CHAPTER – 3
STUDY AREA

3.1 Darjiling District

This small township of Darjiling was laid out by Lord Napier (http://www.darjeeingnews.net) of the Royal engineer and has since been the destination to the British people. The name Darjiling is believed to have derived from two sources, (i) the Tibetan word '*Dorje ling*' where '*Dorje*' the celestial spectre or double headed thunderbolt and '*ling*' is the land. Thus it literally means the place of thunderbolt of lamaist religion and (ii) the Sanskrit word '*Durjay Ling*', means Siva of invincible prowess who rules the Himalayas (Rai, 2002; Lama, 2004). The evidence of the worship place, which stands atop the Observatory Hill, corroborates the sources and thus the district came to be known by the same name.

The creation of the present district in the middle of nineteenth century came after accession of Darjiling and Kalimpong region from two neighbouring countries by signing treaties. The Sikkim part of Darjiling was acceded to the then British India government by an accidental involvement of the British in the affairs of Sikkim. The Terai and hills west of Teesta were a part of Sikkim prior to 1789 AD. The expansionist ambition of warrior like Nepalese force started adventuring along the southern, western and the eastern boundary annexing smaller territories so, much so that they established their rule upto west of Teesta. However, their defeat at the hands of the British force saw the signing of Sugali treaty in 2nd December 1815. The treaty dictated to return of Terai area and Darjiling part of its possession to the British India. The British restored the region to Raja Chogyal of Sikkim by signing the treaty at Titleya on 10th February 1817, thereby, making a buffer state between India and Tibet. This peace of land was donated by the Raja of Sikkim to the British on 1st February 1835 with the request by the then Governor general Lord William Bentick for establishing a summer capital and a sanatorium for the wary and/or sick soldiers as a friendly gesture. Kalimpong, on the other hand, was originally a part of Sikkim but later occupied by Bhutan. It was acceded to British India by the Sinchula treaty of 10th November 1865 by the Govt. of Bhutan on a lease basis and was then notified as a sub-division of Daurs. It was transferred to Darjiling in 1866. Since then the district has retained its geographical dimension, though its administrative placement kept on changing

from Rajsahi province to Bhagalpur province (Bhujel, 1996; Das, 2004). Its final annexure to the state of West Bengal was an automatic incident in 1947. The three hill sub-divisions are now under the administrative purview of the Darjiling Gorkha Hill Council (DGHC) that came into effect on the 22nd August 1988.

3.2 Location

Darjiling is the northernmost and the only hill district of West Bengal state and appears as an inverted wedge with its geographical extent of 26° 27' 05" and 27° 13' 10" N latitude and 87° 59' 30" and 88° 53' E longitude (Fig 3.1). The mountainous tract is contiguous with the rest of the Himalayan region with different political boundaries. Floristically, Eastern Himalayas, including Darjiling hills is part of Indo-Malayan realm. Biogeographically the area shares two important zones *viz.* 7B and 8 of Gangetic Plains and the North-East India. (Rodger and Panwar, 1990).

The district is separated by major rivers, the Mechi forming boundary with Nepal on the West; the Jaldhaka separating Bhutan in the North-East and East; the Teesta and the Rangeet form its northern border with the state of Sikkim. The plains of Terai and Duars maintain continuity with Jalpaiguri district of West Bengal and Bangladesh on the East; Purnea district of Bihar on the South-West and the North Dinajpur district of West Bengal is on South. Apart from the entire Siliguri Subdivision and a small part of the Kalimpong subdivision, the rest of the district is mountainous with difficult terrain. In the present study, the hills of Darjiling extending from 180 m amsl and covering places like Lohagarh, Changya, Rohini, Sukhna, Kalijhora, Gorubathan etc along the foothills upto the highest point at Phalut (3660 m amsl) in the north-west and Rachilla danda (3030 m amsl) at Neora valley National park in the north-east have been covered.

LOCATION MAP OF STUDY AREA

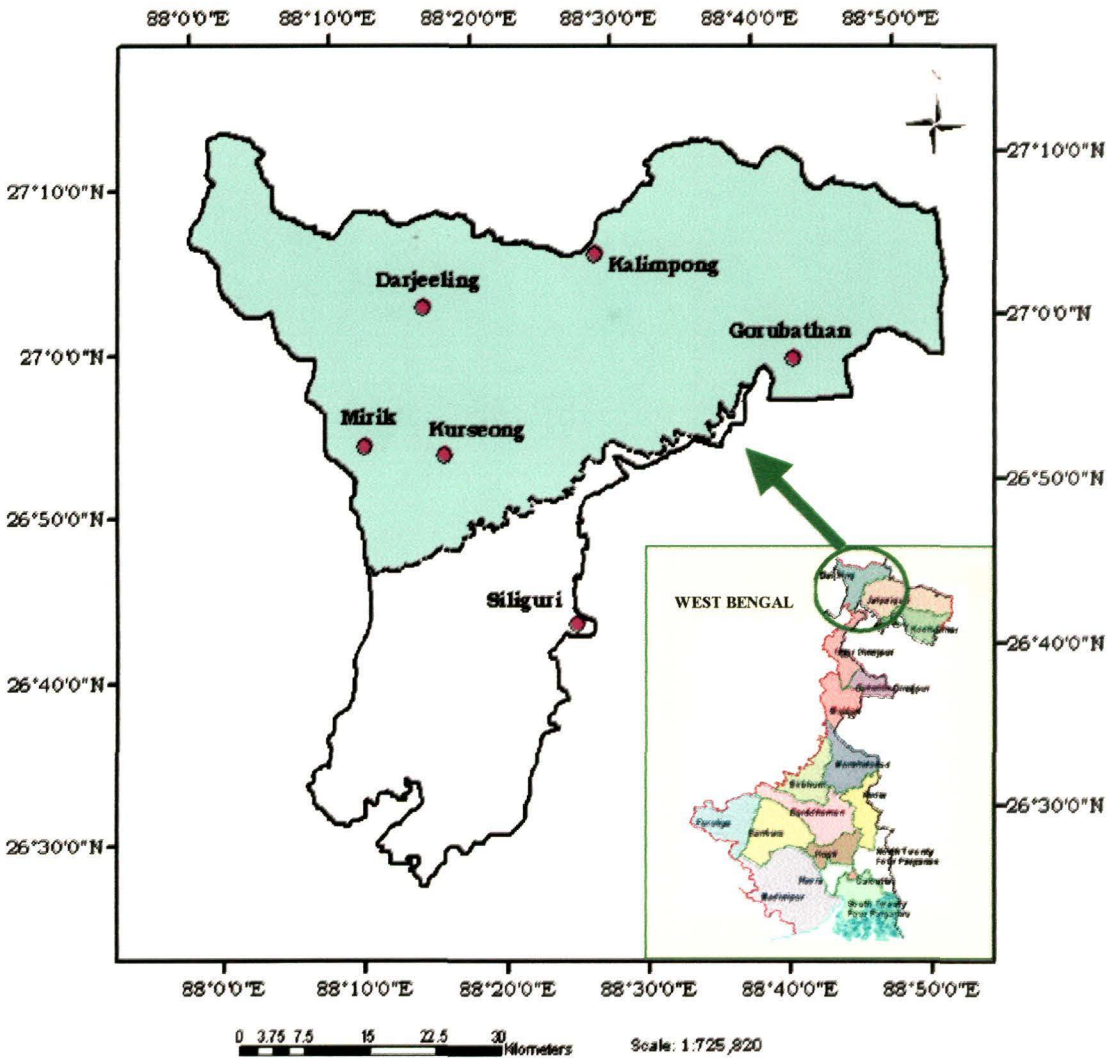

Fig. 3.1

3.3 General features

3.3.1 Topography

The Darjiling district is basically mountainous with elevation towards the northern direction. The hills of Darjiling are the extension of Singalila range that enters the district near Phalut from Mt. Ghosla (3800) m at Sikkim. The highest points Sandakphu and Tonglu of the district after Phalut (3700 m) are the continuation of the Ghosla-Phalut ridge. The Ghosla Phalut ridge enters the Tiger Hill node from where four major ridges radiate out along four directions (Banerjee, 1980; Das, 1986; Bhujel, 1996) *viz.* Darjiling ridge in the north extends to Lebong through Jalapahar, BirchHill and descends to the river Rangeet at Badamtam. The Takdah spur in the east spreads down to Teesta Bazar. In the southern region, the Dow Hill ridge which is long and forms numerous spurs rolls down to the plains of Darjiling and Jalpaiguri districts; the fourth forming a horse shoe-shaped ridge is the longest of all traverses along Sukhia, Simana, Mirik extending in south-western direction from the node finally descends down to Dudhia where it joins the plains of the district and Nepal. The Rechila and Thosum peaks in Kalimpong sub-division of the district lie on the eastern ridge and spreads from Lava.

3.3.2 Geology

Very little geological investigations has so far been carried out except in the foot hills of Eastern Himalaya because of prolonged wet monsoon seasons which mask a great deal of the geological features (Gansser, 1964). However, Geological investigation of Sikkim and adjoining Bengal region began as far back in 1854 where Hooker in his famous 'Himalayan Journals' reported regional gneissic domes, the overlying bedded sedimentary rocks and crinoidal limestones at the Tso Lhamo lake during his extensive travels in many parts of Sikkim. An excellent account of the geology of the Darjiling district and its foothills has been made by Mallet (1874). Von Loczy published a geological section from Darjiling to Kanchendzonga, which he observed as far back as in 1878 (Gansser, 1964). Ray (1947) has given a detailed description of the Darjiling area and stresses the zonal metamorphism. Sinha Roy (1974) studied polymorphism in daling rocks of Eastern Himalaya. Other notable works on the geology of the region were made by workers like Bose (1891), Wager (1934), Auden (1935), Heim and Gansser (1939), Acharya (1968), Mukhopadhyay and Gangopadhyay (1971), Lahiri and Gangopadhyay (1974), Srimal (1974), Powde and Saha (1982).

The Himalayan region is believed to be an old geosyncline that was once occupied by a long arm of the sea called Tethys. A series of upheavals led to the elevation of the ancient sea of Tethys that led to the accumulation of the various sediments. The upheaval of the mountains is not a continuous process; it took place in four successive stages separated from each other by long intervals of time. The first upheaval took place in the Upper Eocene period, resulting in the breaking up of the continuity of the sea basin into smaller areas of sedimentation. The second upheaval of the Middle Miocene led to longitudinal depressions on the southern side where the succeeding Siwalik sediments were laid down. The third phase of Himalayan orogeny, during the Upper Pliocene period, gave rise to the present day Siwalik hills and the fourth that commenced in the Pleistocene led to the alluvial deposits being pushed up to their existing heights. This phase continues and the mountains are still believed to be getting higher as a result. The Sikkim – Darjiling Himalaya is wedged between Central (Nepal) Himalaya and the Bhutan Himalaya and consists of unaltered sedimentary rocks. The Sub-Himalaya is entirely constituted of *Siwalik* and younger deposits of Tertiary age. They are comprised of coarse grained sandstone, shaly sand stone, siltstone and conglomerate. All along the foothills of the Darjiling district the Siwaliks are steeply overthrust by formations belonging to the *Damudas* (Lower Gondwanas). Damudas are coal-bearing rocks of Gondwana age and most of them found in this region are believed to be an inverted section, which are highly tectonized and does not resemble the well known Damudas of Peninsular India. This thrust zone coincides with the well-known Main Boundary Fault, which extends for the whole distance along the Himalayan range. They seem to be a characteristic representative of the late Precambrian to early Cambrian argillaceous sequence (Gansser, 1964). Gondwana formations, comprises mainly of felspathic and micaceous quartzitic sandstone, carbonaceous shales, thin lenses of crushed and shred coal and pebble/ boulder bed. Northward, the Damudas is succeeded by the very uniform and characteristic *Dalings* with a sharp thrust contact. Dalings the term coined by Mallet (1974) are remarkable for their constant development and the monotonous lithology over a great thickness. As a result they exhibit gradual increase in metamorphism (inverted metamorphism) as one move from river Teesta to Darjiling. The Daling series are well developed all along the lower and middle course of the river Teesta and form over 50 km long core of the large north-south directed domal uplift. The most interesting geological feature of the lower Himalayas is the upwards progressively increasing metamorphism of the Dalings. A three fold division has

been suggested by Heim and Gansser (1939) and Gansser (1964) as Daling schist, garnetiferous mica schists and Darjiling gneisses starting from river Teesta to Darjiling. The *Darjiling gneiss* succeeds the Pre Cambrian Dalings that lie further north. It comprises garnetiferous biotite Gneiss, vatities of high grade schistose rocks and magnetite.

3.3.3 Soil

The Darjiling–Sikkim Himalayas enjoy a wide range of physiography, geology and vegetation that influence the formation of different kinds of soils (Planning Commission, 1981). In accordance with the physiographic sequence and terrain features soil of Darjiling Sikkim Himalayas is represented with 5 orders. The lower elevations comprise of the *ultisols* of the palehumultus group and comprises of red, brown and yellow soil with coarse texture. Further north the ultisols give way to the *alfisols* of the hapludalfs or submontane type. The alfisols are followed by the *mollisols* comprising or three suborders udolls, argiudolls and hapludolls occupies the steeper slopes under the temperate forests. The *entisols* with four sub orders arents, psamments, flubents and orthents occur further to the north and the *inceptols* with two sub-orders orchrepts and umbrepts make up the northern most part of the region. The depth of the soil varies from 0-100 cm in different regions, with texture varying from fine sandy, loamy to sandy. The pH of the soil of the region is acidic due to heavy rainfall the region experiences leading to the leaching of bases from the soil surfaces to low horizons. The pH ranges from being slightly acidic between 5.6-6.5 in some parts with the major portion showing highly acidic soil with pH below 5.5. Almost everywhere the soils are derived from weathering of underlying rocks. The impervious clay is found mixed with the grains of quartz, feldspar and flakes of mica. This has a bearing to the massive landslips in the hilly regions.

3.3.4 Drainage system

The rivers of the district ultimately drains to the south but the west to east ridges across the hills causes a series of rivers, rivulets and streams to flow northwards or eastwards before joining the main river system (Fig 3.2). The two most important rivers of Darjiling are the river Teesta and the Great Rangeet. Both these glacier fed rivers originate in Sikkim. While the Teesta originates from the Zemu glacier located in north Sikkim, the Rangeet arises from Rothong glacier in West Sikkim. The Teesta traverses through a large part of Sikkim and enters the district of Darjiling at the point it meets with the Great Rangeet at Tribeni

near Teesta bazar in the northern part of the district. The main tributary of Teesta is the Great Rangeet, It receives tributaries like Ramam river, Sirikhola arising from Singalila, little Rangeet originating in Manebhanjang saddle and the Tonglu and Rungdung khola originating in Jorebonglow saddle. After collecting other numerous small riverulets from the adjoining area, finally joins the Teesta. Teesta after receiving the Rangit flows through the Darjiling district and finally enters the plains of North Bengal and joins the mighty Brahmaputra in Bangladesh. Tributaries join the Teesta through all directions. Among the north flowing rivers are Rangbhang khola and Rishi khola originating in the Neora valley, Mandum khola in Algarah and Medong reserve forest, Kasbyam khola originating in Damsong in Kalimpong which drains in the Rangpo chu and subsequently joins Teesta from the eastern side. The major west flowing tributaries of river Teesta are Relli khola, which originates at Algarah, Tumthang khola originating in Chumsering and Payong reserve forest of Kalimpong sub-division and finally joins the Teesta. Among the east flowing rivers, Reyang khola originating from Mahaldiram Reserve Forest (2438m), Peshok and Gail khola, Kali khola are its main tributaries on the right bank.

The other important rivers of Darjiling include the *Balason* arising from the Ghoom saddle running south till it reaches the plains at an altitude of 304.8m and then turn south east and subsequently join the Mahanadi further south. It receives tributaries like Pulungdung khola, Rangbang Khola, Marma khola, on the right bank and Rinchingtong khola, Rakti khola, Rohini khola, Jor khola etc on the left. The *Mahanadi* has its source near the Mahaldiram Dime east of Kurseong and flows south-east receiving a few sizable right side tributaries the Siva khola being the most important one. Its left bank tributaries include the Jholi khola, the Jogi khola, Gulma khola Babu khola and Ghoramara khola. The Teesta and Jaldhakha form the western and eastern boundaries of the sub Division of Kalimpong. A number of rivers and tributaries originate in this sub-division the principal ones include the *Lish* which originates at the ridge of Pabringtar village and flows downwards receiving the Amlkhola on the western side and Turungkhola on the east further southwards it is joined by the Phangkhola and Chunkhola near the Bagrakote Colliery and eventually joins the Teesta at the Kalagaiti Tea estate. The *Gish* is formed by joining two small rivulets; one originating below Lava and the other below Chumang reserve forest. Ramthi and Lethi form the major tributaries of the river, which joins near uttar fulbari. The *Chel* originates in the Pankhasari in the Neora valley national park, where it receives major rivers like Dalim

chu near Fagu and Nir chu at Ambeok and finally joins the Teesta. The *Neora* originates from the Rechila Chawk just below the Rechila danda and joins the Thosum chu at the boundary of Thosum and Rechila. It then flows southwards collecting smaller streams and eventually joins the Teesta. The *Relli* originates in Khempong reserve forest below Lava-Algarah and runs along the southern boundary of Saihur reserve forest after which it is joined by the Pala and Lolley khola and moving southwards it joins the Rani khola. *Murti* originates in the Mo block south of Thosum hills flowing through the reserve forest and emerging in the Samsing area and eventually joins Jaldhaka river. The glacier fed river *Jaldhaka* originates in north Sikkim, after flowing through Bhutan joins the district near Todey-tangta. The important tributaries are Chutang chu, Kizing chu, Tapdong chu, Chi chu, Jal chu, Rongo Chu and Ma Chu all originating from Neroa valley that drains into Jaldakha river.

DRAINAGE MAP OF DARJILING HILLS

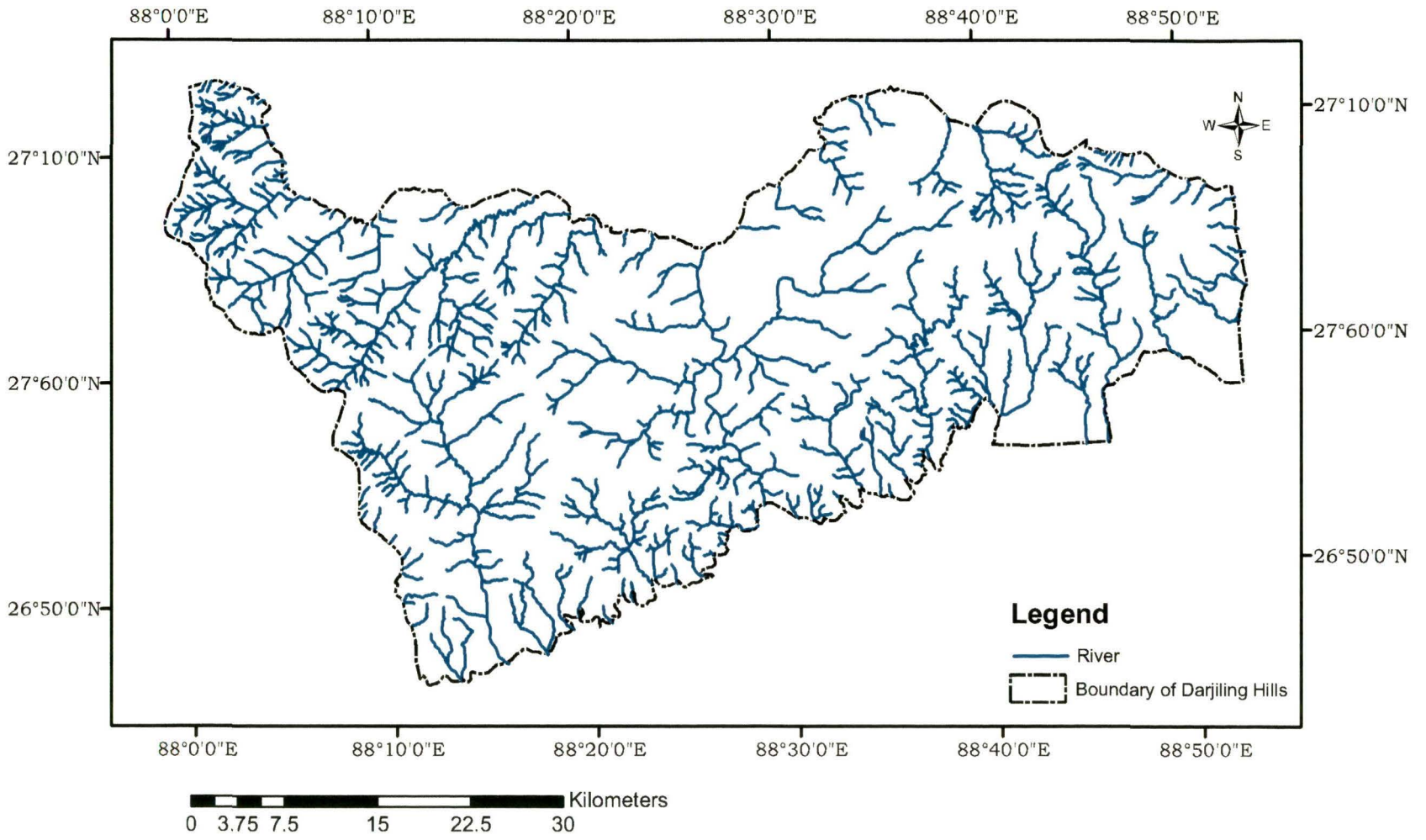

Fig. 3.2

3.4 Climate

Due to varied topographical and altitudinal conditions, the climate is much variable in different parts of Darjiling hills. The physical features of Indian subcontinent are of great importance as they have profound influence on the wind systems. This ultimately affects the climatic regime of the entire Himalayan region including Darjiling, affecting local temperature and rainfall. The Darjiling Himalaya shows its own climatic peculiarities caused by its geographical location, relief and a wide range of altitudinal variations ranging from 135m to 3660m amsl. It exhibits a typical monsoon climate, with wet summer and cold and dry winter. Such variations are brought about by the direct exposure to moisture laden south-west monsoon flowing upwards during June to September from the Bay of Bengal that lies at close proximity. The climate varies greatly corresponding to variation in altitude and configuration of the neighbouring mountain ranges greatly influences air movement, rainfall and temperature. Even within very short distances great climatic contrasts occur. Mountainous configuration of the district has led to varied climates ranging from the subtropical to the temperate and sub-alpine type. Thus, based upon the elevation the region shows three distinct climatic zones, viz. Tropical, Temperate and Sub-alpine. This variation is responsible for the creation of the various types of vegetation and also in bringing about great biological diversity. Four climatic seasons can be recognized within the region (a) Monsoon or Rainy Season, (b) Autumn, (C) Winter, and (d) Summer (spring). Spring and summer cannot be differentiated.

3.4.1 Rainfall

The area receives rainfall throughout the year, except for a short spell during the winters. Maximum rainfall is brought about by the south-west monsoon, which picks up the moisture from across the Indian Ocean and the Bay of Bengal and showers throughout June to September in the form of torrential rains. This constitutes 82% of the total rainfall. The south facing hill receives the highest rainfall compared to north facing places, which receives lesser amount. North-east retreating monsoon during December to March also contributes to rainfall in the region though to lesser extent (4% to the total rainfall in the region). The rainfall data recorded from 9 meteorological stations (5 from the upper hills and 4 from lower hills) have been analysed that has been provided in the form of ombrothermic graph in Fig 3.3 (a, b and c).

The average annual rainfall varies from 2,004 mm to 4,400 mm. Average annual rainfall in Sukhna is 4082 mm, Kalimpong 2004 mm, Singbulli 3800 mm, Sermali 4400 mm, Rambi 2987 mm, Sonada 3819, Lava 3367 mm, Darjiling 2910 mm and Monteviot 3977 mm. The average annual rainfall of the hills is 3483 mm. The upper elevation receives more rainfall than the lower hills, with upper hills receiving 3518 mm and lower hills with 3455 mm.

Average monthly rainfall varies from 21.62 mm to 902.66 mm for the entire Darjiling hills; 17.82 mm to 899.25 mm for the lower hills, whereas for the upper hills it is 22.29 mm to 906.91 mm. The rainfall gradually increases from March onward and peaks in July and gradually recedes. June to August is the wettest month, with consistently high rainfall. Highest average monthly rainfall of 1139.13 mm has been recorded from Sukhna met-station in the foothills and 1119.68 mm from Monteviot Tea garden met-station in the upper hills.

3.4.2 Temperature

The general temperature trend that prevails in the Darjiling hills is given in Fig. 3.3 (a, b and c). Wide altitudinal variation within the hills has lead to dramatic fluctuation in temperature regime; with warm and hot plains, cool weather in the higher altitudes yet extreme cold in the upper reaches of Singalila National Park at places like Sandkphu, Phalut and Rechilla in the Neora Valley National Park, where temperature remains below 10°C throughout the year. Mercury level at these places remains below zero for 2 – 3 months in winters with heavy snow covers. The plains are warm or hot throughout the year except a brief period during winters. During summers, the mercury hovers to around 27°C; in winters the temperature falls down to 8.5°C or less. Whereas, the upper hills, is relatively cool with temperature hovering to a maximum of around 21°C. Winters are severely cold where the temperature remains at sub-zero level, though for a brief period at places like Darjiling, Sonada, and Lava. Normally January is the coldest month and the average monthly temperature remains 6.5°C.

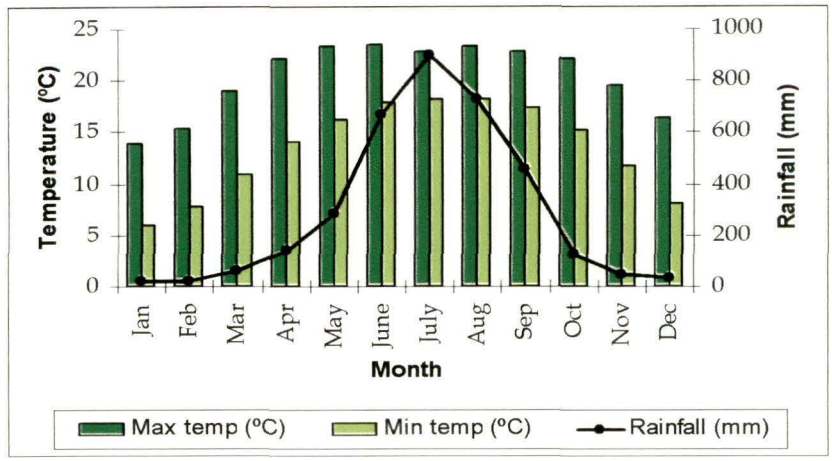

Figure 3.3a: Average monthly temperature and rainfall of Darjiling Hills

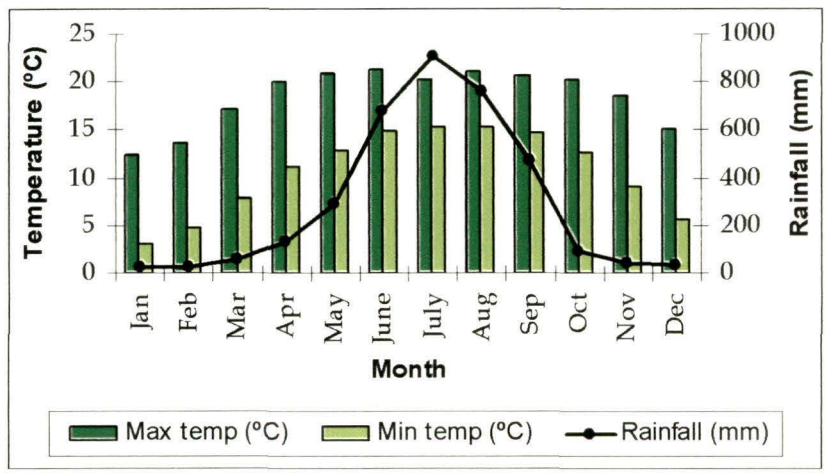

Figure 3.3b: Average monthly temperature and rainfall in the upper hills of Darjiling Hills (recorded from Sonada, Darjiling Agricultural office, Montivet & Lava weather stations)

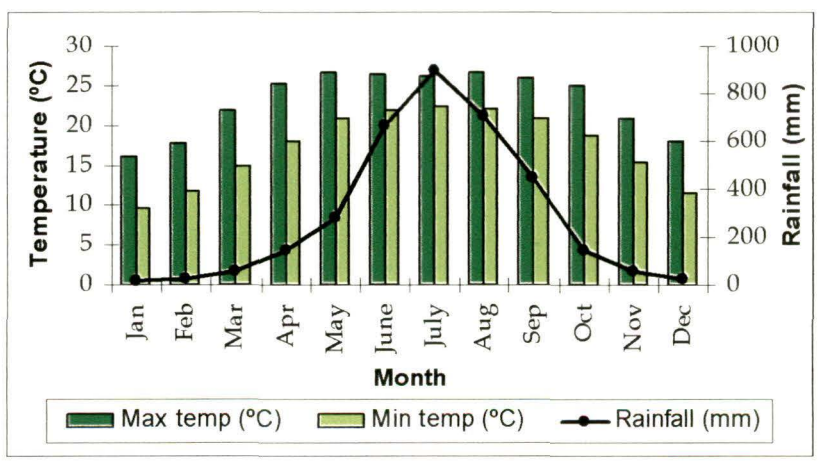

Figure 3.3c: Average monthly temperature and rainfall in the lower hills of Darjiling Hills (recorded from Sukhna, Sericultural office, Singbulli, Sermali and Rambi weather stations)

3.4.3 Relative humidity

The Darjiling hills experiences a high relative humidity, without much variation. Drier months of March and April are less humid. Wetter months show high humidity 86.53%. The relative humidity for a period of six years for three locations in the hills along with the district average is provided in Fig: 3.4

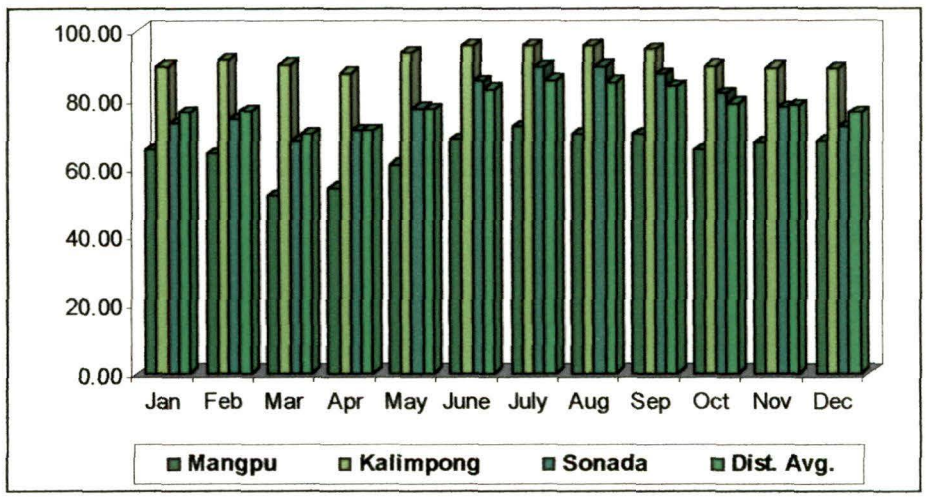

Figure 3.4 Relative humidity in three locations and the district average

3.5 Communication network

Physical features of the Darjiling Hills are treacherous, with extremely difficult topography in the upper elevation, the detail account of the difficulties faced by the then Britishers in road construction in Darjiling hills is given by O'Malle (1907) and Hooker (1954). The hills are well connected by two national and state highways in addition to number of motorable roads. A large number of metalled and unmetalled roads have come up since 1988 after the formation of the Gorkha Hill Council connecting the once inaccessible remote parts of the country with the mainstream. The road network of the Darjiling hills is given in Fig 3.5. The first motorable road connecting Darjiling with Siliguri was constructed as far back as in 1842. This Old Military road runs from Siliguri to Darjiling via Pankhabari, Dowhill running along the crest of Ghoom ridge. The present national highway NH-50, the hillcart road, an alternative to the Old military road was completed and became operational in 1869 connecting Sukhna, Rongtong, Tindharia, Gidhey pahar, Mahaldiram, Sonada in between these two major towns of Darjiling district. The national highway connecting Siliguri town with Gangtok in Sikkim runs parallel to the river Teesta was completed in the beginning of 1900s. This road connects Kalimpong town with the

rest of the areas in the plains and the hills. The state highway connects places like Mirik, Sukhia, Pesok, Kalimpong, Pedong Bijanbari, Lebong, etc. In addition, other motorable road connects places like Takdah, Gail, Badamtam, Namring, Rimbick, Manebhanjang, Pokhriabong, Gorubathan, Lava Todey, Suruk, Samtar etc.

The lone rail network, which has acquired a 'Heritage' status from UNESCO, traverses through the Senchal ridge via Mahaldiram and Kurseong that connects Darjiling town with Siliguri in the plains, which is operational since 1881.

3.6 Socio-economic status

General economic condition of the hills people is not very good; it is more of a subsistence type. The region lacks co-operate industries because of its poor location, infrastructure and other resources. But there are other industrial sectors, Tea being one of them. Its tea is known world over and highly sought after. Large sections of the population are employed in this sector. However, its cultivation is restricted to lower hills of Darjiling and Kurseong sub-divisions, and few in the Kalimpong sub-division. This industry has a work force of 52,000 persons (Paramanantham, 2003; www.teaindia.org). Tourism is another sector that provides employment to large number of population directly or indirectly. Yet another industrial sector is the cinchona industry, with a work force of 6000 people. These industries have helped uplift the economic condition to large section of the hill people. However, much of the population depends on agriculture sector with 26.58% of the hill population being directly involved in agriculture (Census, 1991). Hills of Darjiling supports 36.76% district population of 16,05,900, with a population density of 267.75 per sq km distributed in 342 villages and 3 municipal towns (Provisional Census, 2001). The rural population of the hills is 97.4%. Figure 3.6 shows the settlement map of Darjiling hills.

ROAD NETWORK MAP OF DARJILING HILLS

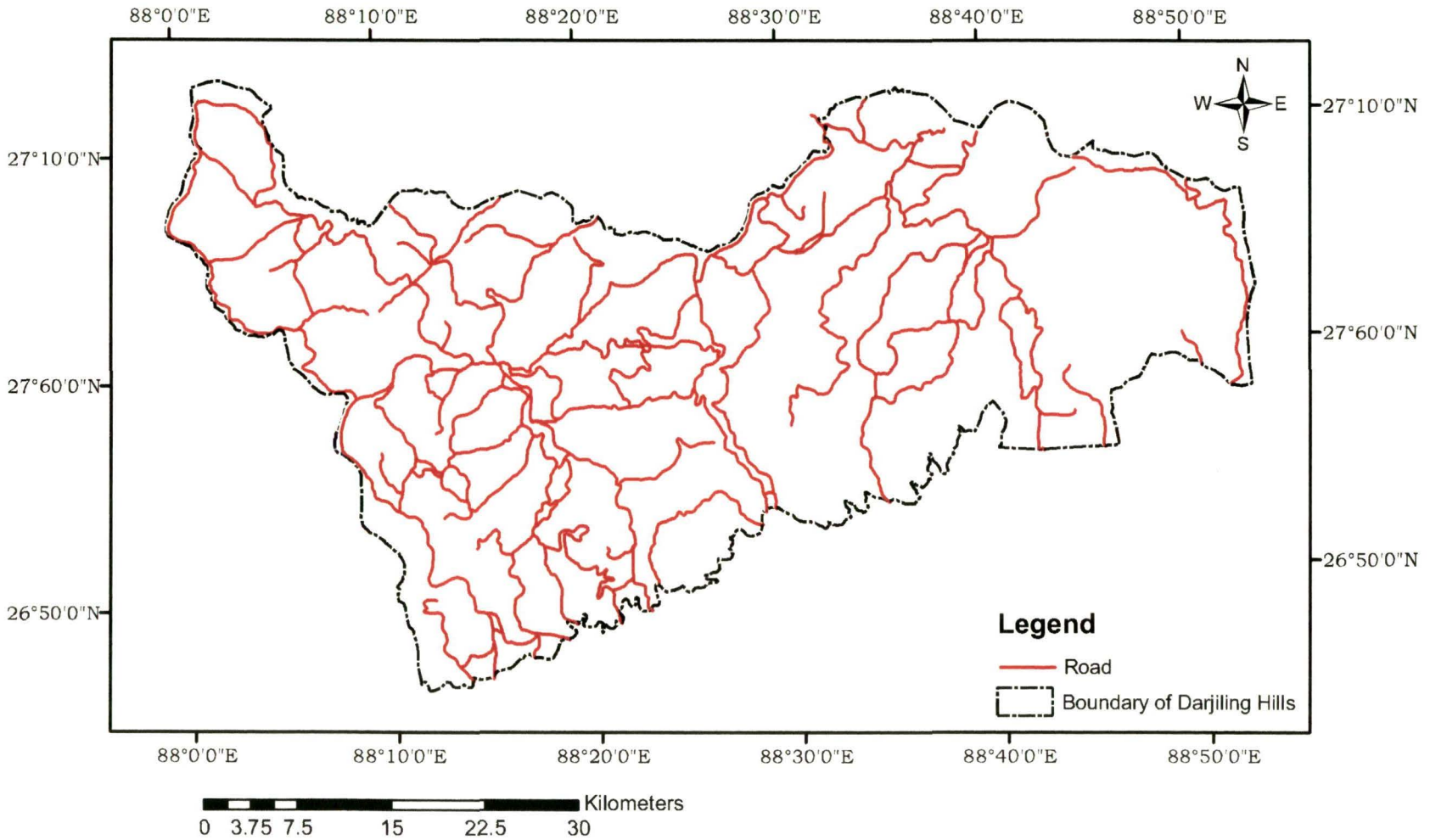

Fig. 3.5

SETTLEMENT MAP OF DARJILING HILLS

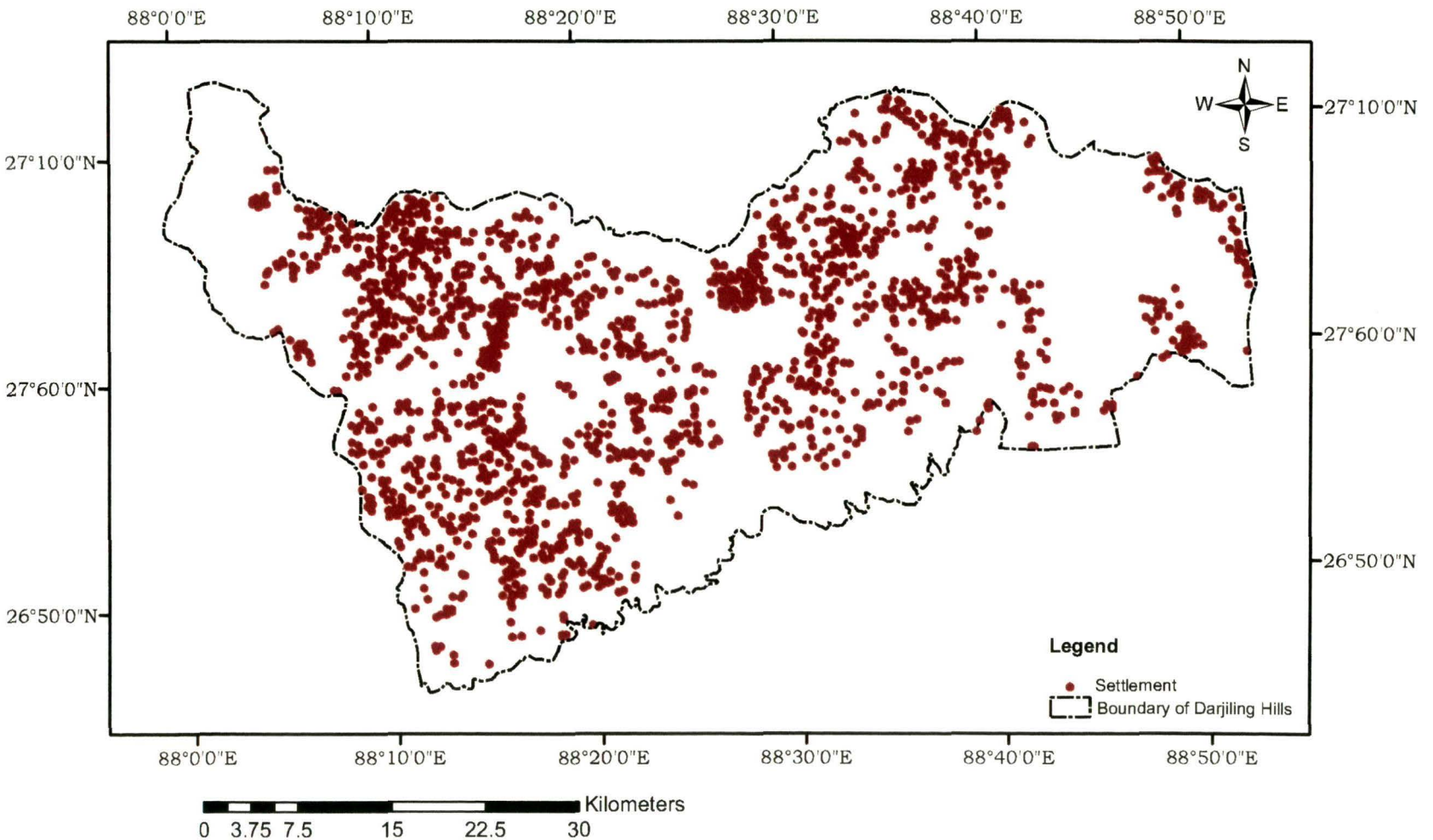

Fig. 3.6

3.7 Biological resources

The hills of Darjiling with its four protected areas (2 National Parks and 2 Wild Life Sanctuaries) apart from a large number of reserve forests, social forests etc. in different ecological zones provides an ideal home for diverse flora, fauna and microbes and forms a core part of Indo-Burma Hotspot. Because of extremely variable habitat, its micro-climatic condition, the region supports flora and fauna of diverse affinities.

3.7.1 Flora

Although geographical extent of Darjiling Hills is a meagre 2228.13 km^2 but the flora of the region is richest both in extent and in diversity of species composition. This great floristic diversity is largely attributed to its geographical and climatic factors that have not only helped the local flora to evolve but also to some plant species from surrounding places like China, Malaysia, Africa, Europe to migrate and successfully established in the region (Das, 1995; 2002). The unique location of Darjiling hills embracing small tract of plain and some partial snow covered landmass on its northern frontier has been a home to diverse type of vegetation. This climatic zonation is one of the important factors responsible for high proportion of diversity. A large number of angiosperms, pteridophytes along with gymnosperms are found to occur in this region some of which are endemic. An estimated 3500 species of angiospermic plants are found to occur in Darjiling district alone. An enormous number of timber yielding species, medicinal and aromatic plants and other economically important plants are found to occur in this region.

The forest types of Darjiling Himalaya as outlined by Champion and Seth (1968) in their revised survey can be classified as North tropical semi-evergreen, Eastern sub-montane semi-evergreen forest (2B/$C1_b$), North Indian moist deciduous Eastern hill sal forest (3C/C1a), North Indian moist deciduous Eastern bhabar sal forest (3C/C1b), North Indian moist deciduous forest (3C/C3b), Eastern Himalayan sub tropical wet hill forest (8A/C1), East Himalayan wet temperate forest (11B/C1a,bandc), East Himalayan mixed coniferous forest (12/C3a), Montane bamboo brakes (DS.1), Alder forest (1S1) and East Himalayan sub-alpine birch/fir forest (14/C2).

Dash (1947) classified the forest of Darjiling Hills based on altitude as Lower hill forest upto (970 m), Middle hill forest (970 - 1940) m and Upper hill forest. (1940 - 2900) m.

Bhujel (1996) has classified the vegetation of Darjiling hills in five major types with further down to phenological/associational sub-types for some types. These natural forests are the major source of timber, medicine and economically important plants. Among the chief timber yielding species are *Shorea robusta* Gaertner f., *Tectona grandis* L.f., *Terminalia bellirica* (Gaertner) Roxburgh, *T. alata* Roth, *T. chebula* Retzius, *Chukrasia tabularis* Jussieu, *Schima wallichii* (DC.) Korthals, *Michelia champaca* L., *Magnolia campbellii* Hook. f. and Thomson, *Acer campbellii* Hiern, *A. thomsonii* Miquel, *Tsuga dumosa* (D. Don) Eichler, *Cryptomeria japonica* (L.f.) D.Don, *Pinus roxburghii* Sargent, *Abies densa* Miller, *Gmelina arborea* Roxburgh, *Lithocarpus pachyphylla* (Kurz) Rehder, *Quercus spp, Castanopsis spp, Pterospermum acerifolium* (L.) Willdenow, *Sterculia villosa* Smith, *Pterygota alata* (Roxburgh) R. Brown, *Lyonia ovalifolia* (Wallich) Drude, *Rhododendron spp. Duabanga grandiflora* (DC.) Walper etc. are of worth mentioning.

The database for the medicinal and aromatic plant species have come from the medico-ethnobotanical studies over the last three decades. Das and Mondal (2003) has recorded 92 species of plants that have been used as medicine by the hill folk, Rai (2002) has extensively studied various therapeutic values of plants and has reported 421 species. Yonzon *et al.* (1984), Rai and Das (1996) have also contributed much in this field in their past studies. Some of the important medicinal and aromatic plants that are found to occur in the wild includes, *Acacia catechu* (L.) Willdenow, *Emblica officinale* L., *Terminalia chebula* Retzius, *T. bellirica* (Gaertner) Roxburgh, *T. alata* Roth, *Syzygium cumini* (L.) Skeels, *Schima wallichii* (DC.) Korthals, *Berberis aristata* DC., *Heracleum nepalense* D. Don, *Artemisia indica* Willdenow, *Rhododendron arboretum* Smith, *Dichroa febrifuga* Loureiro, *Dactylorrhiza hatageri* (Don) Soo, *Dioscorea deltoidea* Wallich ex Kunth etc. The forests of the region also supports myriad of plant species of commercial and aesthetic values. A large number of wild orchids, pteridophytes, climbers, shrubs, herbs and tree form the source of income as non-timber forest produce.

The climatic and edaphic isolation of the sub-Himalayan region have resulted in the high percentage of endemism. Results from relentless and extensive works of Das (1995), Bhujel (1996), Bhujel and Das (2002), Das (2004) on the flora of Darjiling hills have reflected a very interesting picture on endemic species. They have recorded over 404 endemic species (21.26%) from the region.

3.7.2 Fauna

The hill also represents great faunal diversity. Some of the rare avi-fauna found in the Darjiling hills are Buzzard (*Butea sp*), Himalayan redbreasted Falconet (*Microhierax caerulescnes*), Spotted Seops Owls (*Otus spilocephalus*), Himalayan Goldenbreasted Tit-Babbler (*Aleippe chrysotis*), Golden Stadt's Redstart (*Phoonicurcus erythrogaster*), Eastern Plaincolored Mountain Finch (*Leucostricta nemoricola*), Monal pheasant (*Lophophorus impejanus*), Crimson tragopan (*Tragopan satyra*), Blood pheasant (*Ithaginis cruentus*), Patridge (*Fancolinus* sp), Eagles (*Aquila* sp), *Falcons* sp, Hwaks (*Spizaetus* sp) etc. Besides, various rare and endangered mammals like Tiger (*Panthera tigris*), Red Panda (*Ailurus fulgens*). The Himalayan salamander (*Trilitotriton himalayana*), which is in the schedule I of Indian Wildlife conservation list have been found to occur in some places of Darjiling. Among other mammalian species are Ghoral (*Nemorhaedus goral*), Wild dogs (*Cuon alpinus*), Mountain fox (*Vulpes vulpes*), Himalayan black bear (*Sclenoroctos* thibetianus), Leopard (*Panthera pardus*), Porcupine, Armadelos, Wild bors, Barking deers, Wolf, Fox, Bisons, Clouded leopard, etc.