



**Forests,
Forestry
and
Wildlife in
North-East
India**

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S. NEGI

Forests, Forestry and Wildlife in North-East India

S.S. NEGI



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Preface

The north-east region of India comprises of Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, Mizoram, Tripura and Sikkim. It has rich biodiversity in terms of animal and plant species, which are influenced by diversity of the Tibetan plateau, eastern Himalaya, Myanmar, Indo-Malaya region, Bengal and other parts of the Indian sub-continent. The management of forests and wildlife of this region is a complex process, involving a high degree of knowledge and skills.

This book deals with the forests, forestry and wildlife of north-east India, covering chapters on of Regional Setting of North-east India; Forest Types; Forest Utilization; Bamboos and Canes; Important Trees; Forest Management and Administration; Grasslands and their Management; Shifting Cultivation; Wild Animals; National Parks and Sanctuaries; and Biosphere Reserves. The book is based on a vast quantum of published and unpublished literature and would be useful for foresters, wildlifers, environmentalists, scientists and even the laymen.

The author is thankful to his friends and colleagues for their good wishes, to his family for their self-denial and to the publishers for bringing out this volume in a short time.

S.S. NEGI

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1

Regional Setting of North-East India

North-east India comprises of the states of Sikkim, Arunachal Pradesh, Assam, Meghalaya, Manipur, Tripura, Mizoram and Nagaland. They have a distinct identity from the rest of India, in terms of physiography, vegetation, fauna, ecology, anthropology and culture. A brief state-wise description of north-east India is given in this chapter.

SIKKIM

The state of Sikkim is one of the smallest states of India and is bounded by Nepal in the west, Bhutan in the east, Tibet in the north, while in the south it has borders with West Bengal or the Darjeeling hills. It has a geographical area of 7906 sq. km. Many experts have opined that the word Sikkim means "new place".

Physiography

Sikkim is an entirely mountainous state forming a part of the eastern Himalaya. It consists of the lower hills bordering the Brahmaputra plains, and further in the north are the middle hills and the main Himalayan range.

The main or great Himalayan range lies in the northern part of the state and comprises of very high mountain peaks under a

perpetual cover of snow. It is also made up of alpine meadows and glaciers with the most prominent one being the Zemu glacier. In this tract the population density is very sparse and often the high altitude pastures are visited only by migratory grazier communities in the summer season.

The main or great Himalayan range of Sikkim is dominated by Kanchunjunga peak (8598 mts) which is the third highest peak in the world. Other important peaks of Sikkim Himalaya are Kinchijahan (6900 mts), Siniolchu (6815 mts) and Chomiome (6800 mts).

The Singalila range runs south from the Kanchunjunga massif and lies between Nepal and Sikkim. This range is covered with snow-bound peaks with the main Singalila peak lying at the tri-junction of Nepal, Sikkim and north Bengal or the Darjeeling hills and is an offshoot of the main or great Himalayan range that stretches across northern Sikkim. The Singalila range forms the border of the state with Nepal.

In the east lies the Dongkya range whose elevation is more than 5000 mts and forms the border of the state with Bhutan. In the north this range merges with the main or great Himalayan range.

The lower hills of Sikkim occur in the southern part of the state and extend from the foothills to the mid-hills. These are an extension of the Shiwalik hills of the central and western Himalaya and they have a less distinct identity than their western counterparts. Many important hill stations including the state capital Gangtok are located in the lower hills.

Drainage

The Teesta river and its tributaries form the drainage system of Sikkim. All major rivers of this state rise in the snow-clad main Himalayan range and flow southwards to join the main stream of the Teesta river. This river rises at the snout of the famous Zemu glacier and flows southwards to be joined by many rivers and streams before it flows into the foothills. The Teesta river is a part of the Ganga river system and its waters finally drain into the Bay of Bengal through the Sunderbans delta.

The main tributaries of the Teesta river are:

1. The Lhonk river which rises from Pauhunri and meets the Teesta at Chunthang.
2. The Lachung river which rises near the Green lake.
3. The Rangit river which is a major tributary of the Teesta river and joins the latter in the Peshok area near Kalimpong.
4. The Rangpo river.
5. The Rongni Chu river.

The river Teesta and its tributaries flow through high mountains and deep gorges, and many small settlements have developed along their course. It is in spate in the monsoon season and floods the foothills and plains.

Climate

Sikkim experiences a variety of climatic conditions varying from sub-tropical in the lower hills and the valleys of the higher Himalaya to arctic in the alpine pastures and tracts above the snowline on the main or central Himalaya wall. Sub-tropical conditions prevail at lower elevations, while as the elevation increases, temperate conditions occur and in the tracts above the snowline, arctic conditions are experienced.

The most significant impact on the climatic conditions of the state is made by the south-west monsoon winds whose Bay of Bēngal branch causes heavy and widespread rain in most parts of the state for about four months from late May onwards. The total annual precipitation in the state is more than 3500 mm, bulk of which is received in the monsoon season. The amount of rainfall depends on altitude and aspect and at higher elevations, precipitation is both in the form of rain and snow.

The winter season is long and cold, particularly in the higher altitude areas, which receive heavy snowfall and the ground may be covered under a thick blanket of snow for many weeks at a stretch. During the cold season, the mercury may drop down to below freezing point in areas above an elevation of about 2000 mts and this causes very cold and harsh conditions. Snow is common in tracts above 2000 mts and heavy and frequent snow is received

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in the higher reaches. The area above the snowline is under a permanent cover of snow.

The arrival of the spring season in March brings with it sunshine and optimum growing conditions for plants and animals. The spring season has a short duration and summer sets in quickly. The mean maximum summer temperature depends on the altitude and aspect and may be about 35°C in the lower hills to 25°C in the higher hills.

ARUNACHAL PRADESH

The state of Arunachal Pradesh lies to the east of Bhutan and borders the Brahmaputra valley. It has an area of about 83,743 sq. km and was a remote and largely inaccessible area till the Chinese invasion of 1962 after which development has taken place. A large part of the state lies in the eastern Himalaya, while the rest forms part of the offshoot ranges comprising of the hills of north-east India, which merge with the Arakan Yoma mountain system of Myanmar.

The border of this state with Assam runs in an irregular crescent shape extending along the northern part of the Brahmaputra valley and then southwards along the southern part of the valley to the base of the Patkai hills in the south-east. It also shares its border with Nagaland, Tibet and Myanmar. The main or higher Himalayan mountain wall occurs along the border of Arunachal Pradesh with Tibet.

Physiography

The state is comprised of three major physiographic regions viz., the main or great Himalayan range, the central mountains, and the lower hills. The hills and mountains rise in elevation towards north in a series in ascending order and merge with the main Himalayan mountain wall. The general orientation of these ranges is parallel or diagonal with each other.

Snow-bound peaks that rise from the great or main Himalayan mountain wall that form the boundary between the state and Tibet

form the northern part of the state. The western part of this mountain wall is formed by Kangto (7089 mts) group of peaks and there are many other snowy massifs on this range. It extends till the Namche Barwa peak (7765 mts) which also forms the eastern limit of the Himalayan range. The high mountains are steep and house many snowfields and glaciers. The Brahmaputra river flows at the base of this peak while entering India. The main Himalayan mountain wall has a profound impact on the physiography and drainage system of the state.

The central part of Arunachal Pradesh is rugged and is formed by many prominent ridges, V-shaped valleys and forested hills. These have been cut across by numerous river systems, forming deep valleys, and terraces. Slopes are steep and may have been broken into terraces for cultivation. The central mountains are the widest amongst the three major physiographic regions of Arunachal Pradesh.

Between the central mountains and the Brahmaputra plains lie the lower hills of Arunachal Pradesh, which form an extension of the north-eastern hills. They comprise of low hills rising above the Brahmaputra plains and merge with them in the foothills. Many settlements occur in the lower hills of the state.

The Mishmi hills of Arunachal Pradesh have a distinct physiographic identity. The lower ranges extend from the foothills and the plains and gradually merge with the higher ranges. These hills are considered to be unstable as these are affected by landslides.

The Patkai hills of the Lohit and Tirap regions form the border with Myanmar. These lie to the south of the Brahmaputra river and are not considered to be a part of the eastern Himalaya.

Drainage

Arunachal Pradesh is drained by a complex system of rivers, most of which rise in the snows of the main Himalayan mountain wall and drain, either directly or indirectly, into the Brahmaputra river. The main river systems draining the state have been described in brief below:

1. The Kameng river system drains a part of Arunachal Pradesh,

- with its main tributaries being the Bichom and Tenga rivers. The Tenga river valley flows to meet the main Kameng valley.
2. The Subansiri river system drains a large part of the state with its main tributaries being the Yuma Chu and the Chaval Chu. The watershed between Subansiri river and the main channel of the Brahmaputra river is formed by the Abhor hills.
 3. The Lohit river system drains the eastern part of the state. It rises in Tibet and flows through the Mishmi hills before its waters flow into the main channel of the Brahmaputra river. Its main tributaries are the Digaru river from the western flank and the Kameng river from the eastern flank.
 4. The Tawang river system drains the north-western part of the state. It is a tributary of the Manas river flowing from Bhutan.
 5. The Siang river is the main river of the Adi region of the state. The main channel of this river flows through deep gorges in the upper reaches and enters the plains near Pasighat. The waters of the Siang and Dibang river join that of the Lohit river near Sadiya, and downstream of this junction, the river is known as the Brahmaputra.
 6. The Dibang river joins the Siang river near Nizamghat and its important tributaries are the Yangsang Chu and Yamne rivers.

Most of the rivers of Arunachal Pradesh have large flows and are in spate in the monsoon season, when a large volume of water flows down their channels.

Climate

There is a wide variation in the climatic conditions experienced in Arunachal Pradesh and this depends greatly on the latitude, elevation and aspect. In the lower hills and along the foothills, the climate is sub-tropical, while the climatic conditions change with elevation and become temperate, sub-arctic and finally arctic above the snowline. Warm conditions are experienced in the valleys of the temperate zone also.

Like other states of north-east India, Arunachal Pradesh too experiences very heavy and widespread rainfall from the south-west monsoons from early June till the end of September. The total annual precipitation across the state is more than 250 cm, with snowfall accounting for a part of it in the upper tracts. The wettest months are June and July and the humidity varies from 75 to 90% in this season. The north-east monsoons also cause rainfall in Arunachal Pradesh. Most rivers of Arunachal Pradesh remain in spate during the rainy season.

The rainy season is followed by a short autumn when the weather is largely dry and sunny. Winter sets in earlier in the higher reaches while the lower tracts continue to experience pleasant weather till the early part of the winter season. It becomes extremely cold in the areas near or above the snowline and the ground remains under a thick blanket of snow. The mercury drops down to below the freezing point in winter in tracts lying above an elevation of about 2000 mts. In the upper reaches the minimum temperature could be 4 or 5°C below the freezing point. However, winters may not be extremely cold in the lower hills of the state.

A brief spring season is experienced after the middle of March and then the summer season sets in. Summers are hot in the lower tracts and the average maximum temperature may be more than 35°C, while in the higher reaches this is about 19°C. Summers are largely dry and hot in the lower hills and foothills of the state.

MIZORAM

The state of Mizoram is located on the eastern-most part of India, with its boundaries touching those with Assam, Manipur, Myanmar, Tripura and Bangladesh. It has a total geographical area of 1014 sq. km.

Physiography

Most of the state is comprised of hills and mountains, being a

transition between the hill ranges of north-east India and the mountains of Myanmar. They radiate in multiple directions and have sharper crests and tops. Their slope towards west and north-west is gentler and gradually merge in the west and north with the plains. Some of the hills of this state merge with the Chittagong hill tract of Bangladesh and the hills of Tripura. Thus, the physiography of Mizoram is complex and contains elements of the north-east hills, the offshoots of the mountains of Myanmar and those of the Chittagong hill tract of Bangladesh. Amongst the highest peaks in the state is Phawangpui or Blue mountain, that has an elevation of more than 2300 mts and there are no snow covered peaks in the state as it does not lie in the eastern Himalaya, unlike Sikkim and Arunachal Pradesh.

In the north-eastern part, the hills grade into an irregular plateau, which opens into the Manipur valley. Most ranges in Mizoram are a part of those of the adjoining states or countries. Foothills and plains have a limited extent and support a relatively denser population. Heavy rainfall and mountainous terrain causes severe erosion of soil and landslides in the monsoon season.

Drainage

Due to the relatively small geographical area of the state, there are no major rivers. The following rivers form the drainage of Mizoram:

1. The Tlawng river drains a considerable portion of Mizoram and drains into the Barak river of Assam. Its important tributaries are the Turial and Tuivawl rivers in the north. The Tlawng river is known as the Dhaleswari river in the Hailakandi plains. It flows through the mountains and deep valleys before joining the Barak river in the plains.
2. The Chhimtupui river enters Mizoram through Myanmar, drains a part of the state and then flows back into Myanmar.
3. The Karnaphuli river drains a part of Mizoram and then flows into the Chittagong hill tract of Bangladesh, before draining into the Bay of Bengal. Its tributaries are the Tuipui and the Tuichang rivers.

Climate

The climatic conditions experienced in Mizoram range from sub-tropical to temperate. The variation in climatic conditions is not as varied as in the eastern Himalayan states of Sikkim and Arunachal Pradesh. Even though the mountains are not as high as in the eastern Himalaya, they have a profound impact on the climatic conditions of Mizoram. The general climate is hotter in the areas bordering Assam, Bangladesh and Tripura.

Heavy and widespread rainfall is received from the south-west monsoons from June to September. The total annual precipitation is more than 220 cm, with places like Aizwal receiving about 200 cm of rainfall while Sunglei receives about 350 cm of rainfall and is considered to be rainiest place in the state.

Winters are fairly cold in Mizoram, though no snowfall is experienced in any part of the state. The temperature drops down to about 3°C in the mountains in winter, while in the foothills, the conditions remain warmer. It becomes very cold in the higher areas in winter and some precipitation is also experienced in this season.

The summer season is fairly hot in many parts of the state, though in the higher parts of the mountains the summer season is pleasant. The maximum temperature in summer in most parts of the state is not more than 30°C.

NAGALAND

Nagaland is another small state of north-east India having a geographical area of 16,579 sq. km. It is bounded by Assam in the west, Arunachal Pradesh in the north, Myanmar in the east and Manipur in the south.

Physiography

Nagaland is dominated by the Naga hills that are considered to be an offshoot of the Himalayan mountain range. They have rock formations belonging to the Tertiary age and comprise mainly of loose sandstones, clay, carbonaceous shales, coal seams and slates.

The general elevation of Nagaland ranges from 914 mts to 3840 mts. The Brail or Radhura mountain range enters Nagaland from Assam and passes through Kohima area. An offshoot of the Arakan Yoma mountain range of Myanmar joins the Brail range at Japava, which is the highest peak of the area. Thereafter, the main range extends in a northern and north-easterly direction. A prominent valley is formed between the Brail range and the Samaguling hills. Further east lie the Kohima and Naga hills of the state. The Patkai range forms a watershed that marks the border of the state.

The Brail and Patkai hills are connected by a number of smaller ranges. One such connecting range is in Kohima and Ukhrul area and its direction is from SE to NW till Mao beyond which it takes an easterly direction and then turns towards south. Most of the smaller ranges linking the major ranges are in a zig-zag manner and have an irregular alignment. A few mountain peaks like the Japfu may receive snow during the winter season. Landslides affect the mountains of Nagaland, particularly in the monsoon season.

Drainage

Many rivers, with the major ones originating in the central ones and flowing either southwards or northwards drain Nagaland. Important rivers of this tract are:

1. The Doyang river rises from near Mao and flows towards north before entering the Brahmaputra valley. It is amongst the largest rivers of the state.
2. The Dhansiri or Temaki originates in the south-western part of Kohima district, flows in a westerly direction, thereafter towards north and then flows into the Brahmaputra river.
3. The Duidiki or Diphu river rises from near Paona peak, flows in a northerly direction before entering the plains. Its main tributary is the river Khuki.
4. Amongst the main south-flowing rivers of Nagaland is the Tizu river, which drains into the Chindwin river basin of Myanmar.
5. Other south-flowing rivers of Nagaland are the Tuilang, Manglu, Tahaki and Teipuki.

Since the rivers of the state are rainfed, their discharge is less in winter, while they remain in spate during the rainy season.

Climate

The climatic conditions prevailing in Nagaland are tropical monsoon type. Some of the upper reaches may experience sub-tropical and temperate climatic conditions.

Like other parts of India, the most important season in the state is the rainy season extending from mid-June to mid-October with the south-west monsoons, then the north-east monsoons causing heavy and widespread rains in all parts of the state. The weather remains overcast for most of the time, with occasional clear days. Most of the total annual rainfall is received during this season. The average total annual rainfall is more than 250 cm. July and August are the rainiest months in Nagaland. Rainfall becomes less in October.

The winter season begins in late November and continues till early March. The minimum temperature is around 4°C in the mountains, while in the lower tracts, it is about 10°C. The months of November and December are dry. The coldest month is January and there occurs fog and mist during this season. The tracts lying above an elevation of 2000 mts become very cold in the winter months. Light snowfall may be experienced on the mountain peaks of the state.

The hot season begins in late March and extends till the arrival of the rainy season in June. The maximum temperature in summer may be around 40°C in the lower tracts while in the mountains it is cooler and pleasant. The pre-monsoon showers occur in late April and may be experienced with breaks merging with the rainy season. In late summer, the relative humidity is from 60 to 78 percent.

MEGHALAYA

Meghalaya, the abode of clouds, is situated in the mid-western part of north-east India and is bounded by Bangladesh and Assam.

It has an area of 22,500 sq. km, and is inhabited mainly by the Khasi and Garo tribes.

Physiography

Meghalaya comprises mainly of rolling hills that rise above the Brahmaputra plains. In the north, the hills merge with the Brahmaputra plains while in the south they merge with the hills of Bangladesh.

The Garo hills are amongst the most important ranges of the state. Within these mountains, the Tura range is located in the central part extending from west to east. It contains the highest peaks of the Garo range viz, Nokrek (1412 mts), Megongiri (1283 mts) and Meiminram (1196 mts). Other ranges of the Garo hills are the Someswari and Arbella ranges, which intersect each other.

The Khasi and Jaintia hills are the other important hills of the state, extending in an east-west alignment. They form a number of flat-topped plateaus. Many spurs radiate in different directions from these tablelands.

The Shillong plateau is the highest tableland of the state and along with the Nokrek peak, form the water-divide between the north and south flowing rivers of the state. Lower river basins and valleys surround the Shillong peak.

Drainage

The drainage system of Meghalaya comprises of rivers that flow towards north into Assam and south into Bangladesh, with the Shillong plateau forming the main water-divide. The devastating earthquake of 1897, which had its epicenter in the Khasi hills had a significant impact on the drainage of the region, altering the course of many rivers. All rivers of Meghalaya are rainfed and remain in spate during the rainy season.

The main rivers of the state are:

1. The Damring river rises to the south of the Tura range, flows northwards and enters the Brahmaputra valley. Its main tributary is the Dudhnai river that runs along a parallel

course form a considerable length before merging with the former in the foothills.

2. The Bugi river rises from the Tura range and flows towards south before leaving the state.
3. Another important river is the Simsang whose tributaries are the Rompa, Chima and the Rongdik.
4. The rivers rising from the Shillong plateau include the Wah Shella and the Umngot that flow southwards and enter Bangladesh.
5. The river Kynshi drains the western part of the state and flows into Bangladesh. Its main tributaries are the Umblei and the Rilang rivers.

Climate

The climatic conditions of Meghalaya are influenced by elevation. These vary from sub-tropical to semi-temperate. There occur three distinct seasons, with the rainy season, extending from May to October, being the most significant.

The Bay of Bengal branch of the south-west monsoons reach Meghalaya and cause heavy and widespread rains in all parts of the state. In fact, Cherapunji, the rainiest place in India, is located in this state. The average annual rainfall at Cherapunji and Mawsynram is more than 10,000 mm. Other places also receive very heavy rainfall as the Garo, Khasi and Jaintia hills lie directly in the path of the rain-bearing monsoon winds. This is the most pronounced and prolonged season in the state. During some periods, rainfall may occur for 10 to 14 days at a stretch in the monsoon season.

A brief autumn season occurs between the rainy season and winter season and the latter sets in by late November. The temperatures become fairly low during this season, though snow is not experienced in any part of the state. The winter season continues till March and in the upper parts of the mountains, the mercury may drop down to the freezing point. Rains are also experienced in the winter season in Meghalaya.

Fairly hot summers may be experienced in the lower parts of

the state and the mean maximum temperature is about 35°C. However, the mountains and plateau experience a pleasant climate in the summer season.

MANIPUR

Manipur is situated in the extreme eastern part of the country and has an area of about 22,327 sq. km. Its borders touch those of Nagaland, Assam, Mizoram and Myanmar.

Physiography

There are three distinct physiographic divisions of the state, the Manipur valley, the Manipur hills and the Barak plains. The Manipur valley or Imphal valley is a broad and flat valley surrounded by the Manipur hills and formed by alluvial deposits. The average elevation of this valley is about 800 mts. The Manipur river and its tributaries drain this valley. Another prominent valley of the state is the Khoumum valley, which has a smaller extent and is surrounded by hills.

The Manipur hills comprise of a large part of the total geographical area of the state and the Manipur valley lies within these hills. They consist of a series of hill ranges, with a general slope towards the south. In the north, the altitude is about 3000 mts while it is about 800 mts in the south. The Manipur hills extend in a series of parallel ranges and form ridges and valleys. They comprise of peaks from which many ridges radiate.

The western-most range of the Manipur hills is known as the Nunjaibung range and it extends southwards from the tri-junction of Manipur, Assam and Nagaland. It runs almost parallel to the western boundary of the state. Another important range of the Manipur hills is the Kala Nag range, which extends from the border of the state with Nagaland and is parallel to the Nunjaibung range. Towards south, their general elevation decreases.

Another important range forming part of the Manipur hills extends in the north-western part of the state. Important peaks in this range are the Vallelbung and Laikot peaks. Secondary ranges

branch off from the main range from these and other peaks. A prominent range also occurs in the eastern part of the state, extending from the bend of the Tizu river in the north-eastern part of the state and running in a south-westerly direction till Ukhrul. A number of ranges forming part of the Manipur hills also lie along the border of the state with Myanmar and form the water-divide of the drainage.

The Manipur plains are relatively flat with occasional hillocks and low rolling hills. They resemble flood plains in physiography and contain many waterbodies and swamps. The plains are subjected to inundation by floods by the rivers every year in the rainy season. The occurrence of floods is more common in the southern part of these plains.

Drainage

Many rivers and streams drain the state of Manipur. All these are rainfed and are in spate in the rainy season. The Barak river and its tributaries form the major river system that drain the state. The eastern part of the state drains into the major catchment of the Chindwin-Irrawady river system. Important rivers of Manipur are:

1. The Barak river drains the western part of the state and forms a large catchment. The main stream of this river rises near the Manipur-Nagaland border and its upper course is known as the Sangu Lok. Important tributaries of the Barak river are the Erang, Jiri, Makru, Kozeri Lok, Majatki Lok, Karukuioi Ki and the Sulen rivers. The Barak river first flows in a south-westerly direction, then for short distance northwards, then westwards and again in a south-west course before leaving the boundaries of Manipur.
2. The Erang is another important river of Meghalaya and a major tributary of the Barak river. The main tributaries of the Erang river are the Asikade nadi and the Tuipi rivers.
3. The Makru river drains the tract between the Nunjaibong and the Kala Nag ranges and flows in a southerly direction. It is another tributary of the Barak river.

4. The Jiri river is a tributary of the Barak river and has its origin near the tri-junction of Assam, Nagaland and Manipur.
5. The Manipur river drains the Manipur valley and joins the Chindwin river system. Its main tributaries are the Imphal and Chapki rivers.
6. The Imphal river rises in a ridge east of Tongiang and flows through Imphal before merging with the Manipur river. The important tributaries of the Imphal river are the Iril, Thoubal and Khuga rivers.
7. Other important rivers draining Manipur are the Lanier, Chingai, Phou Khong and Yu rivers.

Climate

The climatic conditions prevailing in Manipur are largely pleasant and sub-tropical, though like in other parts of north-east India, there are variations with altitude and physiography.

The rainy season of Manipur extends from May to September and the rain-bearing south-west monsoon winds influence this period, while the retreating monsoons also cause rains in many parts of the state during October and November. In the rainy season, most rivers are in spate and flash floods occur, washing away millions of tons of soil. The total annual rainfall varies from 1400 to 2000 mm, being high in the hills.

The winter season extends from December to February, with January being the coldest month. During this season, the temperature may drop down to below the freezing point and there occurs fog and mist in winter. The minimum temperature at places like Imphal is 4°C, while it is much cooler in the mountains. Occasional showers may also be received in this season.

It begins to be warmer in March when the summer season starts and it is fairly hot in April. In the summer season, the nights are pleasant while the days are hot. The rainy season starts in May and the temperature does not rise any more than that in April, unlike in other parts of India, where May and June are usually the hottest months of the year.

ASSAM

Assam is the largest state of north-east India, having a geographical area of 78,483 sq. km. It has boundaries with Bhutan, Bangladesh, Arunachal Pradesh, Nagaland, Manipur, Meghalaya, Tripura and West Bengal. Most of the state lies in the vast plains of the Brahmaputra river and also the foothill tracts of the eastern Himalaya as well as the hills of north-east India. The Brahmaputra river is the lifeline of the state.

Physiography

The river Brahmaputra enters the Assam valley near Sadiya and while flowing westwards forms a striking plain, known as the Brahmaputra plain which is the most prominent physiographic feature of the state. The main physiographic features of Assam are the Brahmaputra valley, the northern hills, the Barak valley and the southern hills.

The vast Brahmaputra valley lies between the eastern Himalaya in the north and the Shillong plateau and its offshoot ranges in the south. This Brahmaputra river drains through all districts of the state before turning towards south and entering Bangladesh. The Brahmaputra valley is a monotonous plain, with occasional hillocks and also drained by numerous tributaries of the main river, which flow from all directions. The valley is formed of deposits brought down by the Brahmaputra river and its tributaries during the past millions of years. In many places, they form swamps and flood plains formed by the annual floods in the Brahmaputra river.

The Brahmaputra valley can be divided into the upper Brahmaputra valley and the lower Brahmaputra valley. The former lies between two more or less parallel ranges, having undulating plains in the upper parts and in the side valleys. Well formed terraces may be seen in the Dafla and Dihang valleys. The lower Brahmaputra valley is flat though there may occur occasional hillocks.

The northern hills of Assam constitute a distinct physiographic entity and form part of the eastern Himalayan foothills. They extend from Teesta river in the west to the Sadiya gorge in the

east. The general slope of the land is towards the south and many rivers and streams have cut across the hills.

The Barak valley is made up of swamps with occasional hills. It is separated from the Shillong or Meghalaya plateau in the south. This valley is drained by the Barak river and its tributaries.

Undulating and mountainous tracts form the southern hills of Assam, which constitute the fringe of the Shillong or Meghalaya plateau. This tract does not have flat lands and the general slope of the land is towards north.

Drainage

Assam lies mainly in the catchment of the Brahmaputra river, which receives tributaries both from the north as well as from the south. The rivers are both snow-fed as well as rainfed. Most rivers of the state are in spate in the rainy season. The Brahmaputra river is also used for navigation. The main rivers of the state are:

1. The Brahmaputra river rises in Tibet and flows in an easterly direction before cutting across the Himalaya and entering the Assam valley. Thereafter it follows a westerly course and drains the state before crossing the Garo hills in the south. Downstream of Assam, it joins the Ganga river and its waters ultimately flow into the Bay of Bengal. The Brahmaputra valley is located between the eastern Himalaya in the north and the Shillong or Meghalaya plateau in the south.
2. Important tributaries, which drain into the Brahmaputra river from the north, are the Manas, Subansiri, Bharali and Pagladia.
3. The tributaries from the south, which drain into the Brahmaputra river, are the Buri Dihing, Dikhow, Jhanji, Dhansiri and the Kulsi.
4. The Barak or Surma river is another important river of Assam. It rises in Nagaland and flows through Manipur, Cachar and Sylhet before emptying into the old bed of the Brahmaputra river. It flows through the Barak valley of Assam and has formed flat flood plains and swamps.

Climate

The climatic conditions prevailing in Assam are humid monsoon type, found in the sub-tropical regions. The main factors influencing the climate of the state include the physiographic features, changes in the pressure conditions, western disturbances and the south-west monsoons. Both the eastern Himalaya in the north as well as the Shillong or Meghalaya plateau in the south have a profound impact on the climatic conditions experienced in the state.

Like in other parts of north-east India, the monsoon season is the most important season in the state. It extends from June to September and there occur heavy and widespread rains during this period. July is the rainiest month. In the early part of the monsoon season, the heat is oppressive; humidity high and the skies remain cloudy for long periods.

The retreating monsoon season begins in early September and fair weather sets in. There is a gradual fall in the temperature, though the diurnal range of temperature increases.

The winter season sets in during late November or early December and extends till February. The western disturbances cause rain in many parts of Assam during the winter season, while in the late winter, there may occur thunderstorms. Winters are usually mild in most parts of the state, except in the hills. However, cold winds from the Tibetan plateau in the north may cause occasional cold spells, accompanied by sudden drops in the temperature.

The temperature begins to rise in early April with May and June being the hottest months. There occur some showers in March and April, with May and June being hot and dry. Pre-monsoon showers begin in June and continue from time to time till the arrival of the monsoon season. The temperature cools down after the onset of the monsoon.

TRIPURA

Tripura has a geographical area of 10,491 sq. km and is bounded on three sides by Bangladesh. The southern part of Tripura is not

very far from the Bay of Bengal, though a part of Bangladesh lies between Tripura and the Bay.

Physiography

The physiography of Tripura comprises of plains and mountains interspersed by valleys, rivers and streams. The physiography of Tripura has been described in the following text.

The plains constitute about 40 percent of the total geographical area of the state and lie below an elevation of about 100 mts. Most of the plains occur in the extreme southern and western parts of Tripura, though plains may also lie in pockets within the north and north-eastern parts of the state, which are dominated by mountains. These plains have formed from the deposits brought down by the streams and rivers.

A considerable part of the state comprises of hills and mountains forming part of the offshoot ranges of north-east India. They merge with the Mizo hills on one side and also with the Manipur hills. The mountainous terrain is undulating and broken by valleys of streams and rivers.

Most of these ranges branch off from the central mountains and the general elevation decreases away from the main tract. The highest peaks have an elevation of more than 1000 mts, while the general height of the mountains is about 700 mts. Thus as compared to the eastern Himalaya, the average altitude in Tripura is less.

The eastern-most hill range of the state is Jam Sai Jtang, having an average elevation from 600 to 800 mts. The valley formed by the Manu river is an important physiographic unit of the state. This valley is also of immense cultural as well as socio-economic significance. Other important hill ranges of the state are the Debtamura, Baramura, Atharmura, Sardeng, Longtharai, Jampui and Sakhantang. Amongst these, the last two are more prominent in terms of general elevation, which is between 800 and 1000 mts.

The Jampui range lies parallel to the eastern border of the state, while the Sakhantang range is located to the west of this range. The Longtharai range is located further towards west and has a

north-south alignment, with the Longtharai peak being the highest in this tract.

Drainage

The rivers of Tripura are rainfed and rise in the mountains either in the state or from adjoining areas and drain into the Bay of Bengal through Bangladesh. The pattern of drainage is dendritic, with the smaller tributaries merging into the larger rivers. Most rivers are in spate during the rainy season and have vast deposits of boulders in their lower reaches. They do not have deep and wide channels and hence cannot be used for transport. The main rivers of the state are:

1. Important streams and rivers that flow towards north are the Manu, Juri, Khowai, Dhalai and Deo. Manu is one of the most important rivers of the state, having its origin in the Sakhan range.
2. Amongst the important west-flowing streams and rivers of Tripura are the Gumti, Hawra and the Barigang. Gumti is one of the most important rivers of the state, and the important town of Udaipur is located on its banks. It forms a fertile and alluvial valley.
3. The south-flowing streams and rivers of the state are the Surma, Raima, Laogang and Mukari.

Climate

Tripura experiences a tropical moist or warm humid climate, which is influenced by the proximity of the Bay of Bengal. The total annual rainfall is more than 2000 mm, bulk of it being received from the south-west monsoons, between June to September, though precipitation also occurs in most months of the year. The monsoon winds from the Bay of Bengal reach Tripura early and cause heavy and widespread rain in this season. Humidity is very high in these months and may range from 80 to 100%. Heavy floods may occur during the rainy season.

The winter season begins in November, though January is the

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coldest month. However, winters are cool and it is cold only in the mountains. Occasional cold wave conditions may be experienced in the winter season.

Summers are hot in most parts of the state and the mercury soars to over 36°C, though at higher elevations, the temperature is mild. May and June are the hottest months and the temperature cools down after the arrival of the monsoon winds.

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