Chapter 1

INTRODUCTION

Introduction

The small township of Darjeeling (Darjiling, after the 1981 census), was laid out by Lord Napier (http://www.darjeelingnews.net) of the Royal Engineer and has since been the destination of people from all across the globe. The name Darjiling is believed to have been derived from the two sources i.e. the Corrupted form of Tibetan words 'Dorje or the celestial spectre or double headed thunderbolt and 'ling' meaning the land. Thus it literally means the place of thunderbolt of lamaist religion and from this Sanskrit words 'durjay ling', means Shiva of invincible prowess who rule the Himalaya (Rai, 2002; Lama,2004). The evidence of the worship place that stand at the top of Observatory hill, corroborates the source and thus the district came to be know by the name Darjiling.

The present Darjiling district was created during the middle of nineteenth century after the accession of Darjiling and Kalimpong from the two neighboring countries of Sikkim and Bhutan through the treaties. The Sikkim part of Darjiling was annexed by the Nepali forces,who extended the territory up to the west of the river Teesta. However the defeat of nepali warrior at the hands of British force lead to the signing treaty of Sugali on 2nd December 1815 through which Terai and Darjiling part was returned to the British India and eventually, the British restored the region to Raja Chogyal of Sikkim after Signing of the treaty of Titleya on the 10th February, 1817.This piece of land was donated by the Raja of Sikkim and the land gifted to East India Co. in 1835, did not comprise the whole present Darjeeling. It was narrow enclave of about 138 square miles, being about 30 miles long and 6 miles wide (http://darjeeling.gov.in/darj-hist.html).Constatnt invasion by the adjoining state of Bhutan plundering of areas of Darjeeling,lead to the deputation of Ashley Eden to negotiate with Bhutan in1863. The British on being openly insulted returned to Darjiling and in the winter of 1864, a military force was dispatched that led to the British capturing the whole Bhutan Duars .On the 10th November 1864, the treaty of Sinchula was signed through which the Bhutan

Duars along with the passes leading into the hills and Kalimpong were ceded to the British.

The Darjeeling district with an area of 1234 sq miles can be said to have assumed its present shape and size in 1866 (http://darjeeling.gov.in/darj-hist.html). The district retained its dimension but its administrative placement constantly changed from Rajsahi province to Bhagalpur province (Bhujel,1996;Das,2004). **The Goverment of India** (EXCLUDED AND PARTIALLY EXCLUDED AREAS) ORDER, 1936, No.166 placed the Darjiling district under partially excluded area **(**http://www.darjeelingtimes.com/columns/hilman/291-excluded-and-partially-excluded-areas.html). Its final annexure to the state of West Bengal was automatic incident in 1947. Presently the three hill subdivision is under the Gorkhaland Territorial Administration (GTA) that came into effect on October 2012.

1.1 Location

The Darjiling district lies between 26° 27' 05" and 27° 13' 10" N latitudes and between 87° 59' 30" and 88° 53' E longitudes **(**O'Malley, 1999**)**. The Darjiling hills is a segment of Eastern Himalaya, a part of Indo-Malayan realm and has an area of about 2436.55 km² or 77 % of the total area of the district. The altitudinal variation ranges from 130 m amsl to 3660 m amsl that present diverse topographical conditions (Das 1995; Acharya & Acharya,2001).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 Jaldhaka separating Bhutan in the Nort-East and the East; the Teesta and Rangit forming a northen border with the state of Sikkim; the Mechi forming a boundry with Nepal in the East.The hilly tract of Darjiling is contigious with the Plains of Terai, Duars and maintain the continuity with Purnea district of Bihar on South-West;Nepal on the West; Jalpaiguri District and Bangladesh on the East and The North Dinajpur district of west Bengal to the South. The Darjiling hill comprises of the three sub-division of Darjiling district which is mountainous and a difficult terrain. The present study covers all the hilly tract of Darjiling extending from 180m amsl and including places like Rohini,Sukhna, Singla ,Goak,Gorubathan,Sumbung etc. along the

foothills up to the highest point at Phalut (3660 m amsl) in the north-west and Rachilla Danda (3030 m amsl) towards the north –east.

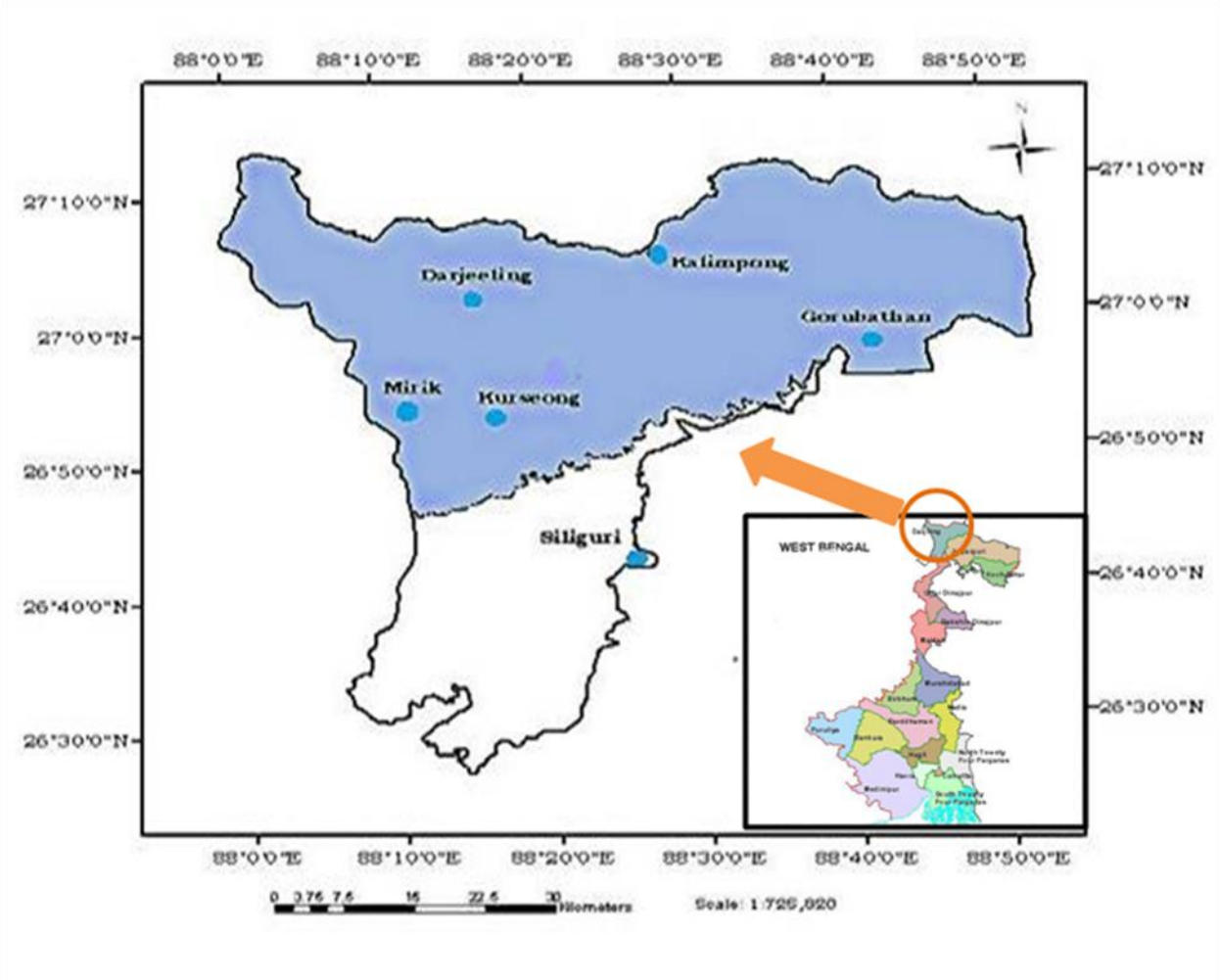

Figure 1.1: Map of the study area.

1.2 General Features

1.2.1 Topography

The three subdivision viz Darjiling,Kuresong and Kalimpong form a hilly tract with elevation towards the northly direction. The highest point of the District i.e. Phalut (3660 m amsl) is an extension of Singalila range that is the continuation of Mt Ghosla of Sikkim. 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, the Darjiling ridge extends towards the north through Jalapahar and descends at Badamtam. The Takdah spur in the East that spreads down to Teesta bazaar through Peshok. The Dow hill ridge form numerous spurs and descends to the plains of Darjiling and Jalpaiguri in the Southern region. The fourth ridge, the longest one traverses along Simana,mirik descends down in Changya-Panigahata in the south-west where it eventually form an contiguous with the plain area of District and with Nepal. The Rechila and Thomsum peaks in Kalimpong sub-divison lie on the eastern ridge and spreads from the Lava to…..

1.2.2 Geology

The geological investigation of Darjiling and Sikkim date as far back as 1854, where Sir Joseph Dalton Hooker in his famous Himalayan journal, reported regional gneissic domes, the overlying bedded sedimentary rocks and crinoidal limestone at the Tso Lhamo lake during his extensive travels. Various other works have studied the geology of this region, notable among them are Wager (1934), Heim and Ganseer (1939),Lahiri and Gangopadhyay (1974),Powde and Shah(1982). The geological formation of Darjiling district consist of different grades of metamorphic rocks in the plains andTerai while the hilly area confined to the south consist of unaltered sedimentary rocks. Very little geological investigation have been carried out except, for the foothills of the eastern Himalaya due to prolonged wet monsoon that mask a great deal of its geological features (Gansser,1964).Yin (2006), the Proterozoic rock sequences of the Lesser Himalaya in Darjeeling-Sikkim and Arunachal Pradesh are bound by the Main Central Thrust (MCT) in the north and the Main Boundary Thrust(MBT)in the south. The Himalayan range is a result of a series of upheavals in an ancient Tethys sea which had accumulated sediments of different Geological era. The upheaval took place in four successive phase, separated by long interval of time (Rai,2006). The rocks of Darjiling district has been divided by Mallet into five groups viz Gnesis, Daling series, the Buxa series, Gondwanas and the Tertiary system (O' malley,1999). One of the most striking feature of Darjiling hill is that the younger formation appear to underlie the older thus, the Tertiary bed ultimately disappear under the Darjeeling gnesis .

The Darjiling hill is comprises of Siwalik and younger deposit of Tertiary age. The foothill comprises of formation called *Damudas*(lower Gondwana) which are coal bearing rocks. The continuity of *Damudas* towards North is succeeded by the *Dalings* that show a sharp thrust contact. The Daling series rest under foliated metamorphic rocks which are partly Igneous and Sedimentary in Origin. This groups of rocks are Globally known as Darjeeling gnesis. The Daling group of rock comprises quartz-chlorite- sericite phyllite, Muscovite-biotite phyllite, slates, Quartzoes phyllite andquartzites of Gourbathan and dolomite,limestone and varigeted phyllite of Buxa formation (Geological Survey of India).

The rock types of the area investigated around Kalimpong comprise of politic, psammitic, carbonaceous and calcareous metasediments belonging to the Darjeeling and Daling series. Three generations of fold structures can be recognized in both the Darjeeling and the Daling rocks (Mukohopadhyay, 1971).

1.2.3 Soil

The soils of Darjeeling Hill area have developed depending upon the underlying geological structure along with fluvial action and their lithological disintegration (http://www.darjeeling.gov.in/geography.html). The Darjiling–Sikkim Himalayas enjoy a wide range of physiography, geology and vegetation that have influenced the formation of different kinds of soils (Planning Commission 1981). The texture of the soil varies from loamy to sandy and its depth range from 0 to120 c.m in different regions. Heavy rainfall in the area results in the leaching of the base from the soil with the pH remaining acidic in range between 5.6 – 6.5.The soli of Darjiling is represented by 5 orders i.e. a. Ultisols, b. Alfisols, c. Mollisols, d.Entisols and e .Inceptols. The lower tropical belt comprises of Ultisols that have a coarse texture and comprises of red to brown coloured soil. As the region ascends towards the sub-tropical zone the Utisols are replaced by Alfisols.The Mollisols make up the sub-temperate forest with steeper slopes.Towards the higher temperate zone the Mollisols are replaced by Ensitols. The Ensitols usually occur at Sub-alpine zone. The weak and unstable geology along with monsoonal type of per humid climate and undulating terrain with diversified landforms are some of the natural processes helping soil degradation in Darjiling and North –Eastern states (Patiram and Bhaduria, 1995).Thus, Dent(1984) regards the Himalaya as the most severely degraded region of the world.

1.2.4 River and Drainage System

Darjiling hill remains traversed by many rivers that ultimately drain towards South. The two biggest glacier fed rivers are the Teesta and Great Rangeet,that have their source of origin at the Zemu glacier located in North Sikkim and Rothong glacier in West Sikkim respectively. Teesta enters the district of Darjiling at the point it meets the Great Rangit (Melli) and its major tributaries in Darjiling hills are Reyang, originating from Mahaldiram Reserve Forest (2438m), Peshok and Gail khola constitutes its main tributaries on the right bank. The Great Rangeet is the main tributary of river Teesta and their point of confluence is called as trivani which is in Teesta bazaar. Great Rangeet originating from Rathong glacier in West –Sikkim enters the district of Darjiling on the northern boundry where it recives the Ramam river and Rangu arising from Singalila and Senchel respectively as the right bank tributaries. The other tributaries include little Rangeet originating in Manebhanjang saddle and the Tonglu and the Rungdung khola originating in Jorebonglow Saddle. The Teesta attains a mammoth size and flows through the Darjiling district and enters the plain of North Bengal and joins the Brahmaputra in Bangladesh.

The other important rivers of Darjiling is Mahanadi originating in the Mahaldiram Dime, East of Kurseong . It flows in the South-East direction with Siva khola, right bank tributary. The Jholi khola, the Jogi khola, Gulma khola, Babu khola and Ghoramara khola make up its left bank tributaries. The river Balason arises from the Ghoom saddle and subsequently joins the Mahanadi in the south. The important tributaries of Balason include Pulungdung khola, Rangbang Khola, the Marma khola, Dudhia khola on the right bank and Rinchingtong khola, Rakti

khola, Rohini khola, Jor khola etc on its left bank. The Teesta and Jaldhakha form the western and eastern boundaries of the sub-division of Kalimpong.

Numerous rivers and rivulets originate in this sub-division of Kalimpong chief among which is Lish having its source on the ridge of Pabringtar village. It flows downwards receiving the Amlkhola on the West and Turungkhola on the east. The river descend further Southwards and it is joined by the Phangkhola and Chunkhola near the Bagrakote Colliery and eventually joins the Teesta at the Kalagaiti Tea estate. The lava and Chumang reserve forest are the source of two rivulets that form the river Gish, its main tributaries being Ramthi and Lethi.

The Neora originates from the Rechila Chawk and joins the Thosum chu at the boundary of Thosum and Rechila and eventually joins Teesta. The Relli originates in Khempong reserve forest and runs along the Southern boundary of Saihur reserve forest. The two tributaries are Pala and Lolley khola and move Southward and joins the Rani khola. Murti originating in the Mo block south of Thosum hills flows through the reserve forest and emerging in the Samsing area and eventually joins the river Jaldhaka . The Jaldakha originates in North Sikkim,flows through Bhutan and enters the district at Todey-tangta. Its important tributaries include Chutang chu, Jal Chu, Rongo chu and Ma chu.

1.3 Climate

The meteorological parameters like precipitation, temperature, humidity, sunshine, velocity etc. and its cumulative effect on a locality is called as climate.

The great Himalayan range forms a barrier which separates the northern part of the Asian continent from the Indian subcontinent. The physical features of the subcontinent have a profound influence on the wind systems, which ultimately affect the climate. The Darjiling hills have a wide range of altitudinal variations

ranging from 300m to 3360m above sea level. The climate varies greatly with the variation in the altitude and the configurations of the hills greatly affect air movement, rainfall and temperature. Even within very short distances great climatic contrasts occur. The latitude of the region is located within the sub-tropical climate regime yet there is varied climate ranging from subtropical to temperate and subalpine type due to the mountainous configuration of the area. 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.

1.3.1 Rainfall

The area remains dry during the winters with occasional precipitation in the form of snow. Apart from the winters the area receives rainfall more or less throughout the year. The ascending south west monsoon laden with moisture from the Bay of Bengal account for about 82% of the total rainfall received in the region from June to September. .

The south facing slope of the town Kuresong receives the highest rainfall in the district of Darjiling that exceeds 4000 mm per anum. The north-east retreating winds also contribute around 4%of the total rainfall of the region. The rainfalls recorded from three weather stations in Darjiling Hills have been provided in the Figure 1.2.

1.3.2 Temperature

The temperature is inversely proportional to the altitude of a place in Darjiling hills. The places show marked differences in temperature with the altitudinal difference, where places like Sandhakphu, Rechilla, Phalut has an average temperature of 10^0 c throughout the year.In contrast the plains like Shukna, Teesta, Mungpong are warm and hot. In higher altitude the mercury hovers around sub-

zero level in winters. Figure 1.3,1.4 and 1.5 shows the detailed month-wise temperature record of Happy Valley Tea Estate, Darjiling (2150m), Tea research association(TRA) Kurseong (1480m) and Barnesbeg Tea Estate, Darjiling (750m) from 2011 to 2014. January is the coldest month and the daily temperature at Darjiling, Sonada and Labha often touches sub-zero level in day, at night it's even chillier.

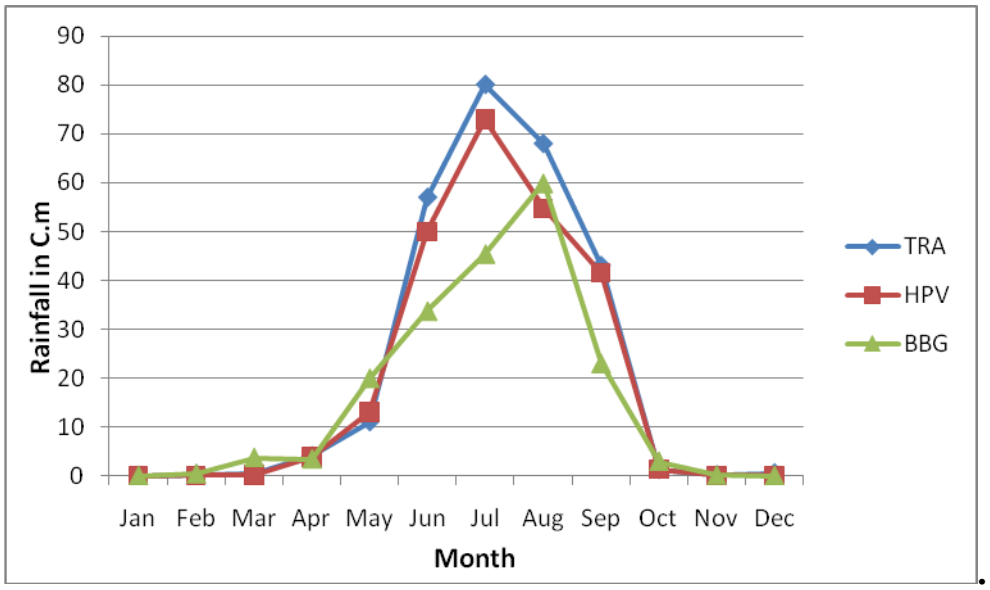

Fig 1.2: Average Monthly Rainafall (TRA= Kuresong, HPV= Happey Valley tea Estate, BBG= Barnesbeg Tea Estate)

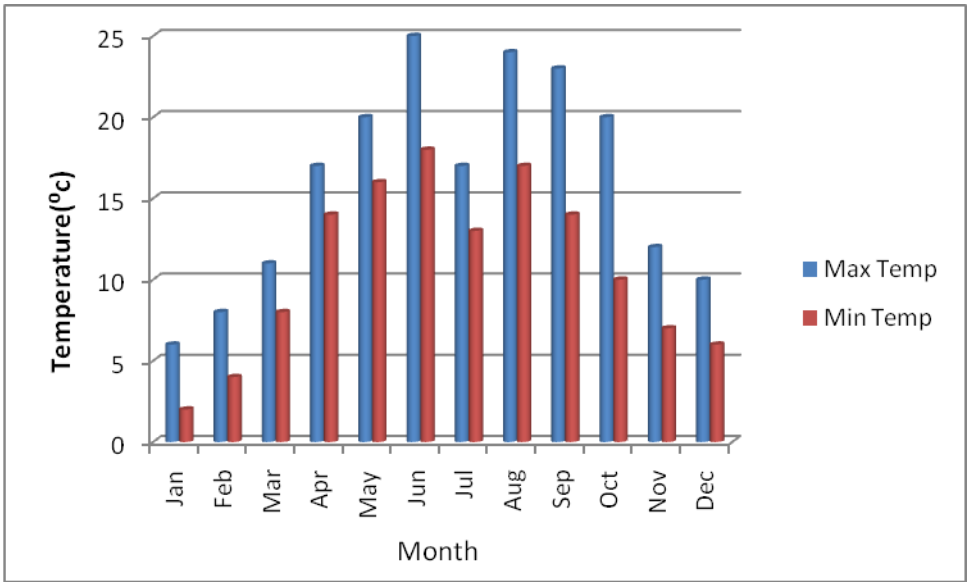

Fig 1.3: Average Monthly Temperature in the Upper Hills of Darjiling (Recorded from Darjiling, Happy Valley Tea Estate)

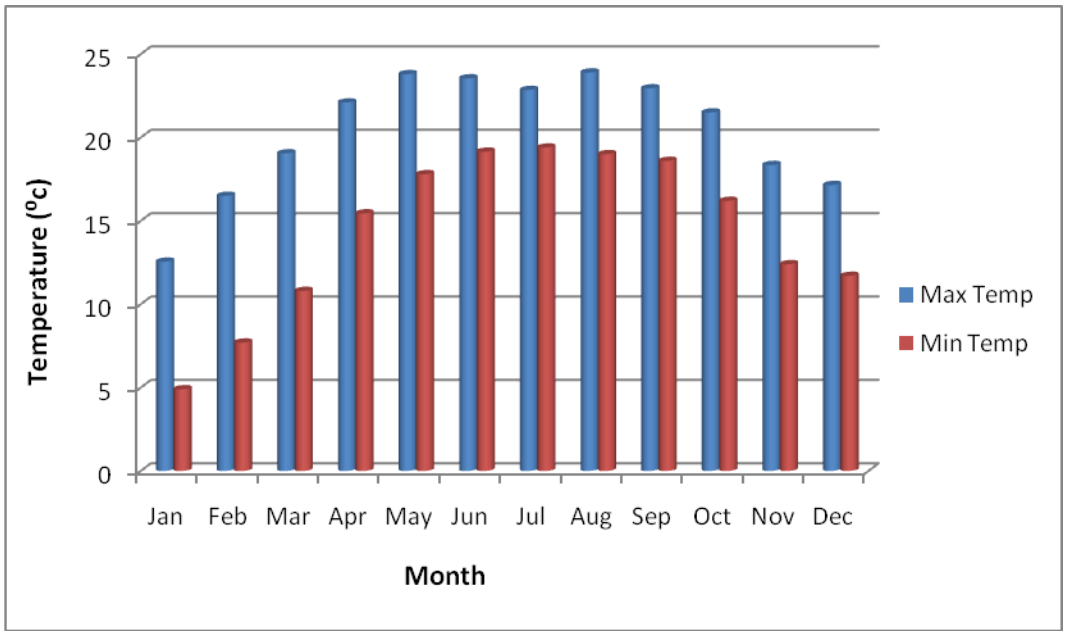

Fig 1.4: Average Monthly Temperature in Kuresong (Recorded from TRA,kuresong)

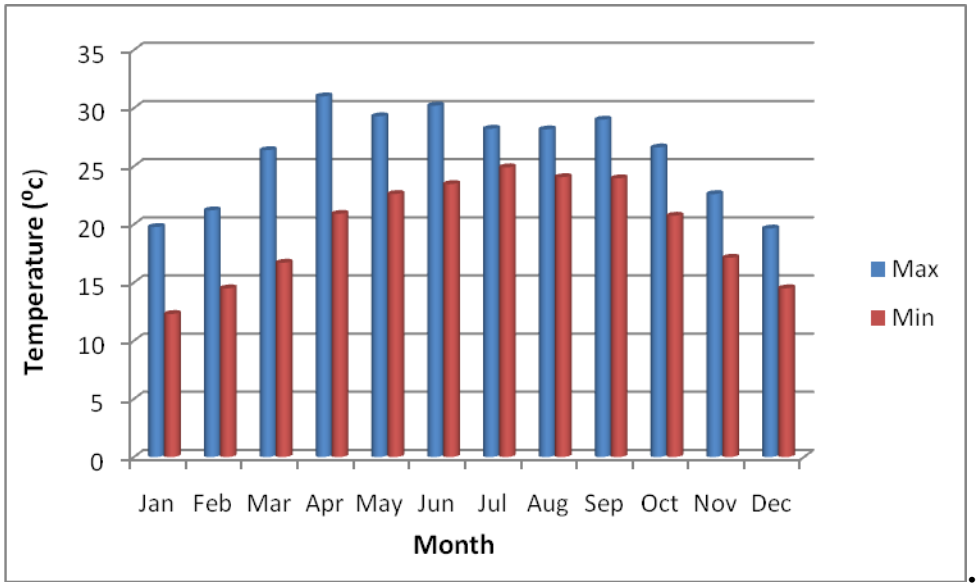

Fig1.5: Average Monthly Temperature in lower hill in Darjiling (Recorded from Barnesbeg Tea Estate)

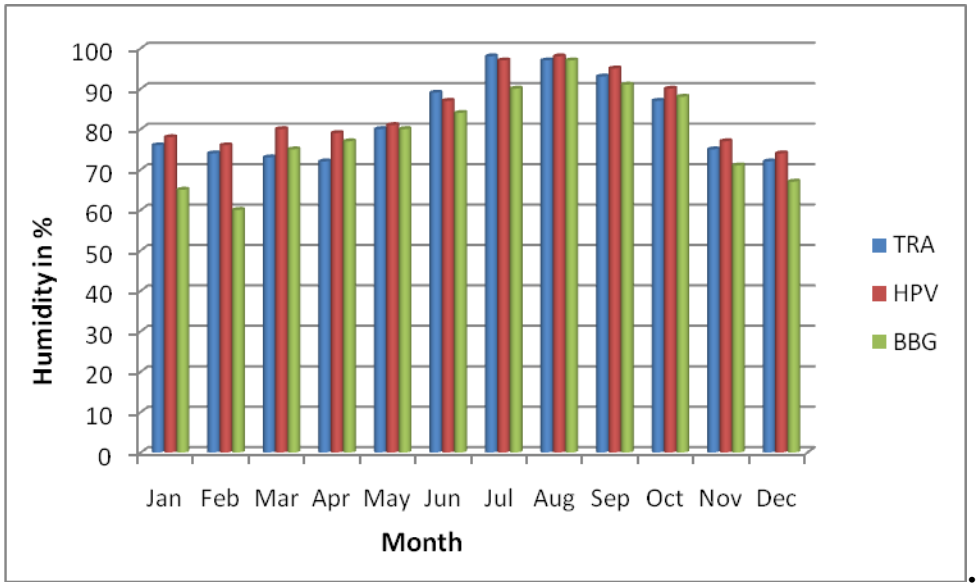

Fig 1.6: Average Monthly Humidity (TRA= Kuresong, HPV= Happey Valley Tea Estate, BBG= Barnesbeg Tea Estate)

1.3.3 Relative Humidity

Relative humidity in Darjiling hills remains comparatively high for most period of the year. March and April remain drier and show lowest relative humidity. The north facing slopes are colder and remain humid throughout the year. The highest

mean value (90 to 93%) occur in Darjiling from June to September (Dash,1947). The Relative humidity for a period of 4 years for three locations in the hill sub divisions of Darjiling have been given in Fig 1.6.

1.4 Communication Network

The topography and the steep ascend of treacherous Darjiling hills and the detail account of difficulties faced by the British during the construction of road has been well discussed by O'Malley (1907).In 1842, a motorable old military road was constructed connecting Darjiling to Siliguri via Pankhabari, Bagawra along the Ghoom ridge. After a gap of 27 years the Present Hill cart road the NH-55 was constructed connecting Darjiling to Siliguri. The NH-31 connects Gangtock to Siliguri that runs parallel to the river Teesta traversing the Darjiling District and Kalimpong sub-division. A number of State highway connect Mirik, Sukhai, Pedong, Bijanbari with the plains. After the formation of DGHC in 1990 and later GTA in 2013, numerous roads have been constructed that interconnect far-flung areas that were once remote and difficult to reach. Programs under Pradhan Mantri Gram Sadhak Yojna have helped Panchayat areas construct new roads providing and improving connectivity of the rural areas.

1.5 Biologcal Resource

Darjiling hills with an area of 2228.13km^2, with 4 protected areas viz Singalilla National Park, Neora valley National Park, Senchel wildlife Sancturay,Mahananda wildlife Sanctuary, reserve forest etc is an ideal home for diverse flora and fauna. Phytogeographically, the contiguous Darjiling-Sikkim Himalaya is a part of the Eastern Himalayan Province that in turn is one of the thirteen provinces of the Eastern Asiatic Regional Centre of Endemism (Takhtajan, 1986). Geographically the Darjiling hill is a segment of eastern Himalaya, having diverse ecological niche with diverse species composition.

1.5.1 Flora

Floristically, the Eastern Himalaya is one of the richest regions in the world and is literally considered a *botanist's paradise* and has thus, attracted a large number of plant hunters and botanists during the last three centuries (Don 1821, Das 1995). Phytogeographically it forms a meeting ground of the Indo-Chinese and Indo-Malaysian tropical lowland flora, the Sino- Himalayan east Asiatic flora and the Western Himalayan flora comprising about 9000 spp. with a high percentage of endemic plants (Chatterjee, 1939; Puri *et al*, 1983; Myers, 1988; Wilson ,1992; Das, 1995; Bhujel, 1996). This great floristic diversity is largely attributed to its topography and climatic factors that not only help the local flora to evolve, but also successful migration of plant species from surrounding places like China, Malaysia, Africa and Europe (Das, 1995; 2002). This province along with Khasi Manipur has the richest flora of the Indian subcontinent with the exception of Myanmar (Rao and Murti, 1990). A comprehensive travelogue through the dense and magnificent forest and vegetation of this region is rather difficult to conceive due to the nature of Himalayan terrain and intricacy of the plant cover comparable to almost that of the tropical rainforest in some of the river valleys (Bhattacharya, 1997). The forest of Darjiling and Sikkim himalya has been classified according to the altitude as Lower hill forest, Middle hill forest, Upper hill forest, Alpine and Sikkim alpine (Dash,1947).However later workers has classified vegetation of Darjiling hills into five types (Bhujel,1996).

The region is rich in Plants with Ethnobotanical values,92 species of plant has been documented for their utilization in medicine by the hill folk (Das and Mondal,2003), 421 species of plant has shown therapeutic values from Darjiling hills (Rai,2002),Chettri (2005) gave a current status of ethnomedicinal plants in the Darjiling Himalaya and listed 281 species where 14% of the medicinal plants are in different categories of threat, 256 plants species belonging to 220 genera and 120

families has been documented for ethno biological uses in the Darjiling hills (Yonzone et al, 2011),the study on 15 villages in Darjiling hills for ethnomedicinal plant documented 57 species,38 are herbs,9 are shrubs and 10 are trees (Samuel et al,2013). The important medicinal plants like, *Podophyllum hexandrum, Aconitum ferox , Pycorhiza sp* etc are lost due to over exploitation. Some timber yielding trees of the region are *Shorea robusta,* Gaertner f., *Tectona grandis* L.f., *Temanilia bellirica* (Gaertner)Roxburgh , *Michellia champaca* Linnaeus., *Cryptomeria japonica* (L.f)D.Don, *Taxus bacata* Linnaeus , *Abies densa* Miller, *Castonopsis spp* ,*Rhododdendron spp.*

1.5.2 Fauna

The variation in altitude of the region with contrasting climate and vegetation has lead to the diversity of Fauna in Darjiling Hills. It is a home for *Trilitotriton himalayana,* listed in schedule I of Indian Wildlife conservation. Ailurus fulgens and Panthera tigris are rare and endangered mammals of the region. Two wild goats are found which are Jamarach's Serow and Brown Himalayan Goral. Wild dogs, Himalayan Black Bear, Mountain Fox wild Boars, Barking Deer's, Porcupine, Clouded Leopard, Bison's are the other important Mammals found in Darjiling Hils.The region is well traversed by fresh water streams and are home to fishes like Indian Trout, Katli, Goonch and Mahseer. The three varities of Mahseer are found , Golden Himalayan Mahseer, Red finned Mahseer and Copper Mahseer. Darjiling District conatins nearly one quarter of the species of birds found in the Indian empire, Burma and Ceylon (Dash,1947). The avian fauna found in this region are Monal Pheasent, Blood Pheasent, Hwaks, Buzzard, Patridge, Hwaks etc. The invertebrates are exceedingly rich in Darjiling hills where Lepidopterans forms the major chunk.

1.6 Past Floristic Works

The floristically rich Darjiling and Sikkim Himalayas has attracted plant explorers, botanists and researchers since the 18th century (Das 1995; Don 1821).North western Himalayas were first to be scientifically and systematically explored by Thomas Thomson in two attempts since 1840. It was Sir J. D. Hooker in 1848 who, took up the third botanical expedition to the Eastern Himalayas and in doing so became the first ever-botanical explorer of the Eastern Himalayas while writing the Flora of British India as a whole (Burkill, 1965).Darjiling was a part of a Sikkim and in all previous work Darjiling and Sikkim have been considered together. The major contributions include J. D. Hooker (1849-51,1854,1855,1872-1897,1907); T. Anderson(1832-1870); C. B. Clarke (1876,1885); H. J. Elwes (1877); George Watt (1881); G. A. Gammie (1893); R. Pantling with Sir George King (1989); Sir George King (1840-1909): Sir W. W. Smith (1911, 1913) ; C. C. Laccaita (1916); W. J. Buchanan (1916); P. Bruhl (1926); I.H. Burkill (1907,1965); P. C. Ducan (1935); H. Hara (1963, 1966, 1971); Hara *et al* (1978, 1979, 1982); M. Mizushima (1963); S. Nakao (1964); H. Ohashi (1975); A.J.C. Grierson and D. G. Long (1978, 1979, 1982, 1983, 1984, 1987, 1991) and H. J. Noltie (1993).

On the other hand workers like J. S. Gamble (1875, 1986), A.M. Cowan and J. M. Cowan (1929) have published floras floras from the Darjiling Himalaya taking the foresters' point of view (Lama,2004).

Different Indian workers have studied the flora in Darjiling hills which includes D. Chatterjee (1940); S. K. Mukherjee (1940, 1945, 1958); K. P. Biswas (1940, 1967); H. L. Chakraborty (1959); R. S. Rao (1964, 1964b); PN. Mehra and S.S. Bir (1964); B. D. Sharma and Ghosh (1971); G. S. Yonzone (1976); K. M. Mathew (1981); Sahni (1981); K. K. Tamang and G. S. Yonzone (1982); B. Mathew

(1983); S. S. R. Bennet (1983); A. K. Mukherjee (1983); A. P. Das and R. B. Bhujel (1983); N. C. Muzumdar, B.Krishna and M.C. Biswas (1984); U. C. Pradhan and B. M. Rai (1983-85); A. P. Das and Chanda (1986, 1986a, 1987, 1990); R. B. Bhujel (1984, 1992,); P. C. Lama (1989); R. B. Bhujel *et al* (1994, 1996); T. Rai and L. Rai (1994) A. P. Das (1995, 1995a); A. K. Samanta and A. P. Das (1995, 1996); A.S. Chauhan (1998);D. Lama(2004); U.Rai (2006);R.Yonzone (2011,2014).

The above list of workers and their floristic studies has contributed a lot for the flora of the region but scrutiny of literature reveals a large tract of natural vegetation mainly forested are yet to be surveyed. The rapidly increasing human population in the region leading to increase in habitational areas leading to steady dwindling forest cover, naturalization of numerous exotics etc. are exerting tremendous pressure on the natural vegetation of this area (Das 1995, 1998) resulting in the loss of many species and leading to many becoming endangered.

1.6.1 Past floristic study on ferns and Fern-allies

India is a mega biodiversity hot spot region and accounts for more than 7% of vascular plant species. The Pteridophytes belong to the group of vascualr cryptogram comprising of fern and fern-allies, represented by 1100 species (Fraser-Jenkins,2012) or 1200 species (Dixit 1984) in India. On the other hand the estimated global diversity of Pteridophyte species ranges between 9000 – 15000 (Smith et al, 2008) or 13,600 (Kramer and Green,1990).The Indian pteridophyte list will increase as the entire north east haveing a close proximity with a part of centre of origin and diversification of asian ferns i.e yunan province of china having maximum concentration of asian ferns abounds(Ching,1978;Bir ,1988),has to be thoroughly investigated as they are still Virgin Forest. It is wise to say that 10% of global Pteridophyte species occur in indian subcontinent. In India the floristic study dates back to 1883 when Col. R.H Beddome published “A

Handbook to the ferns of British India,Ceylon and the Malaya Peninsula" and its supplement in 1892 but without Azollaceae,Marsileaceae and Salvinaceae among the fern and fern allies as a whole.

Charles William Webley Hope (1832-1904) was a british pteridologist,collected and studied the ferns of western himalya.He published a book entitled "The ferns of North –Western India"(1899-1904).

Charles Baron Clarke (1832 -1906),collected and studied the Ferns of North india and published "A review of the ferns of Northern India" in Trans.Linn.Soc.London II.1 (1880).

Prof .John Firminger Duthie (1845-1922) studied ferns of Kumaon and western himalaya,published his two works. The "Flora of the upper Gangetic Plain" in the year 1903 and "Catalogue of the Plants of Kumaon" in the year 1918.

Sir Joseph Dalton Hooker (1817-1911), studied the flowering as well fern species in eastern himalaya from the year 1848 to 1852 and published his finding in "Himalayan Journal" (1855).

Christopher Roy Fraser –Jenkins (b.1948), studied the fern and fern-allies of Nepal ,Pakistan and India .His detailed Monographic paper on Indian Su-continent include the publication of 1977, 1979,1984, 1985,1986,1988, 1991,1992,1993, 1997a, 1997b,2001 and Fraser jenkinset al (1982 a&b, 1985,1986, 1996 ,1997 ,1999). His two books namely; "New species syndrome in Indian Pteridology and the Ferns of Nepal (1997)" and "Taxonomoc Revision of Three hundreed Indian Subcontitnental pteridophytes with a Revised census List-A new picture of Fern Taxonomy and Nomenclature in the Indain Subcontinent (2008).Similarly the paper entitled Rare and Threatened Pteridophyte of Asia2.Endangered Species of India-the Higher IUCN Categories (2012) throw a light on the status of species in India .The latest publication was Fern and Fern allies of Nepal 1,2015.

Prof.Hiroshi Hara of Tokyo university organized botanical exploration to Eastern himalaya from 1960 to 1985 and visited Darjelling in 1960 with H.Kanai,Gen Murata Togashi and Takasi Tuyama. The result of five expididton to Darjeeling

and Nepal From 1960 to 1985 is enumerated in three volumes of Flora of Eastern Himalayas (1971,1975 &1988).

Prof M.kato of Kosikawa Botanical Garden,University of Tokyo wrote a monograph on Asian *Cornopteris* (Kato1979) and *Deparia* (1984) which also included the species from Darjiling and Sikkim himalaya.

Prof . B.K Nayar of Calicut University studied Indian ferns and Some Nepalese species.(Nayar et al,1952,1980).

Dr. R.D Dixit from Botanical survey of India published a book on Indian Pteridophytes, "A census of Indian Pteridophytes " (1984), Where he enumerated more than 1000 species from Indian Subcontinent,comprising of 67 families and 191 genera. In the year 1992 he published "Selaginellaceae of India",in which he enumerated 62 species from the political boundry of indain Sub contitnent.Similarly he Published Lycopodiaceae of India in the year 1987 where he enumerated species from indain Sub-continent.

S.Chandra in the year 2000 Published a book "The Ferns of India" which dealt with enumeration,Synonyms and distribution. Similarly in the year 2008 he published a paper in Taiwania entitled "A Summary of the Status of Threatened Pteridophytes of India" where they have said one sixth of the Indian Pteridophytes are critically endangered and 46 species are endemic to India.

In the year 2004 Ghosh *et al*, published a book entitled "The Pteridophytic Flora of Eastern India", where he presented 810 species and 37 sub species in 179 genera within 60 families.

Later in the year 2010 B.S Kholia published a book entitled" Fern and Fern allies of Sikkim, A pictorial handbook Part-I", where he presented 149 species of Fern and fern allies. However 50% of the Indian Pteridophytes are found in Sikkim, according to (Chandra et al.,2008) and (Fraser-Jekins,2008).

1.7 Aims and objective of the Present work

1. Taxonomic enumeration and documentation of pteridophyte flora of Darjiling hills with preparation of artificial keys for easy identification.

2. Ecological status of individual species taking into consideration the horizontal and vertical distribution of the different species of pteridophyte in the hills of Darjiling.

3. Creation of database for pteridophytes of Darjiling hill with GPS data for all the species encountered in the study area.

4. Preparation of pteridophyte flora of Darjiling hill and publication to assist the future botanist for their study in pteridophytes.

5. Survey of local uses and economic importance.