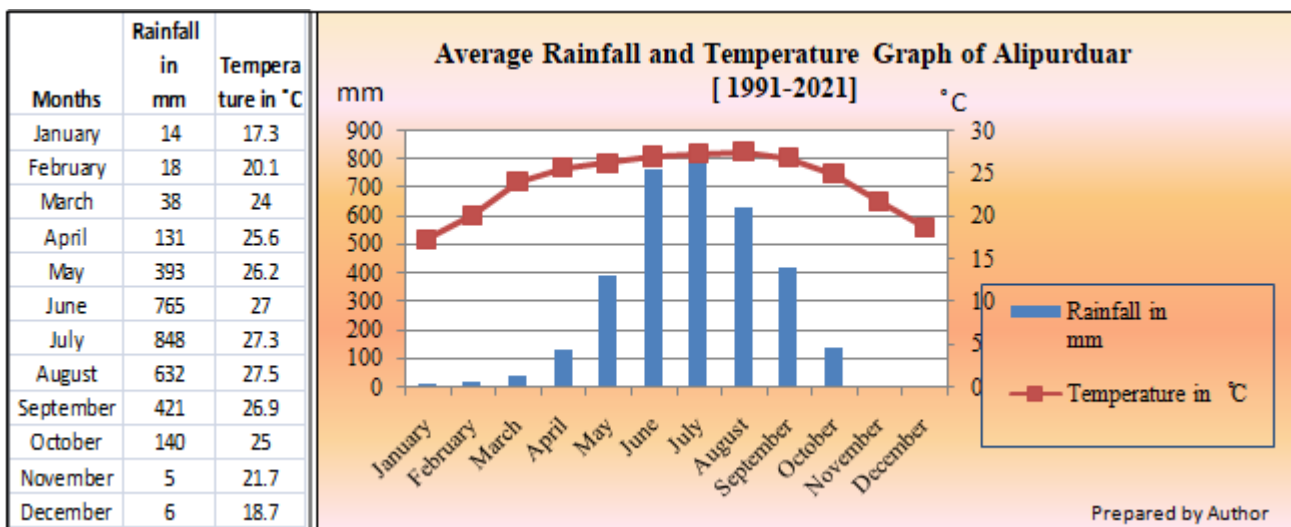
The plain is mostly rainy and climatic variation is less but has a sharp contrast with the mountainous areas. The amount of rainfall and humidity decreases southwards, as one move from the north towards south. Due to heavy rainfall and high humidity and flat character of the terrain greater amount of water is available for downward percolation. Due to a sharp break in slope, the torrential mountain rivers coming down the hills become flat creating very broad fiat courses and marshy lands forming enormous source of atmospheric moisture which is an additional source of moisture during, the local thunderstorms over this region especially during hot weather months. Annual average rainfall is 250 to 350 cm and climate are humid and moist compare to south of West Bengal.

### 3.2 Climatic Variations in North Bengal - B. District wise regional analysis:

**a) Alipurduar District:** Geographically the district lies in between 26.4°N to 26.83°N and 89°E to 89.9°E. The climate

of Alipurduar is swampy with heavy rainfall lasting from May to September. Heat is moderated but humidity is high. The winter is very strong as it is comparatively in the high

latitude located at the foothills of the “duars”. The town is surrounded by deep forest and tea garden.

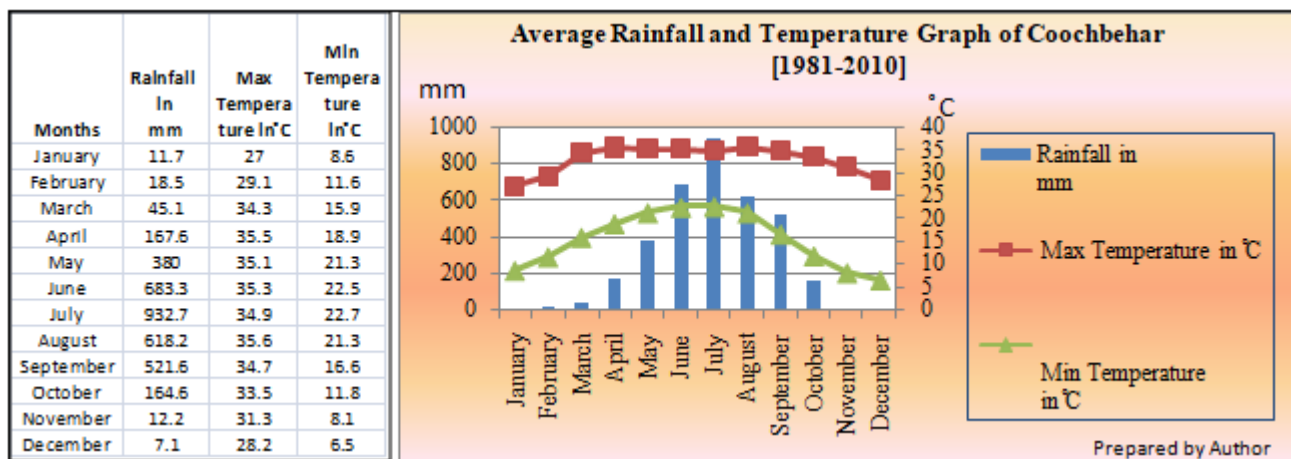


[Data link: [https://en.climate-data.org/asia/india/west-bengal/alipur-duar-47546/#google\\_vignette](https://en.climate-data.org/asia/india/west-bengal/alipur-duar-47546/#google_vignette)]

Rainfall in Alipurduar district has broken all records in the past 25 years in 2020. The average yearly rainfall i.e., 3300mm has already crossed in 2020.

**b) Coochbehar District:** Cooch Behar lies between 25°57'47"N to 26°36'2" N and between 89°54'35"E to 88°47'44"E. Five distinct seasons (summer, monsoons, autumn, winter and spring) can be observed in Koch Behar, of which summer, monsoons and winter are more prominent. Koch Behar has a moderate climate characterised by heavy rainfall during the monsoons and slight rainfall from October to mid-November. The district does not have

high temperatures at any time of the year. The summer season is from April, the hottest month, to May. The winter season lasts from the end of November to February; January is the coldest. The atmosphere is highly humid except from February to March, when relative humidity is around 60 percent. The rainy season lasts from June to September. Average annual rainfall in the district is 3,248 mm (127.9 in).



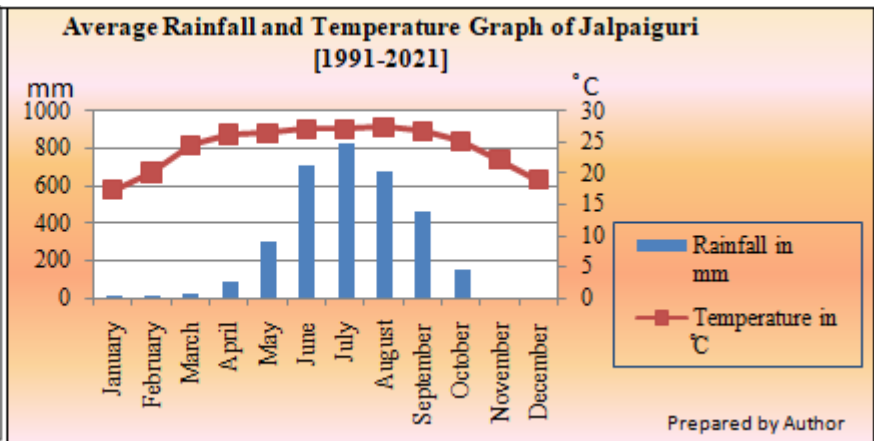
[Data Source: India Meteorological Department.]

The highest temperature in Cooch Behar was 41.0 °C, recorded on 11 September 1977; the lowest temperature recorded was 3.3 °C, reported on 31 January 1964. The heaviest monthly rainfall was 1871.6 mm, recorded on July, 1985.

**c) Jalpaiguri District:** Jalpaiguri district is situated between 26° 16'N and 27° 0'N and 88° 4'E and 89° 53'E. Jalpaiguri is part of monsoon climate zone of South-Eastern Asia. May is the hottest month of this region with average maximum

temperature of about 32 °C whereas January is coldest with 11 °C. The average annual humidity in the district is of 82%. The annual average

Months	Rainfall in mm	Temperature in °C
January	11	17.4
February	13	20.1
March	30	24.5
April	92	26.3
May	306	26.5
June	712	27
July	826	27.2
August	681	27.4
September	466	26.8
October	152	25.1
November	6	22.2
December	4	19



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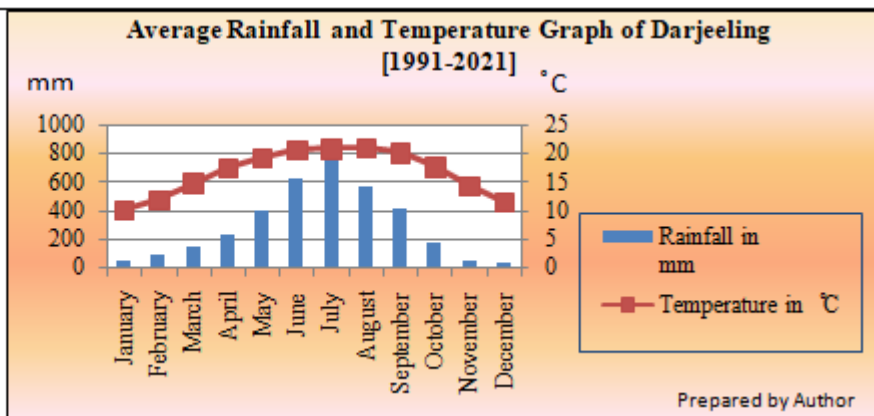
rainfall is 3160 mm. December is the driest month with average rainfall 0.2 mm and July is wettest with 809.3 mm. Number of rainy days are 0 to 1 during November to February and 24 days during July. Thunderstorms are common weather phenomenon during May.

The highest temperature in Jalpaiguri was 40.9 °C, recorded on 21 July 1986; the lowest temperature recorded was 2.2 °C, reported on 3 February 1905. The heaviest monthly rainfall was 1546.2 mm, recorded on July, 1996.

annual mean maximum temperature is 14.9 °C while the mean minimum temperature is 8.9 °C, with monthly mean temperatures ranging from 6 to 18 °C. The average annual precipitation is 3,092 mm (121.7 in), with an average of 126 days of rain in a year. The highest rainfall occurs in July (more than 790 mm) and minimum temperature fluctuate between 14-15°C.

**d) Darjeeling District:** Darjeeling has a temperate warm climate with wet summers caused by monsoon rains. The

Months	Rainfall in mm	Temperature in °C
January	39	10.2
February	79	12
March	144	14.9
April	227	17.6
May	389	19.3
June	622	20.8
July	854	20.9
August	560	21
September	410	20.2
October	172	17.7
November	39	14.4
December	23	11.5



[Data link: [https://en.climate-data.org/asia/india/west-bengal/darjeeling-33809/#google\\_vignette](https://en.climate-data.org/asia/india/west-bengal/darjeeling-33809/#google_vignette)]

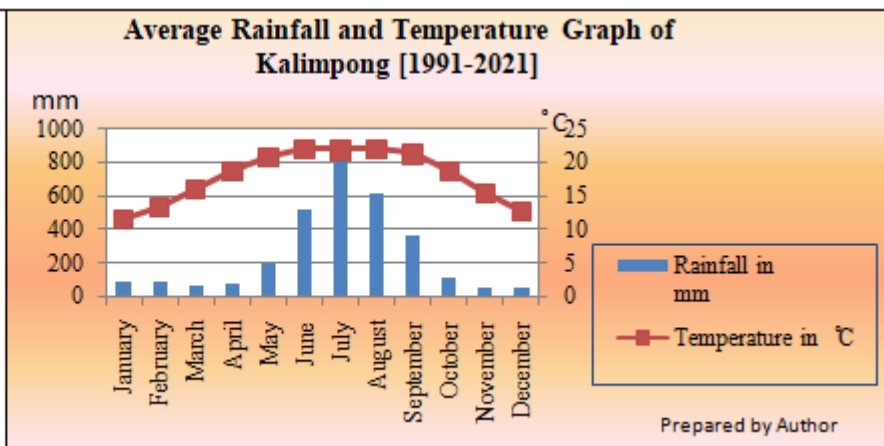
The highest temperature in Darjeeling was 28.5°C, recorded on 21 August 1970; the lowest temperature recorded was -7.2 °C, reported on 30 January 1971. The heaviest monthly rainfall was 1479.8 mm, recorded on July, 1890.

**e) Kalimpong District:** Situated at a height of 1250 metres and between 26°51'N to 27°12'N and 88°53' E. Kalimpong has a mild and temperate climate. Summers are mild. Temperatures in winter however between a high of 17°C and a low of 5°C. The annual temperature is 18°C and the average annual rainfall is 220 cm. Kalimpong has five

distinct seasons. Spring from March through April, summer in May and June, monsoon from mid-June to September, autumn in October and November and winter months stretch between December and February. The monsoons are severe and the typical rainy season is marked by heavy downpours and long, persistent drizzles.



Months	Rainfall in mm	Temperature in °C
January	80	11.5
February	81	13.2
March	60	15.9
April	74	18.8
May	187	20.8
June	519	22
July	861	21.9
August	617	22
September	360	21.3
October	114	18.8
November	47	15.5
December	53	12.7



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The highest temperature in Kalimpong was 35.0 °C, recorded on 23 May 2012; the lowest temperature recorded was -0.6 °C, reported on 27 December 1922. The heaviest monthly rainfall was 1209.2 mm, recorded on July, 1991.

Extreme Temperature and Rainfall			
Place	Highest Temperature Recorded (°C)	Lowest Temperature Recorded (°C)	Highest Recorded 24 hrs Rainfall (mm)
Coochbehar	11 September 1977/ 41.0	-	-
Malda	1 October 1978/ 40.5	-	-
Darjeeling	-	30 January 1971/ -7.2 2 February 1971/ -6.4 1 March 1971/ -4.8 16 April 1971/ 0.0 1 May 1981/ 1.4 26 July 1944/ 3.9 31 October 1972/ 3.2 26 November 1970/ -4.4 29 December 1970/ -4.6	10 January 1967/ 134.6
Jalpaiguri	-	5 February 1914/ 2.2 10 May 1987/ 11.5	-
Siliguri	-	4 March 1965/ 6.2 4 April 1965/ 9.6 30 November 1971/ 6.4 26 December 1961/ 2.4	-
Kalimpong	-	-	5 October 1968/ 419.2

Source: India Meteorological Department

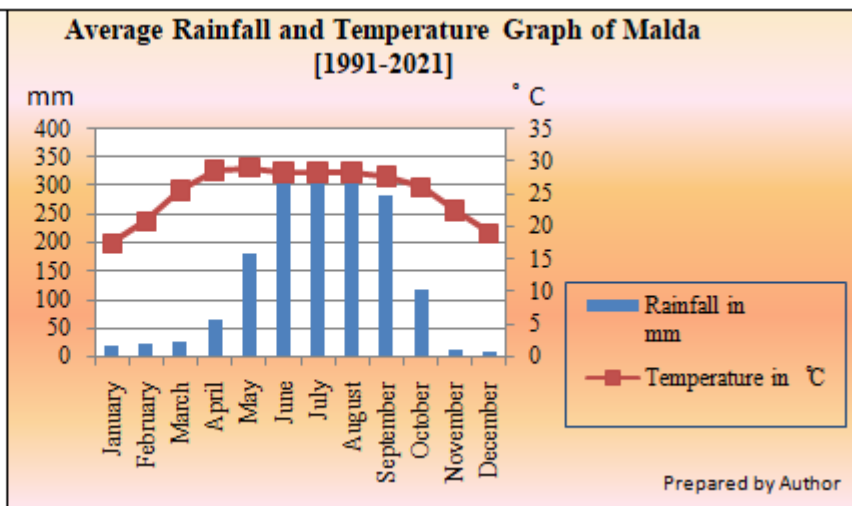
and longitude 87°49' E to 90°00' E . The climate of this district is characterised by hot-summer with high humidity, abundant rainfall and cold winter. The summer begins from April. Monsoon starts from June and lasts till September. December and January are the coldest months.

**g) South Dinajpur District:** Under the Köppen climate classification, Dinajpur has a tropical wet and dry climate with summer monsoon. The district has a distinct monsoonal season, with an annual average temperature of 25 °C (77 °F) and monthly means varying between 18 °C (64 °F) in January and 29 °C (84 °F) in August. Maximum rainfall occurs during the monsoon in July-August.

**h) Malda District:** The latitude range is 24°40'20" N to 25°32'08" N, and the longitude range is 87°45'50" E to 88°28'10" E. The climate is warm and temperate. The summers are much rainier than the winters. This location is classified as Cwa by Köppen and Geiger. In Malda, the average annual temperature is 25.4°C. Precipitation here is about 1349 mm (53.1inch) per year. The driest month is December. The greatest amount of precipitation occurs in July, with an average of 352 mm (13.9 in). The weather of Malda is usually extremely humid and tropical. Temperatures can reach as high as 42 °C during the day in May and June and fall as low as 8 °C overnight in December and January.

**f) North Dinajpur District:** Uttar Dinajpur district lies between latitude 25°11' N to 26°49' N

Months	Rainfall in mm	Temperature in °C
January	16	17.5
February	20	20.8
March	26	25.5
April	63	28.5
May	182	28.9
June	322	28.2
July	343	28.2
August	304	28.2
September	283	27.6
October	117	26
November	10	22.5
December	6	19



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Malda's highest recorded temperature was 45.0 °C (113.0 °F) on 27 May 1958 and lowest recorded temperature was 3.9 °C (39.0 °F) on 3 February 1905. The heaviest monthly rainfall was 1159.8 mm, recorded on September, 1995.

**3.3 Seasonal Climatic Variations in North Bengal:** The Meteorological Department of India, however, divides the seasons of India into the following four seasons:

during rainy season. The amount of rainfall in Jalpaiguri and Koch Behar district during this season is about 250 cm – 350 cm. Buxaduars of Alipurduars district is the highest rainfall region in West Bengal, 455 cm annual rainfall. Over 250 cm rainfall occurs in North Bengal in this season. Due to the uneven distribution of rainfall, occasional severe floods occur in the northern region. The rivers swelled as a result of several days of heavy rains in the narrow area. Due to the accumulation of silt in the river sector, the drainage system was damaged and the water flooded.

Average temperature and rainfall for some cities in summer (March to May)			
S. No.	City/Station	Average temperature in °C	Average Rainfall in mm
1	Darjeeling	13.1	446
2	Siliguri	24.2	447
3	Jalpaiguri	24.0	453
4	Malda	28.3	188
5	West Bengal	26.9	248.3

Source: "Climate of West Bengal", regional Meteorological Department Kolkata".

Average temperature and Rainfall for some cities in autumn (October and November)			
Sl No.	City/Station	Average temperature in °C	Average Rainfall in mm
1	Darjeeling	13.4	74
2	Siliguri	23.2	181
3	Jalpaiguri	23.6	169
4	Malda	26.2	132
5	West Bengal	24.3	160.4

Source: "Climate of West Bengal", regional Meteorological Department Kolkata".

**(1) Hot weather season, mid-March to May:** The mean temperature of West Bengal during summer season is 20°C-30°C. but some places have temperatures ranging from 38°C-45°C. The onset of cyclone Norwesters (Kalbaishakhi) from the north-west in mid-May has resulted in thunderstorms and reduced temperatures. However, in the Darjeeling Himalaya, the summer is pleasant because of the high altitude of the land and temperature drops to 14°C-17°C. The temperature in Jalpaiguri stays below 20°C due to the cool winds of the Himalaya.

**(3) Season of retreating monsoon, October to mid-December:** After September 15, the rainfall decreases and the monsoon winds begin to recede. Rainfall and temperature both decrease during these two months from October to November. The nights feel a little chilly and the morning dew falls. The time is therefore very comfortable. However, the low-pressure belt in the Bay of Bengal and the onset of cyclones or Ashwin storms sometimes cause nuisance. That storm is more harmful than the Norwesters storm. At the end of this season, the air gradually becomes frosty.

Average temperature and Rainfall for some cities in monsoons (June to September)			
Sl No.	City/Station	Average temperature in °C	Average Rainfall in mm
1	Darjeeling	16.4	2796
2	Siliguri	28.1	2651
3	Jalpaiguri	28.0	2674
4	Malda	29.6	1207
5	West Bengal	28.1	1649.0

Source: "Climate of West Bengal", regional Meteorological Department Kolkata".

Average temperature and Rainfall for some cities in winter (December to February)			
S. No.	City/Station	Average temperature in °C	Average Rainfall in mm
1	Darjeeling	7.6	30
2	Siliguri	17.3	60
3	Jalpaiguri	18.9	36
4	Malda	20.6	27
5	West Bengal	17.0	38.5

**(2) Rainy season, June to September:** From this time onwards, moist southwest monsoon began to blow from the Bay of Bengal in West Bengal. The monsoon rains all over the state started within June 15. The mean annual rainfall of West Bengal is 175 cm, but about 125 cm rainfall occurs

Source: "Climate of West Bengal", regional Meteorological Department Kolkata".

**(4) Winter season, mid-December to mid-March:** With the exception of the hilly region of Darjeeling in the north, the average winter temperature in other parts of West Bengal is 13° to 19°C. The highest are in the hills of Darjeeling, ranging from 0° to 5°C. occasionally there is occasional snowfall in Darjeeling during this time. There is usually no rain in winter, but westerly winds and light rainfall occur due to western disturbances.

#### 4. Conclusion

The climate of Jalpaiguri district is characterized by hot and humid condition but extreme diversities in rainfall and temperature pattern between its northern and southern parts. Alipurduar district experiences subtropical climate. It means hot summer prevails from March to May; rainy seasons from June to October and winter is from November to February. Coochbehar district is defined by high humidity level and abundant rainfall. Coochbehar district is characterized by tropical monsoon climate. Kalimpong is known for its pleasant climate throughout the year. Summer is mild and pleasant, Monsoon season brings heavy rainfall, autumn is characterized by clear skies, and winter season is chilly. In Darjeeling district, summers are moderate, Monsoon brings heavy torrential rains which might cause landslides, and winter is much colder compared to plains. Seasonal rainfall and average temperature is high in Malda, South and North Dinajpur. Mountainous region is more temperate than tropical type. Occasional snowfall occurs on the hilly regions. The climate of North Bengal is characterized by tropical humid climate where, summer is warm and humid, but mild in nature than south Bengal.

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