Chapter 2
Study Area

Chapter 2

THE STUDY AREA

2.1. Location and Boundary

The Darjiling Himalaya is located as a spur in the lap of the Eastern Himalaya and extends between 27° 13' 10" N to 26° 27' 05" N Latitudes and 88° 53' E to 87° 59' 30" E Longitudes. It is a hilly district of the state of West Bengal situated at the northernmost end of the Eastern India in the form of an inverted wedge. The northernmost point of the district is the tri-junction near Phalut [27° 13' 10" N; 88° 21' E] and the southern-most point is the Phansidewa block [26° 27' 05" N; 88° 22' E]; likewise the west to east extension of the district lies between Sabarkum near Sandakphu [87° 59' 30" E; 27° 12' N] and Todey village along river Jaldhaka [88° 53' E; 27° 04' N]. The total area of the district is 3149 sq km which is about 3.68 % of the total area of the state of West Bengal. The hilly portion covers an area of 2417.3 sq km and the Terai (plains portion) covers only 731.7 sq km. The district comprises of four sub-divisions of which three are in the hills, Darjiling (935.5 sq km), Kalimpong (1056.5 sq km) and Kurseong (425.3 sq km). However, very recently on 14th February 2017 the Kalimpong subdivision has been elevated to the rank of a district. But, for the present dissertation the previous coverage area of Darjiling district, i.e. including Kalimpong has been considered. The Siliguri sub-division comes under the Terai region and covers an area of 837.4 sq km. The lowest elevation of the district is 98 m amsl at Phasidewa and the highest elevation of 3660 m amsl is at Sandakphu with distinct altitudinal variations between the plains and the mountainous regions (District Administrative Report 2011–12). The district of Darjiling shares its boundaries with the international frontiers like the Nepal in the West being separated by the rivers Mechi and Siddhi to Bhutan and Bangladesh in the East being separated by the river Jaldhaka. Towards the northern side the district shares its boundaries with the state of Sikkim, separated by the rivers like Ramam, Great Rangit and Tista at different locations. The boundary rises parallel up in the north where it meets Sikkim and Bhutan and forms a trijunction at Rechila peak (3150 m). Towards the southern side the district shares its boundaries with Jalpaiguri and West Dinajpur districts of West Bengal and Purnea district of Bihar and Bangladesh. The district

boundary forms another tri-junction near Phalut (3600 m) in the north-west through Rimbick, Rammam, Gorkhey where it meets Nepal (Fig.2.1).

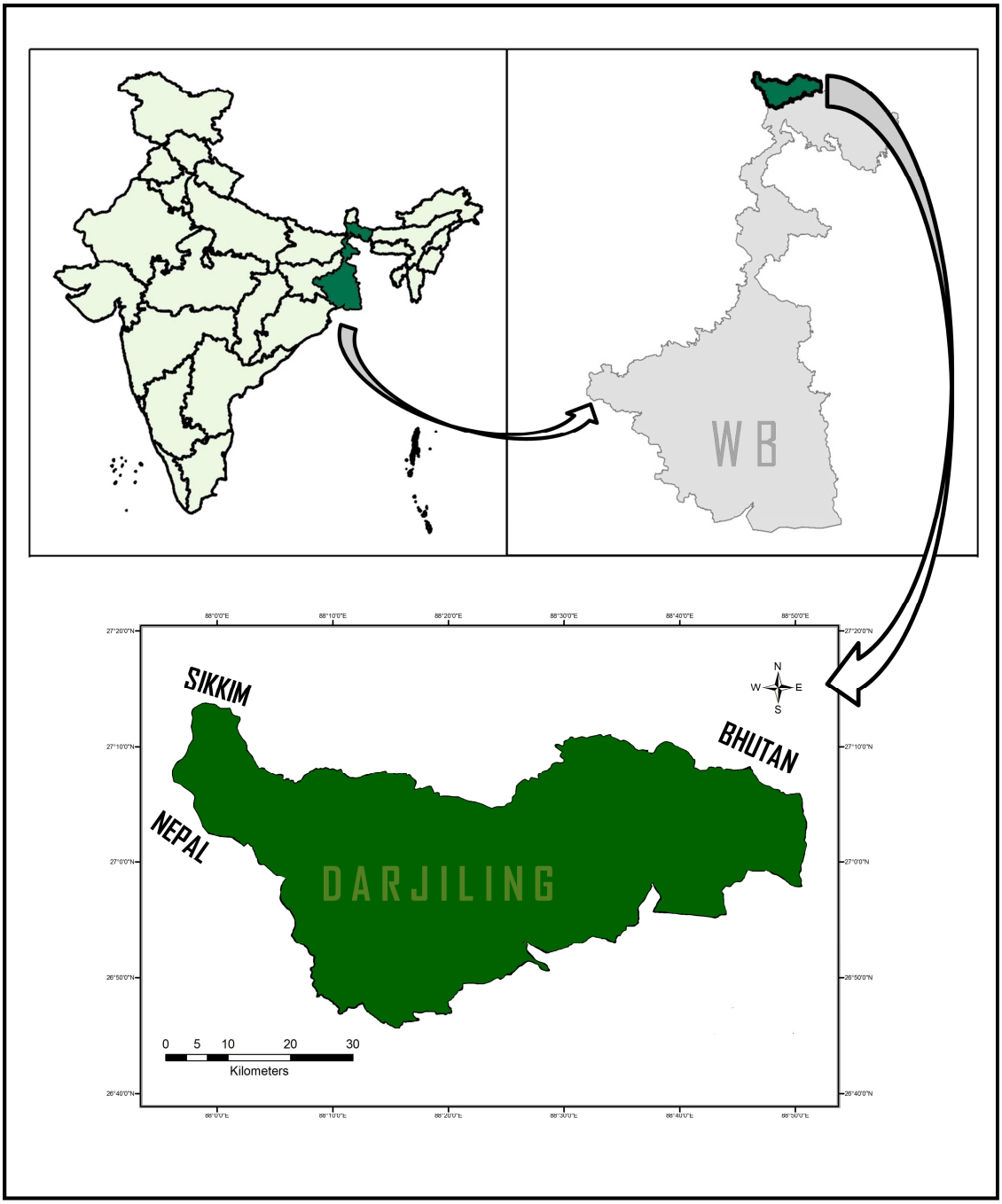

Fig. 2.1. Location map of the study area: Darjiling [prior to 14.02.2017]

2.2. TOPOGRAPHY

2.2.1. Mountain systems

The Darjiling Himalaya lies in the form of an inverted wedge forming a spur of the Singalila Range of the Himalaya Hotspot and originates from two distinct mountainous extensions, one from the north-west corner of the district through Phalut (3600 m) and the other extensions from the north-east corner of the district through Rechila and Thosum peaks (3150 m). The Himalayan region covers an area of 71.28 % of the district and the remaining 28.72 % falls on the feet as the Terai and plains region.

The Darjiling Himalaya falls under the Singalila and the Chola range of the sub-Himalayan region of Mt. Kanchendzonga. The Singalila range stretches south to the plains forming the boundary between Nepal and Darjiling (O'Malley, 1907). The Ghosla – Phalut ridge continuously extends from Phalut towards south through Sabargram (3536 m) to Sandakphu (3660 m) the highest peak of the district (Bhujel, 1996). Then the ridge gradually descends through Kalapokhari (3186 m), Gairibans (2621 m), Tumling (3000 m), Tonglu (3070 m), Meghma (2900 m), Chitrey (2500 m), and finally reaches at Maneybhanjyang (2150 m). All the way from Phalut to Maneybhanjyang the ridge forms the boundary with Nepal towards the western slopes. From Maneybhanjyang, the Phalut – Maneybhanjyang ridge bifurcates. One ridge continue towards south through Sukhiapokhari and Simana (2300 m) towards Mirik (1200 – 1500 m), finally settling down at foot-hills of Lohagarh, Changya and Panighatta (200 – 300 m). Another ridge from Maneybhanjyng extends at right angle towards east transversely through Sukiapokhari – Jorepokhari (2000 – 2500 m) to Ghoom – Jorebunglow (2250 m) where it again divides into three spurs. The first spur leads towards north through Jalapahar (2300 m) to Darjiling town (2000 – 2200 m) extending further to Birch hill (2150 m), Lebong, Ging (1500 m) and finally Badamtam (500 – 600 m) at the bed of river Rangit. The second spur extends towards east through 3rd Mile, 6th Mile and branches to form numerous spurs of Rangerung, Rungdung valley, Dabaipani towards north, Lopchu and Peshok towards east and Mungpoo, Takdah, Rangli-Rangliot, Geil to the southern slopes finally settling down at the basin of river Rangit and Tista. The third and the last spur of Ghoom – Jorebunglow ridge proceeds towards south through Senchal (2300 m), Tiger hill (2450 m), Mahaldiram (1800 m), Baggaunra (1500 – 2000 m), Dowhill (1900 m) and finally

reaches Kurseong (1450 – 1600 m) from where all the hills abruptly fall towards the foothills of Sukna and at the bed of Mahananda Wildlife Sanctuary.

The Chola mountains range of East Sikkim, enter from Tinsimana (3100 m), the north-eastern corner of the district through Rechila Chak – Jorepokhari (3040 m) to Rechila peak (3150 m), the highest peak of these extensions (Bhujel, 1996). From this Rechila peak, all the hill ridges of Kalimpong sub-division arise in three directions. The western ridge extends towards Lava (2100 – 2300 m) through Pankhasari (2200 – 2500 m) and Alubari (2380 m). From Lava, many ridges roll out in different directions. The south-eastern ridge extends towards the bank of Relli river towards Samthar; the third ridge descends down towards Loleygaon – Kafer (1800 – 2000 m) from where one side slops down through Charkholey (1600 – 1700 m) towards Yangmakhum (1000 – 1600 m) and ultimately to Mangpong – Pankhaban forest (200 – 400 m) on the bank of the River Tista. The southern slopes of Rechila enter the spurs of Neora valley from Thosum (2500 – 2800 m), and then roll down towards Ruka peak (2480 m) ultimately sits at Gorubathan (300 – 800 m) and Samsing (300 – 1200 m) foot hills. The third and eastern slope descended towards Tangta (2805 m), Todey (2000 – 2600 m), Godak (1200 m) and Jholung (560 m) along the western slope of River Jaldhaka.

2.2.2. Drainage Systems

The Darjiling Himalaya fosters many rivers flowing freely in different directions through the zigzag ridges and valleys of the hills. Many primary and small rivers and streams may flow initially to different directions finally merging into the large rivers which ultimately drain towards the southern end. There are seven major river systems within the district, namely Tista, Rangit, Mahananda, Balasan, Jaldhaka, Rammam and Mechi.

2.2.2. A. Rivers

- **The Tista:** The River Tista which is the largest river of North Bengal is the lifeline of Darjiling – Sikkim. It originates from Cholamo (Tso Lhamo) lake at North – Western Sikkim at an elevation of 5330 m amsl and is mainly fed by the Zemu glacier. Tista, after receiving the Rangit, flows through the Darjiling district and finally enters the plains of North Bengal and joins the mighty Brahmaputra in Bangladesh. The River longitudinally divided the district from the middle in two parts.

- **The Great Rangit:** This is the second largest river of the district with stony or sandy bed. It originates from Rothong glacier of Kanchendzonga Mountains (4500 m) in North-west Sikkim. This river meets Tista near Melli (100 m). Its meeting with the Tista provides one of the most picturesque scenes along its course (Dash, 1947).
- **Mahananda River:** The Mahananda (*Mahanadi* at origin), a rain-fed river, has its source near the Mahaldiram dome (1900 m), east of Kurseong, and flows through the south-eastern face of Kurseong to Latpanjar, through Mahananda Wildlife Sanctuary to the Terai. Its tributaries are Sivakhola, Babukhola, Jotikhola, Jogikhola, Jholi khola, Ghoramara khola, Gulma and Panchanadi, Chamta and Balasan in the Terai. The river meets with the Balasan on its right below Siliguri, passes towards south and south east forming the boundary between India and Bangladesh and between Darjiling and Uttar Dinajpur districts respectively.
- **Balasan River:** The River is rain-fed and originates from Lapchayjagat forest (2200 m) on the Ghoom – Simana ridge and it flows through the valley between the hills of Kurseong and Mirik. It enters Terai at Dudhey – Panighatta area and meets with Mahananda near Siliguri (Dash, 1947).
- **Jaldhaka River:** The Jaldhaka (*Dochu* at origin) is a medium-large sized river originating from the Kupup Lake (3896 m), a small glacial lake in North-East Sikkim. It carries the largest volume of water among eastern foothill rivers and flowing southwards, joins the district near Todey-Tangta of Neora Valley. It drains down making a boundary with Bhutan and then joins the Bangladesh's trans-boundary river Dharla.
- **Rammam River:** The Rammam is an important medium-large sized rain-fed river and is one of the chief tributaries of the Great Rangit that takes its birth under the Phalut peak in the Singalila Mountains (4000 m). Draining the entire Darjiling – Sikkim border along the northern slope of Bijanbari hill spur, it ends at Singla, meeting the Great Rangit.
- **Mechi River:** The River Mechi that forms the part of the district boundary with neighboring Nepal rises through the south of the west facing Rangbang spur of the Singalila range. The River flows past the dense forest and it ultimately joins the Mahananda in the Kishanganj district of Bihar. The left bank tributaries of

Mechi from north to south are the Kiyang khola, Ashli Jhora and Mana Jhora (Banerjee, 1980).

2.2.2. B. Lakes

Few natural lakes of small and moderate sizes are situated within the district. Mirik Lake (1494 m) is the largest one and now has become one of the major tourist spots. Other smaller lakes are located at Kalapokhari (3186 m), 6th Mile (2050 m) above Takdah. One lake at Jorepokhari in Sukiapokhari (2300 m) has recently been developed artificially as the protective habitat for an endangered Himalayan Salamander (*Tylototriton verrucossus*). In Neora Valley region, a pair of small natural lakes called Jorepokhari is located at Rechila peak (3040 m) which is the basic source of Neora River. Twin lakes of Senchal have been developed artificially for water supply to Darjiling town. Some other small artificial lakes at Deolo, Algarah and Lava have also been created for the purpose of water supply.

2.2.3. Snow Ranges

Places of Darjiling Himalaya above the altitude of 2500 m amsl generally receives snowfall every winter during December to February, sometimes even upto March-April. Some places like Meghma (2900 m), Tonglu (3070 m), Kalapokhari (3186 m), Sandakphu (3660 m) and Phalut (3600 m) receives snowflakes even in the month of March. The mighty Mt. Kanchendzonga flanked by a series of snow covered peaks presents an unforgettable sight from Darjiling town. Occasional snowfall during extreme cold winter occurs at some places like Sonada, Ghoom – Jalapahar (2250 – 2300 m), Senchal (2300 m), Tiger hill (2450 m), Gorkhey (2600 – 2800 m), Gairibans (2621 m), Rechila Chak-Jorepokhari (3040 m) and at Tinsimana (3100 m).

2.3. GEOLOGY

2.3.1. Geological formations

The great Himalayan range was elevated during the Tertiary period, on the site of ancient Tethys Sea that had accumulated sediments of different geological ages (Dash, 1947). Sir J.D. Hooker was the pioneer to investigate the geology of Darjiling Himalaya including Sikkim and adjoining Bengal region. He reported the regional gneissic domes, the overlying bedded sedimentary rocks and crinoidal lime stones at the Tso Lhamo lake of Kanchenjungha mountains (Gansser, 1964). Further contributions were made by H.H. Hayden, the then superintendent of

Geological Survey of India, during the first decade of the 20th century (Hyden & Burrard, 1908). Later on several workers contributed to the geological findings of the region. The Geological studies on the Himalaya have revealed that the deposition of the sediments in years have given rise to a series of upheavals leading to increased elevation and formation of the world's highest peaks. The process is continuing and the Himalayan mountains are still believed to be growing vertically (Molnar, 1986). As per the Geological Survey of India (Powde & Saha, 1982) the types of rock formations observed from outer to inner or South to North in the district are the Siwalik, the Damudas (Lower Gondwanas), the Dalings and the Darjiling gneiss respectively over thrusting one upon another.

- **Siwalik formations:** The formations are composed of sediments deposited by the rivers and flood plains and comprises of coarse grained sandstone, shale sand stone, siltstone and conglomerate.
- **Damuda formations:** The Siwalik series is over thrust by the Damuda formations belonging to the coal-bearing rocks of Gondwana age that comprises mainly of feldspathic and micaceous quartzitic sandstone, carbonaceous shales, thin lenses of crushed and shred coal, pebble and boulder beds which can be observed along the Tista river valley, Tindharay region, and along the Lish and Gish Rivers. This zone seems to be a characteristic representative of the late Precambrian to early Cambrian argillaceous sequence (Gansser, 1964).
- **Daling formations:** The Daling formations comprise of chlorite shales, phyllites and sericite-schist, epidiorite associated with quartzite and quartzite sulphide (Mallet, 1975). The series are well developed all along the lower and middle course of the river Tista. The most important feature of this series is increasing metamorphism upwards, where slates forms the lowest bed which is the most interesting geological feature of the lower Himalayas as well.
- **Darjiling gneiss:** The further northward formations are succeeded by the more metamorphosed rocks known as the Darjiling gneiss (Heim & Gansser, 1939; Gansser, 1964). It comprises garnetiferous biotite Gneiss, varieties of high grade schistose rocks and magnetite.

2.3.2. Soil

Due to the variation in the elevation, degree of slope, vegetative cover and geo-lithology of the Darjiling district, extreme variation in the composition and formation of the soils have been observed. The soils on the ground have been

developed by fluvial action, lithological disintegration or weathering of underlying rocks. Generally there are four different colours of soil found in Darjiling Himalaya *viz.* white clay (*Kamero mato*), gritty red (*Lishailo mato*), brown clay (*Chimte mato*) and black soil (*Kalo mato*).

Based on the physiographic sequence and terrain features from lower to higher elevations or gradually from south to north, the soil of Darjiling Himalayas are classified into five orders (Rai, 2006).

i. the ultisols of the palehumultus group which comprises of red, brown and yellow soil with coarse texture forming the foot-hills and river basins

ii. the alfisols of the hapludalfs or submontane type

iii. the mollisols comprising of three suborders udolls, argiudolls and hapludolls

iv. the entisols with four sub-orders arents, psamments, flubents and orthents

v. the inceptols with two sub-orders orchrepts and umbrepts make up the northern most part of the region.

In general, the major portion of the district shows highly acidic soil with pH below 5.5. Though in some places it is less acidic where pH ranges between 5.6 and 6.5. The alluvial soil of the plains of Terai is highly fertile. The black soils of forests of Terai and lower hills are composed of thick mantle of humus, formed from decomposed plant and animal residues. The greater portion of the district is formed with the reddish loam and yellow-brown clayey sticky soil which is not much fertile but favourable for good quality tea cultivation.

2.3.3. Mineral Wealth

The district contains valuable mineral deposits. The existences of the coal bearing rocks were traced long back by Sir J.D. Hooker in 1849 from Pankhabari and Dalimkot (Banerjee, 1980). However, such coal deposits are commonly exposed in even foot-hill regions like Kalijhora, on both sides of Tista River. Existence of other minerals within the district is estimated. Very impure graphite occurs in the semi-graphitic Gondwana schists of the Rakti River (O'Malley, 1907). Occurrence of copper in Kalimpong, Peshok, Mirik, and Gorubathan; graphite embedded with mica schist along Darjiling–Peshok ridge, Ghaiyabari, Mungpoo, Rakti valley, Singalila and Lava have also been reported (O'Malley, 1907; Bhujel, 1996). Similarly, Iron ores from Sakbir and Samalbong (Kalimpong)

and Lohagarh; dolomite from Senchal ridges, Pankhabari, Yangmakhum and Great Rangit river belt and even the occurrence of uranium have been traced in Yangmakhum-Tik ridge of the Kalimpong sub-division by the Geological Survey of India (GSI, 1980-82). An investigation for talc-steatite around Lepcha Basti and Singla in the extension areas of Gok-Karmi was also made by the Geological Survey of India [GSI, 2010-12].

2.4. COMMUNICATION NETWORK

2.4.1. Roads: The first ever motorable road connecting Darjiling with the Terai and plains was the old military road that ran from Siliguri to Darjiling via Pankhabari, Dowhill and Ghoom that was constructed between 1839 and 1842 (Dasgupta, 1999). The Hill Cart road that connects Siliguri and Darjiling through Sukna, Rongtong, Tindharay, Mahanadi, Giddhey pahar, Kurseong and Sonada was constructed in the year 1869. This road is now recognized as Tenzing Norgay Road or National Highway-55. Another National Highway-31 connects Siliguri with Guwahati and it extends upto Gangtok in Sikkim as Highway 31-A which runs parallel to the Tista River. Another branch, NH-31C, leads through Bagdogra to Bihar also connecting Naxalbari and Khoribari blocks. The State Highway-12 runs in a semi-circular pathway connecting Matigara with hilly places like Mirik, Sukiapokhari, Ghoom, Lapchu, Peshok, Tista bazar, Kalimpong, Algarah, Lava, Gorubathan and ultimately meets NH-31 at Damdim in Jalpaiguri district. There are many other roads connecting the three subdivisions within the district. And, after the implementations of the *Pradhan Mantri Gram Sadak Yojana* (PMGSY) since last decades, a large number of metalled and unmetalled roads have been constructed which have connected almost all the villages especially in the Terai. Though, even to-day, there are many inaccessible remote villages in the hills still to be connected with the mainstream of the country.

2.4.2. Rail: The Darjiling-Himalayan Railway (DHR) was first executed as narrow gauge rail tract from Siliguri to Tindharey in 1879 by Franklin Prestage. By mid-July 1881, the line reached Darjiling via Kurseong covering a distance of about 83 km. The Darjiling-Himalayan Railway was declared as a World Heritage site by UNESCO in 1999.

2.4.3. Air: The closest airport from Darjiling is at Bagdogra (about 88 kilometers downhill and three and half hour's drive) that is connected by air with rest of the major cities in the country.

2.5. CLIMATE

The climate of Darjiling is very peculiar in different parts of the district due to topographical and physiographical variations that play a pivotal role in determining the climate of the district at different locations. The huge differences in the altitudinal range from 130 to 3660 m amsl has tremendous effect on the flow of wind and temperature, thereby causing great extremities from warmer to cooler, and this change affects different seasons. Even in some places of same altitude facing different slopes, great climatic contrasts occur. The Wind systems of the Indian subcontinent have a great impact on the climatic regime of the entire Himalayan region including Darjiling. The Darjiling Himalaya is situated vertically above the Bay of Bengal and in the foot of the Mt. Kanchendzonga and its associated Himalayan peaks. It receives the moisture laden south-west monsoon flowing upwards during June to September from the Bay of Bengal as it lies at close proximity. In accordance with the winter and monsoon, the climatic set-up four seasons are recognized in the region: (i) Winter from December to February, (ii) Spring and summer from March to May, (iii) Monsoon or Rainy Season from June to August, and (iv) Autumn from September to November (Das, 1986; Bhujel 1996). Elevation wise the district shows three distinct climatic zones, namely Tropical, Temperate and Sub-alpine. This variation is immensely significant for the creation of the various types of vegetation and also in bringing about species richness and great biological diversity (Dash, 1947; Bhujel, 1996).

2.5.1. Temperature

The temperature of the Darjiling district varies with altitude, aspect and moisture from place to place. The hilly region experiences a little higher temperature (day and night) during the rainy season than in the summer and spring whereas the temperature in the Terai and plains faces diurnal fluctuation. After the withdrawal of the south-west monsoon, both day and night temperature begins to fall throughout the district and it accelerates from the month of November. Normally January is the coldest month of the year with average temperature of 6 – 7° C (Ghoom-Jorebunglow 2250 m). The occurrences of chilling frost are common

throughout the cold season in the hilly region, sometimes even at Terai. Towards the higher belt, the temperature reduces abruptly during winter leading to the occurrence of hailstones and snowfall for 1 – 3 months. The mean summer temperature in Darjiling varies between 7° to 17° C; the winter gets extremely cold from November to March with temperature dropping down to sub-zero level at places above 2000 m (Moktan & Das, 2014). The summer temperature in Darjiling raises upto 27° C, whereas the plains area gets heated up as other sub-Himalayan districts of West Bengal but in winter the temperature becomes optimum and pleasant. The average monthly maximum and minimum temperature during the year 2009 – 2013 has been provided (Figs. 2.2 – 2.4).

2.5.2. Precipitation

The peculiar configuration of the neighboring mountains deflects wind and brings sharp changes in the rainfall. Due to the hilly nature of the terrain, the area receives rainfall throughout the year except for a short dry spell during winters. Darjiling Himalaya receives highest rainfall from June to September and lowest between November to February. The southern open Terai and slopes near the plains generally receives heavier rainfall than the higher hilly tracts. The ombrothermic graph (Fig. 2.2) prepared for the area reveals that the average monthly rainfall is highest during July-August in Darjiling hills. The average annual rainfall estimated during the year 2009 – 2013 is around 239 mm in Darjiling and 143.4 mm in Kalimpong. The rainfall is higher in Kurseong sub-division with an average of about 337.3 mm. The highest average number of rainy days has been recorded for Kurseong (Das, 1986).

2.5.3. Relative Humidity

The Northern tract of the Darjiling Himalayan region experiences a higher humidity throughout the year. Towards the higher altitude (>2000 m), the Relative Humidity (RH) ranges from 85 – 99 % during monsoon months. At lower elevations the RH gradually decreases and during the dry months it ranges between 45 – 60 %. The average RH for a period of five years for three sub-divisions in the hills has been provided in Fig. 2.5.

2.5.4. Cloudiness

The sky remains heavily clouded during the monsoon months, and in other seasons it remains slightly or moderately clouded. The clear and settled weather in Darjiling cannot be relied on as the cloud and the fog may rise up anytime from the

deep humid valleys and may continue to persist for days (Dash, 1947). In Terai and plains, fog occurs occasionally from December to March. The clear sky and sunny days are mostly seen in autumn and spring. The summer exhibits a smoggy sky throughout the district with a variation in sunlight at different slopes of the Himalayas.

2.5.5. Wind Velocity

The district experiences higher wind velocity from November to May that is predominantly westerly. At higher altitudes (>3000 m), the flow of wind becomes very strong and stormy. Generally the average wind force at Darjiling does not exceed around ten kms per hour. Occasionally, the Terai region is affected by the flow of hot dry winds from the western side. Local storms however occur in all parts of the district (Dash, 1947).

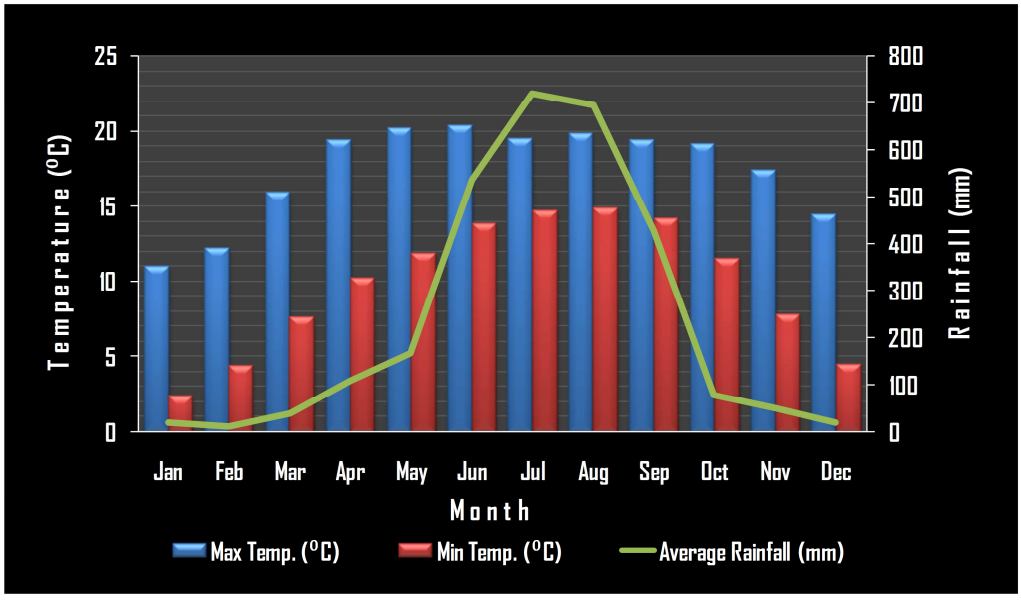

Fig. 2.2. Average Monthly Temperature and Rainfall of Darjiling during 2009-2013. [*Source:* Agriculture Office, Darjiling]

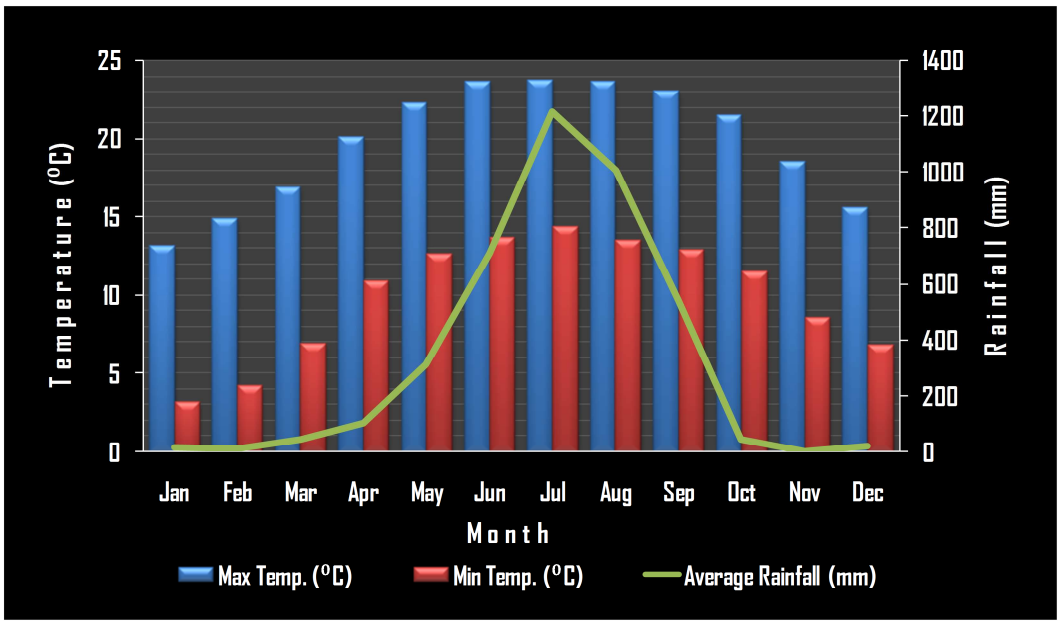

Fig. 2.3. Average Monthly Temperature and Rainfall of Kurseong during 2009-2013. [*Source:* Darjiling Tea Research & Development Centre, Kurseong]

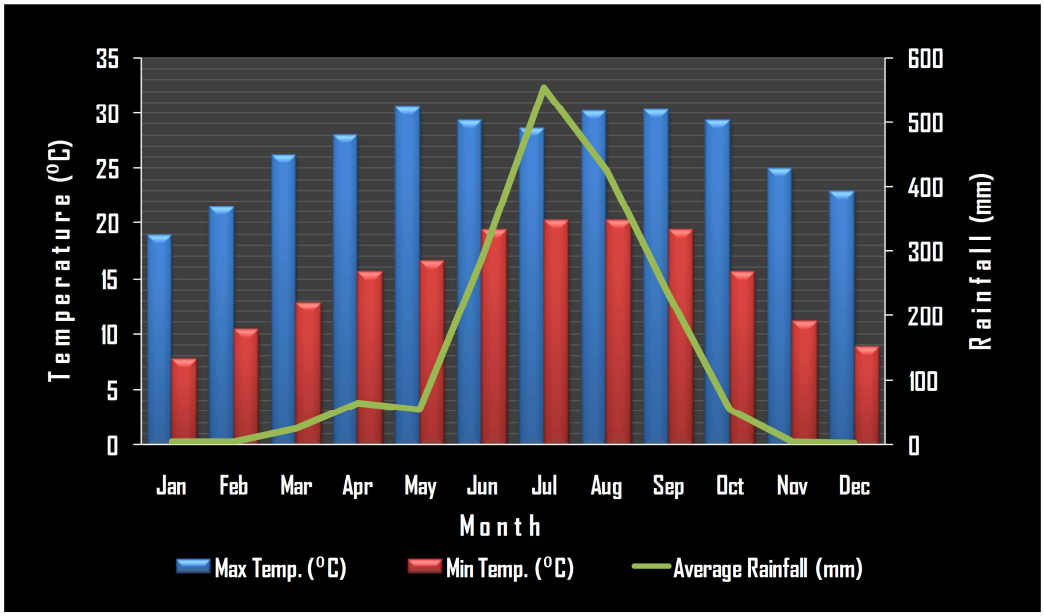

Fig. 2.4. Average Monthly Temperature and Rainfall of Kalimpong during 2009-2013. [*Source:* Regional Sericultural Research Station, Kalimpong]

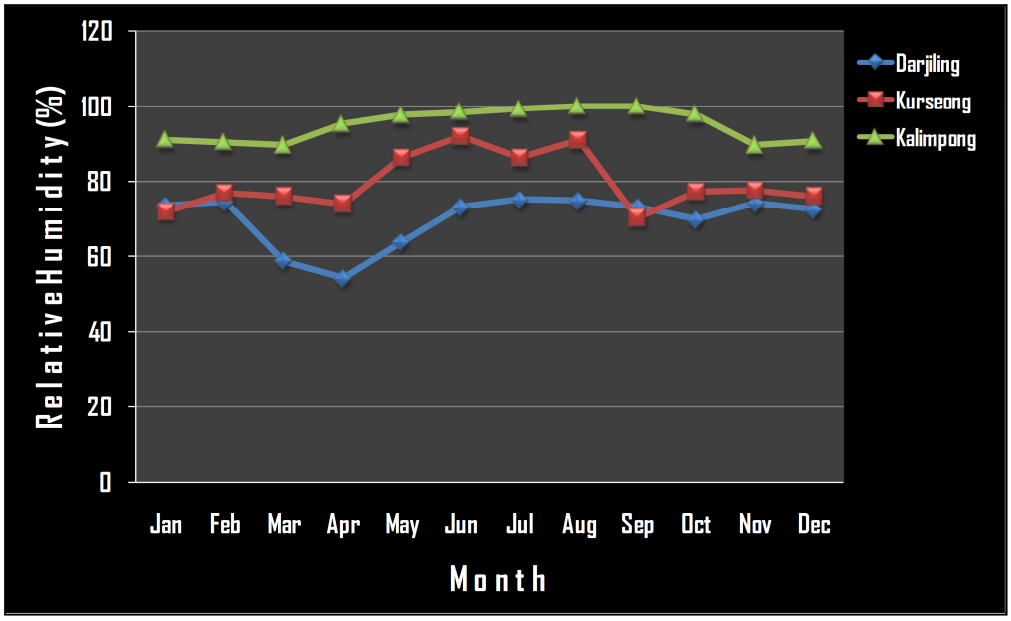

Fig. 2.5. Average Relative Humidity in three sub-divisions during 2009 – 2013

2.6. FOREST DIVISIONS

Although most of the forest areas in Darjiling and Kurseong sub-divisions have been changed into Tea Estates in the past, presently the total forest cover in the district is around 1204 sq km and from the conservation point of view it has been classified as Protected Forest, Reserve Forest, National Parks and Wildlife Sanctuaries under the Wildlife Protection Act and Indian Forest Act XVI of 1972 and 1927 respectively. The major portions of the forests are found at the altitude above 2000 m amsl. There are three Forest Divisions in the district, namely Darjiling, Kurseong and Kalimpong. The plains of Siliguri does not have such a forest sub-divisions except few like Tukuria, Dulkajhar, Taipu, Bengdubi etc. but those are included under the Kurseong Forest Division. There are 90 forest sub-divisions in the district with Kalimpong occupying the largest forest cover (SFR, 1991). The district occupies forest cover of about 14.15 % within the state and 0.34 % of forest cover with the country (SFR, 2013). The forests of Darjiling district have been recognized into three categories: Reserved Forests, Protected Forests and Unclassed State Forests & others (Table. 2.1).

Table. 2.1. Forest Profile of Darjiling district

Forest Divisions	Total Forest cover [sq km]	Protected Forests [sq km]	Reserved Forests [sq km]	Unclassed state Forests & others [sq km]	No. of Forest Villages
Darjiling	311.43	117.52	296.19	1.9	36
Kurseong	301.33	127.22	290.63	8.3	26
Kalimpong	591.24	88.0	582.59	7.5	29
TOTAL	**1204**	**332.7**	**1169.41**	**17.7**	**91**

2.7. PHYTODIVERSITY IN DARJILING HIMALAYA

The hills of Darjiling are the extension of the Singalila range of Eastern Himalaya and very much part of the Himalaya Biodiversity Hotspot with remarkably diverse floral and faunal elements indigenous to the Himalayas (CI, 2005). The district occupies 3149 sq km of total geographic area that possess 1204 sq km of forest cover (SFR, 2010-2011), with wide altitudinal range extending from lowest of 98 m amsl up to the highest in the state of 3660 m amsl. Wide arrays of climatic zones are available within this altitudinal ranges with extreme variability in physical, topographical and geographical conditions, that have resulted in a wide variations in the habitat and diverse vegetation even within minimum altitudinal range throughout the district (Das, 1986, 1995, 2004; Samanta & Das, 1995; Bhujel, 1996; Rai, 2001; Rai, 2006; Ghosh, 2006). In the higher altitudes, the floristic composition is mainly formed of Himalayan and Sino-Himalayan elements, whereas the lower hills are characterized by the elements from the S.E. Asian–Malaysian and Indian plains (Grierson & Long, 1983).

The forests of Darjiling were classified by Dash (1947) as Lower hill forest up to 970 m, Middle hill forest (970 – 1940 m) and Upper hill forest (1940 – 2900 m). Grierson & Long (1983) classified the Eastern Himalayan forest into five zones as Lowland/Riverine forest (under 1000 m), Lower montane forest (1000 – 1500 m), Deciduous forest (1500 – 2100 m), Pine and coniferous forest (2100 – 3500 m) and Alpine grassland and scrub (above 3500 m). The vegetation of Darjiling was later classified by Bhujel (1996) into five major zones as Tropical Zone (plains – 500 m), Sub-Tropical Zone (500 – 1200 m), Sub-Temperate Zone (1200 – 1850 m), Temperate Zone (1850 – 3200 m) and Sub-alpine Zone (3200 – 3660 m).

Darjiling is situated almost at the central part of the Eastern Himalaya and is equally rich in biodiversity with its western and eastern fringes. (Das, 1986; Das & Chanda, 1987; Bhujel & Das, 2002). Das (2005) has estimated that apart from algae, fungi and other microbes, there are at least 3662 species of Bryophytes, Pteridophytes, Gymnosperms, Dicots and Monocots growing in this district. It is also known that out of 1808 endemic species found in Eastern Himalaya, over 30% species of higher plant are endemic to Darjiling Himalaya due to climatic and edaphic isolation (Grierson & Long, 1983; Das, 1995, 2004; Bhujel & Das, 2002). Das (2004) has reported 2137 species of flowering plants from Darjiling Himalaya out of which 21.26 % are local and regional endemics. Rai (2001) while studying the flora of Neora Valley National Park recorded over 14 % of plant species endemic to the Himalaya.

Flora of this region also shows significant number of exotic species which were once introduced and later naturalized in wild, thus together constituting 5.33 % of the total flora (Das, 2002). The climatic variation in this region and heterogeneity of habitat creates conducive environment for development and evolution of species and the process is still continuing (Das, 1995, 2004). Every new exploration by a botanist results in the finding of a new species which proves that the process of speciation is still occurring in this region (Moktan *et al.,* 2012). Apart from two National Parks and three Wildlife Sanctuaries, there are a number of reserve forests, social forests, plantation forests etc. in different ecological zones that forms a core part of Himalaya Hotspot with diverse flora, fauna and microbes. The forests of the district are also naturally rich in timber producing, medicinal plants and NTFPs. Rai (2002) had studied the ethnobotany of Darjiling people and reported around 421 species of plants. Das & Mandal (2003) has recorded 92 species of plants used as folk medicine by the hill people. Chettri *et al.,* (2014) recorded 48 species of plants that are being used medicinally by the tea garden workers. Around 281 species of plants under 108 families were recorded as folk medicine of this region with 14 % of medicinal plants under different categories of threat Chhetri *et al.,* (2005). Besides these, many workers have explored and investigated the rich floral diversity of the district.

The major NTFPs that are being used by the rural livelihood of the district are medicinal, fibre, food, vegetable, agricultural implements, construction of houses, making rope, handicrafts, household articles etc. has been retained through

the generations traditionally in this sub-Himalayan district (Rai *et al.,* 1998). The rich natural resources of the Darjiling Himalaya with beautiful landscapes that are composed of beautiful hills, valleys, rocky slopes, forests, tea gardens, rivers, and gorgeous sight of Mt. Kanchenjunga has given the hill its renowned worldwide name as "Queen of Hills". However, the floral and vegetation diversity in this region of the Himalaya is now deteriorating rapidly. The mountains in the 1830s were completely covered with forests from top to bottom but have changed abruptly within the next turn of the century (O'Malley 1907). Much of the natural forests in higher regions have been changed to the *Cryptomeria* forest and towards the lower plains by *Tectona* plantation by the forest department. Although these species produce high value timber, they destroy the native ground flora very extensively (Das & Lahiri, 1997). Towards the terai belt, the social forests are being replaced by the tea plantations that have become a major source of livelihood in the region. The phytodiversity in the Darjiling Himalaya is therefore under threat due to uncontrolled human activities that has been causing excessive fragmentation, and making the hills much fragile (Das, 1995, 2004; Rai, 2006).

2.7.1. Conservation: The government has implemented several programs and projects in aid to conserve these areas and one of the important acts of conservation is the *in-situ* conservation in the form of National parks, Wildlife Sanctuaries and Reserve forests. In the district of Darjiling, two National Parks and three Wildlife Sanctuaries have been established which occupies a total area of 332.74 sq km (Tables 2.2 & 2.3). Besides these, there are a number of reserved, un-reserved forests, social forests within the area of the Darjiling Himalaya.

Table 2.2. Wildlife Sanctuaries (IUCN Category- IV) located in Darjiling district

Wildlife Sanctuaries	Area (sq km)	Coordinates	Altitude (m)	Beats covered
Senchal	38.88	26º 94' – 27º 07' 26" N 88º 24' – 88º 35' 43" E	1100 – 2600	3rd Mile, 6th Mile, Jorebunglow, Rambhi and Sonada
Mahananda	127.22	26º 76' 54" – 26º 96' 91" N 88º 31' 80"-88º 48' 47" E	150 – 1000	Kalijhora, Lathpanjar, Punding, Sukna, Gulma, Toribari, Sevoke, 7th Mile and Laltong
Jorepokhari Salamander	0.04	26º 70' 91" – 26º 79' 59" N 88º 21' 51" – 88º 31' 11" E	2300 – 2500	Jorepokhari

Table 2.3. National Parks (IUCN Category- II) located in Darjiling district

National Parks	Area (sq km)	Coordinates	Altitude (m)	Beats covered
Singalila	78.60	27º 03' 05" – 27º 22' 06" N; 87º 59' 30" – 88º 07' 87" E	2150 – 3660	Phalut, Sabargram, Rammam, Sandakphu, Kalapokhari and Gairibans
Neora Valley	88.00	26º 52' 03" – 27º 07' 35" N; 88º 45' – 88º 50' E	200 – 3100	Rechila, Thosum, West Nar and East Nar

2.8. VEGETATION

The magnificent beauty of the Darjiling Himalaya harbors rich and diverse vegetation due to its varied topographic, geographic, physiographic, edaphic and climatic features. The vegetation is peculiarly very rich in the number of species and enormously varied range of characters (O'Malley, 1907). The physiographic configuration of the Himalayas with its slopes, valleys and altitudinal ranges have had tremendous effect on the distribution of rainfall, humidity and temperature which, in turn, plays key role in the change of vegetation pattern. The most important factor is the variation in altitude and its effect can be felt in the change of vegetation structure also as one ascends from the plains to the higher zones. Attempts have been made to classify the vegetation of this region from time to time by renowned botanists like Gamble (1875), Hooker (1906), Cowan & Cowan (1929), Champion (1936), Kanai (1966), and Grierson & Long (1983). After many years, Chauhan (1996) and Bhattacharya (1997) had also tried to make the general outline of vegetation classification of the region with few modifications, but the modification requires factors such as climate and altitude and its impact on the vegetation (Bhujel, 1996). However, based on the floristic composition of the region, Bhujel (1996) have classified the vegetation of Darjiling Hills into five categories (Table 2.4).

Table 2.4. Vegetation types of Darjiling Hills (Bhujel, 1996)

Vegetation types	Altitudinal range (m)
Plains and Tropical	Plains to 500 m
Sub-Tropical	500 – 1200 m
Sub-Temperate	1200 – 1850 m
Temperate	1850 – 3200m
Sub-Alpine	3200 – 3660 (-3800m)

2.8.1. Plains and Tropical Vegetation, upto 500 m

This type of vegetation is found in the tropical forests of the plains, foot-hills, river valleys and some part of Terai up to an elevation of 500 m. This zone normally remains warmer throughout the year with temperature ranging from 5.6º to 27º and mean relative humidity of about 71.4 % (Rai & Das, 2005). The vegetation is mainly characterized by the broad-leaved deciduous forests that can further be categorized into following five sub-types:

(i) Riverine forests

(ii) Dry mixed forests

(iii) Sal forests

(iv) Wet mixed forests, and

(v) Grasslands

***(i)* Riverine forests:** This type of forests are found around hot valleys in small patches along the river Tista and Great Rangit and below 500 m amsl of other rivers like Balasan, Mahananda, Rammam, Little Rangit, Relli, Jaldhaka, Lish, Gish and Chel. The vegetation is mostly dominated by tree species like *Albizia procera, A. lebbeck, Terminalia alata, Acacia pennata, A. catechu, Dalbergia sissoo, Meliosma pinnata, Cassia fistula, Lagerstroemia hirsuta* etc. And, shrubs like *Clerodendron infortunatum* and *Croton caudatus* with ground floras such as *Saccharum spontaneum, Eragrostis* spp., *Croton bonplandianus,* etc.

***(ii)* Dry mixed forests:** This type of forests comprises of semi-evergreen species like *Macaranga pustulata, Acrocarpus fraxinifolius, Artocarpus lacucha, Bombax ceiba, Gmelina arborea, Erythrina stricta, Sterculia villosa, Tetrameles nudiflora, Leea asiatica, L. guineensis,* etc.

***(iii)* Sal forests:** These forests are natural to the region especially on the Mahananda Wildlife Sanctuary area that is predominantly covered with *Shorea robusta.* It is sometimes planted by the forest department in association with other species like *Chukrasia tabularis, Dalbergia sissoo, Neolamarckia cadamba,* etc. The other ingredients of the forests are *Tectona grandis, Schima wallichii, Lagerstroemia parviflora* and *Dillenia pentagyna.*

***(iv)* Wet mixed forests:** This type of forest is characterized by the presence of semi-evergreen to evergreen tree species those occurs in the shaded pockets of the larger river valleys and include *Terminalia myriocarpa, T. alata, Magnolia champaca, Litsea monopetala, Syzygium formosum, Duabanga grandiflora,*

Cinnamomum bejolghota, Beilschmiedia roxburghiana are the important components of this vegetation type.

(*v*) Grasslands: The grassland vegetation is dominated by tall and woody grasses along the river banks. The important species occurs there are *Saccharum spontaneum, S. arundinaceum, Eragrostis* spp., *Cymbopogon nardus, Panicum auritum, Setaria pumila, Arundinella bengalensis, Digitaria* spp., *Brachiaria subquadripara, Axonopus compressus, Sporobolus diandrus, Eleusine indica, Cynodon dactylon, Centotheca lappacea, Imperata cylindrica, Chrysopogon aciculatus,* etc. Apart from grasses many other herbaceous also remain there in close association.

2.8.2. Sub-Tropical Vegetation (500 – 1200 m)

The sub-tropical vegetation lies between the altitudinal range of 500 – 1200 m and is characterized by deciduous type with dry winter and humid monsoon (Grierson & Long, 1983). It occurs on the slopes, ridges and spurs along the River Tista, Rangit, Balasan, Mahananda, Rammam, Relli, Jaldhaka, Neora, Lish, Gish, Chel, Mechi etc. The most dominant tree members are *Schima wallichii, Ailanthus integrifolia, Duabanga grandiflora, Gynocardia odorata, Gmelina arborea, Diploknema butyracea, Baccaurea ramiflora, Castanopsis indica, Castanopsis tribuloides, Cinnamomum bejolghota, Callicarpa arborea, Litsea cubeba, Mallotus philippensis, Pterospermum acerifolium, Phoebe lanceolata, Phyllanthus emblica, Spondias pinnata, Syzygium ramosissimum, Terminalia alata, Terminalia chebula, Pandanus furcatus* and bamboos like *Dendrocalamus hamiltonii.*

The dominant shrubs and the under-shrubs of this vegetation type are *Calamus erectus, Phoenix acaulis, Lantana camara, Musa balbisiana, Thysanolaena latifolia, Boehmeria glomerulifera, Croton caudatus, Leea macrophylla, Leea guineensis, Mussaenda macrophylla, Vitex negundo, Eupatorium odoratum, Flueggea virosa, Holmskioldia sanguinea, Jasminum multiflorum, Phlogacanthus thyrsiflorus, Rubus ellipticus, Woodfordia fruticosa, Toddalia asiatica,* etc.

Dominating climbers include *Dioscorea bulbifera, Dioscorea prazeri, Dioscorea pentaphylla, Smilax* spp., *Bauhinia vahlii, Cissampelos pareira, Cissus simplex, Combretum decandrum, Entada rheedii, Millettia pachycarpa, Mucuna pruriens, Spatholobus parviflorus, Thunbergia fragrans, Tinospora cordifolia, Stephania japonica, Stephania glabra, Rhaphidophora glauca,* etc.

Ground covering plants are many and include: *Commelina suffructicosa, Cyanotis cristata, Murdannia nudiflora, Cyperus cyperoides, Fimbristylis bisumbellata, Fimbristylis dicotoma, Kyllinga bervifolia, Kyllinga nemoralis, Ageratum conyzoides, Bidens bipinnata, Spermacoce exilis, Caesulia axillaris, Drymaria villosa, Elatostema lineolatum, Eranthemum pulchellum, Hydrocotyle sibthorpioides, Oxalis corniculata, Phaulopsis imbricata, Pilea hookeriana, Pouzolzia sanguinea, Urena lobata* etc.

2.8.3. Sub-Temperate Vegetation (1200 – 1850 m)

A short vertical zone between 1200 to 1850 m amsl represents this Sub-temperate vegetation vegetation that comprises the flora of both the sub-tropical and temperate vegetation types (Bhujel, 1996). The composition of flora in this zone is neither sub-tropical nor completely temperate, but of intermediate type. This type of vegetation is found in places like Simana – Mirik, Kurseong – Tung, Mungpoo – Lathpanjar, Lodhoma – Rimbick, Peshok – Takdah, Ging – Tukvar, Algarah – Pedong, Kafer – Nimbong.

The dominating tree and shrub species are *Leucosceptrum cannum, Brassaiopsis hainla, Brassaiopsis hispida, Engelhardtia spicata, Macaranga indica, Alnus nepalensis, Ostodes paniculata, Luculia gratissima, Maesa chisia, Buddleja asiatica, Camellia kissi, Casearia glomerata, Cestrum aurantiacum, Cryptomeria japonica, Exbucklandia populnea, Edgeworthia gardneri, Boehmeria glomerulifera, B. macrophylla, Clematis semilacifolia, Tetrastigma rumicispermum, Osbeckia stellata, Oxyspora paniculata, Holboellia latifolia, Dichroa febrifuga, Agapetes sikkimensis* etc. Ground vegetation is dominated by *Persicaria* spp, *Elatostema caveanum, Pilea glaberrima, Porana grandiflora, Schisandra propinqua, Solanum erianthum, Viola diffusa*, etc.

2.8.4. Temperate Vegetation (1850 – 3200 m)

This zone covers the major area of the district with widest altitudinal range of 1850 – 3200 m amsl. It harbors the maximum species of plants including mosses, ferns, lichens, epiphytes and few parasites too. Differences in vegetation can be observed within this zone with lower elevations comprising of broad-leaved deciduous forests, middle portion of evergreen forests and the upper portion covered with conifer forests.

Based on the distinct vegetation types, this zone can be further divided into three sub-types (Kanai, 1966; Grierson & Long, 1983):

(i) Temperate Broad-leaved Deciduous Forest, *(ii*) Evergreen-Oak forest, and *(iii*) Hemlock-Rhododendron forest.

***(i*) Temperate Broad-Leaved Deciduous Forest:** This type of forest can be observed between elevations of 1850 – 2400 m amsl. The vegetation of this type are composed of *Betula alnoides, Betula utilis, Alnus nepalensis, Acer campbellii, Acer sterculiaceum, Magnolia campbellii, Magnolia doltsopa, Cotoneaster griffithii, Lyonia ovalifolia, Engelhardtia spicata, Exbucklandia populnea, Quercus lamellosa, Q. pachyphylla, Q. lineata, Magnolia cathcartii, Betula alnoides, Prunus nepalensis, P. cerasoides, Castanopsis hystrix, C. tribuloids, Machilus edulis, Symplocos glomerata, S. theaefolia, S. symplicifolia, Eurya japonica, Tetradium fraxinifolium, Taxus wallichiana, Rhododendron arboreum, Rhododendron grande, Persea fructifera, Elaeocarpus lanceifolius,* etc.

The shrubs and undershrubs include species like *Aucuba himalaica, Maesa chisia, Neillia thyrsiflora, Gaultheria griffithiana, Elsholtzia fructicosa, Ilex crenata, Rubus lineatus, Leycesteria formosa, Viburnum erubescens, Smilax aspera, Smilax aspericaulis,* and various species of bamboos like *Drepanostachyum khasianum, Himalayacalamus hookerianus, Yushania maling, Arundinaria racemosa, Drepanostachyum intermedium* etc. Herbs in this belt includes *Iris clarkei, Molineria capitulata, Molineria crassifolia, Melissa axillaris, Swertia bimaculata, Bulbostylis densa, Polygonatum oppositifolium, P. punctatum, Maianthemum oleraceum, Maianthemum fuscum, Remusatia hookeriana, Streptolirion volubile* and grasses like *Poa sikkimensis, Pennisetum clandestinum, Panicum notatum, Panicum khasianum, Oplismenus compositus* and few orchids like *Satyrium nepalense, Pleione hookeriana, Pleione humilis, Pleione praecox, Malaxis muscifera, Calanthe truliformis, Calanthe brevicornu,* etc.

***(ii*) Evergreen Oak forest:** This type of forest is characterized by the combination of species like *Acer, Quercus* and *Rhododendron* those dominate the altitudinal range between 2400 – 2800 m amsl. The major components of Oak forest include *Acer hookeri, Quercus lineata, Q. lamellosa, Q. lanata, Lithocarpus pachyphylla, Lithocarpus fenestratus, L. elegans, Magnolia cathcartii, Gamblea ciliata, Cinnamomum impressinervium, Litsea elongata, L. albescens, Juglans regia, Rhododendron falconeri,* etc.

The undershrubs observed under this vegetation includes *Clematis buchananiana, Clematis montana, Polygonum molle, Dichroa febrifuga, Dactylicapnos scandens, Gaultheria fragrantissima, Helwingia himalaica, Daphne bholua, Holboellia latifolia, Rubus acuminatus, Rubus lineatus, Rubus paniculatus, Rubus buergeri, Vaccinium retusum, Arundinaria maling, Smilax elegans, S. orthoptera, Vaccinium retusum, Vaccinium vaccinoides, Lyonia ovalifolia, Piptanthus nepalensis, Prinsepia utilis, Rhododendron grande, Viburnum erubescens, Zanthoxylum oxyphyllum,* etc.

The important ground flora in this vegetation are *Arisaema jacquemontii, Aster tricephalus, Cardamine impatiens, Fragaria nubicola, Clinopodium umbrosum, Clintonia alpina, Hemiphragma heterophyllum, Primula denticulata, Gallium mollugo, Valeriana wallichii, Aristolochia griffithii, Gnaphalium affine, Potentilla fulgens, Elsholtzia strobilifera, Voila pilosa, Viola thomsonii, Hydrocotyle himalaica, Ophiopogon wallichii,* and grasses and sedges like *Cyperus cyperoides, Festuca gigantica, Glyceria tonglensis, Carex cruciata, Agrostis triaristata, Festuca polycolea, Festuca leptopogon,* etc.

***(iii)* Hemlock – Rhododendron forest:** The uppermost canopy that lies within the elevation of 2800 – 3200 m amsl defines the Hemlock (Conifers) and Rhododendron forest. The major composition of this forest zone are *Tsuga dumosa, Abies densa, Betula utilis, Daphne bholua* var. *glacialis, Cotoneaster microphyllus, Rosa sericea, Rubus pentagonus, Rubus treutleri, Neillia rubiflora,* etc., The most predominant species of Rhododendrons in this belt includes *R. barbatum, R. edgeworthii R. grande, R. arboreum, R. dalhousie, R. griffithianum, R. glaucophyllum, R. falconeri, R. hodgsonii, R. campylocarpum, R. thomsonii, R. decipiens* and *R. campanulatum*. The shrubs and undershrubs are composed of species of *Lonicera, Rubus, Ribes* and *Gaultheria* with *Berberis wallichiana, Enkianthus deflexus* and *Euonymus frigidus.* The ingredients in the herb layer are *Valeriana wallichiana, Gallium mollugo, Primula denticulata, Fragaria rubiginosa, Sinopodophyllum hexandrum, Panax pseudoginseng, Swertia chirayita, Arisaema propinquum, Arisaema nepenthoides, Arisaema griffithii, Tripogon trifidus, Trisetum spicatum* including some grass like plants including species of *Carex, Polygonatum Juncus* and *Kobresia.*

2.8.5. Sub-Alpine Vegetation 3200 – 3660 (-3800m)

The high altitude forests within the Singalila range between 3200 – 3660 (-3800m) characterizes the Sub-alpine vegetation of Darjiling Himalaya. The plants in this zone are dwarf, bushy and thorny and comprise of dominating tree species like *Abies densa, Sorbus microphyllus, Viburnum nervosum, Juniperus pseudosabina, Salix sikkimensis, Acer caudatum, Lyonia ovalifolia, Skimmia laureola* etc. The scrubs are composed of *Berberis, Euonymus, Gaultheria* and *Vaccinium.* The dominating herb species are *Arisaema utile, Carex inclinis, Allium wallichii, Saxifraga spp., Juncus grisebachii, Fritillaria cirrhosa, Meconopsis nepaulensis, M. paniculatus, Agrostis micrantha, Helictrotrichon virescens, Trisetum clarkei, T. spicatum* subsp. *himalaicum, Tripogon filiformis, Festuca polycolea, Festuca rubra, Kobresia pygmaea, Kobresia fragilis, Anaphalis contorta, Primula capitata, P. sikkimensis, Cassiope fastigiata, Aconitum ferox, Sedum multicaule,* etc.

2.8.6. Planted Vegetation

For the production of high value timber, extensive plantation has been done in the region both before and after the independence. The most commonly planted species that can be seen all along the hilly terrain is the *Cryptomeria japonica,* an exotic species from Japan that has tremendously destroyed the native flora invasively. In the lower tropical zones, plantation of Sal (*Shorea robusta*) and Teak (*Tectona grandis*) are very much popular. The state forest department conducts various plantation programs like Enrichment program, Forestry Extension Program, and Social Forestry program regularly.

Some of the important tree species that has been planted are *Castanopsis hystrix, Pinus* spp., *Taxus wallichiana, Thuja* sp. and exotic conifers like *Pinus petula, Cupressus* spp. etc at some higher elevation regions. In the Sub-temperate zone, species like *Alnus nepalensis, Albizia* spp., *Betula alnoides, Gmelina arborea, Juglans regia, Magnolia champaca, Magnolia doltsopa, Toona ciliata* have been planted and along with *Shorea robusta* and *Tectona grandis,* species like *Chukrasia tabularis, Dalbergia sissoo, Eucalyptus globulosus, Terminalia alata, Terminalia myriocarpa* have also been planted in the Sub-tropical and Tropical zones (Fig. 2.6). Most of the area in plains and Terai are being cleared now for tea cultivation and at present there are 87 tea estates in the district. In places like Mungpoo, Lathpanjar, Mansong, Gairibans (Dooars) plantation of medicinal plants

like *Cinchona succirubra, Rauvolfia serpentina, Carapichea ipecacuanha, Dioscorea deltoidea,* etc. is being done extensively.

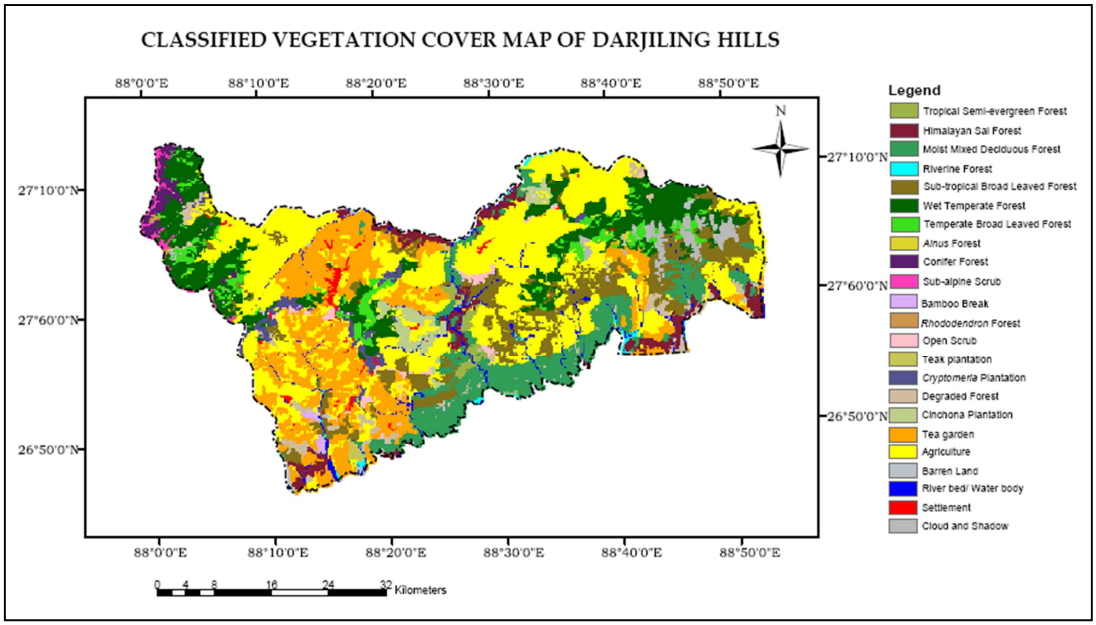

Fig. 2.6. Vegetation cover map of Darjiling Hills (*Rai, 2006*)

2.9. FAUNAL DIVERSITY

The Darjiling Himalaya being botanically blessed is also rich in faunal diversity. Till the beginning of last century there were fairly large numbers of faunal elements such as leopard, large tiger-cat, marbled tiger-cat, Himalayan Black Bear and the Bengal Tigers (O'Malley, 1907). There are two National parks, three Wildlife Sanctuaries, many reserved and other forests and abundant social and private forest pockets within the district those houses numerous faunal species including mammals, birds, butterflies, beetles, snakes, etc. which contributes additional significance to the biodiversity of the district. 72 % of the mammalian diversity of the state of West Bengal is found in the Darjiling Himalayan region of which 53 species are endemic (Chakraborty & Agrawal, 1993). Ninety four species of birds, 276 species of insects and 38 species of other invertebrates have been identified in Neora Valley National Park (Singhal & Mukhopadhyay, 1998). Mallick (2012) reported 99 species of mammals from the district (specially the Kalimpong Hills) out of which 21 species were threatened such as Red Panda *(Ailurus fulgens)* which is found only in the forests above 2500 m, Oriental Small-

clawed Otter *(Amblonyx cinereus),* Gaur (*Bos gaurus),* Golden Jackal (*Canis aureus*), Wolf sp. (*Capricornis sumatraensis),* Mainland Serow (*Canis indica*), Asian Golden Cat (*Catopuma temminckii*), Indian Wild Dog *(Cuon alpines*), Indian Elephant *(Elephas maximus*), Common Indian Hill Otter *(Lutra lutra monticola*), Smooth Indian Otter (*Lutrogale perspicillata*), Himalayan Yellow-throated Marten or Indian Marten (*Martes flavigula*), Sloth Bear (*Melursus ursinus*), Brown Ghoral (*Naemorhedus goral),* Clouded Leopard (*Neofelis nebulosa*), Common Leopard (*Panthera pardus*), Tiger (*Panthera tigris*), Marbled Cat (*Pardofelis marmorata*), Brown-toothed Shrew *(Soriculus nigrescens*), Himalayan Black Bear (*Ursus thibetanus*) whose habitat is the bamboo forests of Senchal Wildlife Sanctuary, Singalila and Neora Valley National Parks. Some of the common mammals include the Common Indian red-tailed Hare (*Lepus ruficudatus*), the monkeys, squirrels, moles, rats and mice.

Some of the rare avifaunal species from the Darjiling hills are Buzzard (*Butea sp*), Himalayan red-breasted Falconet (*Microhierax caerulescnes*), Spotted Seops Owls (*Otus spilocephalus*), Himalayan Golden-breasted Tit-Babbler (*Aleippe chrysotis*), Golden Stadt's Redstart (*Phoonicurcus erythrogaster*), Eastern Plain-colored Mountain Finch (*Leucostricta nemoricola*), Monal pheasant (*Lophophorus impejanus*), Crimson tragopan (*Tragopan satyra*), Blood pheasant (*Ithaginis cruentus*), Partridge (*Fancolinus* sp), Eagles (*Aquila* sp), *Falcons* sp, Hawks (*Spizaetus* sp), Scarlet Minivet, Kalij Pheasant (*Euplocamus leucomelanus*), Common Wood Partridge (*Arboreola torqueola*), Wood Cock (*Scolopax rusticola*), Red Jungle-Fowl (*Gallus ferrugineus*), Red Spur-Fowl (*Galloperdix spadiceus*), Pea-Foul (*Pavo cristatus*), the Lasser Florican (*Sypheotydes bengalensis*), Satyr Tragopan, Brown and Fulvous Parrot-bills, Rufous-vented Tit etc. (O'Malley, 1907). The Himalayan salamander (*Tylototriton verrucossus*), which is a critically endangered species has been included in the Schedule I of Indian Wildlife Conservation list and have been found to occur in some places of Darjiling like Jorepokhari, Lapcheyjagat, Sittong, etc. Not only this, numerous poisonous, less or non poisonous snake species are also found in the district and the common ones are King Cobra (*Naja bungarus*), the common Cobra (*Naja tripudians*), the Krait (*Bungarus coeruleus*), the Banded Krait (*Bungarus fasciatus*), Viper (*Vipera russelli*), the Python (in the Terai) and several species of

Trimeresurus (O'Malley, 1907). A checklist of 37 species of amphibians from the district has been prepared by De (2016).

Besides these, occurrence of various rare and endangered mammals like The Blue Sheep (Bharal) (*Pseudois nayaur*), Porcupine (*Hystrix indica)*, Armadillos, Wild boar (*Sus scrofa cristatus)*, Barking deer (*Muntiacus vaginalis)*, Pangolin, Pika, the Hispid Hare (*Lepus hispidus*) etc. were also confirmed from direct or indirect evidences (Mallick, 2012). The last few decades have brought an extensive construction of roads and thus reduction in the forest area. The local migration of the species is yet to be understood which greatly depends on the adaptability to climatic conditions and food supply.