CHAPTER -1

GEOGRAPHICAL BACKGROUND

1.1. INTRODUCTION

The Darjeeling and Jalpaiguri district covers an area of 9376 sq.km., comprising of 7 sub divisions, 25 blocks and 24 towns (Table1.1). Diversities in geology, physiography, drainage, climate and vegetation are apparent between the northern and southern parts of the districts.

Table1.1

Geographical and Administrative Setup of Darjeeling and Jalpaiguri District.

Sl No.	Districts	Latitudes	Longitudes	Area in sq.km.	Sub-division	C.D Block	G.P.	Urban centre
1.	Darjeeling	26° 31′-27° 13′N	87° 59′-88° 53′E	3149.0	4	12	77	9
2.	Jalpaiguri	26° 16′-27° 0′N	88° 25′-89° 53′E	6227.0	3	13	125	15

1.2. GEOLOGY

The geology of the study area is highly interesting. The Himalayas, forming the northern boundary, had it's origin in an ancient sea and had been subjected to large scale tectonic movement in the comparatively recent geological periods. The study area is divided into four tracts from the geological point of view. These division are from north to south the hard rock area, the piedmont belt, the terai belt and the alluvial plains. In the hard rock region, the southern portion is covered with sedimentary rocks while the northern part is composed of metamorphic rocks .The piedmont belt includes rock fragments, big boulders and fine grained clastics derived from the hard rock region .This area is also characterised by rather steep slopes, boulder surfaces and forest of tall trees. The terai belt is composed

of mostly course granular materials alternating with finer clastics. The whole of Jalpaiguri district excepting the northern hilly region, is covered by; alluvium deposits. The alluvium deposit consist of coarse gravel near the hills, sandy clay and sand along the course of the rivers and south of hills and fine sand and clay in the flatter parts of the river plains . There are over-ridden on a trust plain in an inverted sequence by older rocks namely the Gondwans, Buxas and Daling. Darjeeling gneiss occurs on the greater part of the upper hills. Recent alluvium covers the plain to the south of the foothills. A geological map has been compiled by the investigator (Figure1.1) to show the regional distribution of rocks. The chronological sequence of the geological series /system of the study area is given in table1.2.

1.2.1 Darjeeling Gneiss

The upper hilly part of the study area is composed of Darjeeling gneiss, consisting of garnetiferrous mica-schists, quartzites and sillimantie gneiss. The gneiss is well foliated, much folded and crumpled, highly micaceous and composed of colorless or grey quartz, white opaque, feldspar, muscovite and biotite. Kyanite and sillimanite are occasionally present.

1.2.2 Buxa series

The Buxa hill of the study area is composed of rocks belongs to the Buxa series, which consisted of variegated slates, quartzite and dolomite and are fringed on the south by low hills of upper tertiary stratas. Limestone occurs in considerable quantities in the Buxa series and masses of calcarious materials are found along their base. The Buxa series extended westwords along northern fringe of Jalpaiguri district up to the Rehti river, but east of the Buxa hill, it lies mostly in Bhutan (Lahiri, 1941).

1.2.3 Daling series

In the hilly region, the Daling series occur from the west of Balason river, above the Siwalik and bordering the Damudas in the south to the upper boundary commencing from the west, passing through Khairbari, Gayabari tea estate, Gayabari railway station and Sittong peak in the west which merges with the.Darjeeling Gneiss. In the Duars regions,

the north of Buxa series lies phyllites, schists and quartites, known as Daling series. All these formation have a general east- west strike, and dips are generally considered to be of pre-Gondwana age. In the Duars, the sandstone facies are well developed. Occasionally the sandstones are pebbly or conglomeratic in nature. West of the hills, the Tertiaries are not developed in the foothills regions for a length of about 64.4 km. They appear again in the foothills, west of the river Jaldhaka. The Daling series in the study area consists mainly of slates and phyllites, with silvery mica schists representing transition rocks.

1.2.4 Damuda series

The Damudas constitute a narrow belt between the Daling series in the north and the siwalik in the south. Steeply overthrusting the Siwaliks, they extent in a roughly east-west direction from Balason in the west to Kalijhora in the east. The sandstones are micaceous, feldspathic and brownish, often weathered in badly exposed areas, with coal bearing detrital rocks. Gondwana sandstones and slates with anthracite coal beds intervenes between Tertiary and the Buxa series. The best coal seams measure about 3 meter in thickness (Tindharia region) with sandstone on top and shale below. There is a thin and discontinuous band of limestone from west Kalijhora to Rangtong.

1.2.5 Siwalik series

The Siwalik appear north of Sukna extending from Mechi river in the west to the Sankosh in the east. It is irregularly interrupted by alluvium and fore-thrusts of older rocks. The deepest outcrop forming the southern margin of the Siwalik consist of bluish gray nodular marls and clays with micaceous fine grained sandstones. Occasional conglomerate layers with quartzitic pebbles are also found in many places.

1.2.6 Alluvium

The district of Jalpaiguri lies in the Sub-montane terai region . Excepting the northern hilly region, the whole of Jalpaiguri district is composed of alluvium, gravel beds, boulders and rock fragments. The rivers and stream have cut gorges giving rise to terraces across the undulating and low plateau like drift deposit forming typical piedmont landscape over looking and often merging in to the plains.

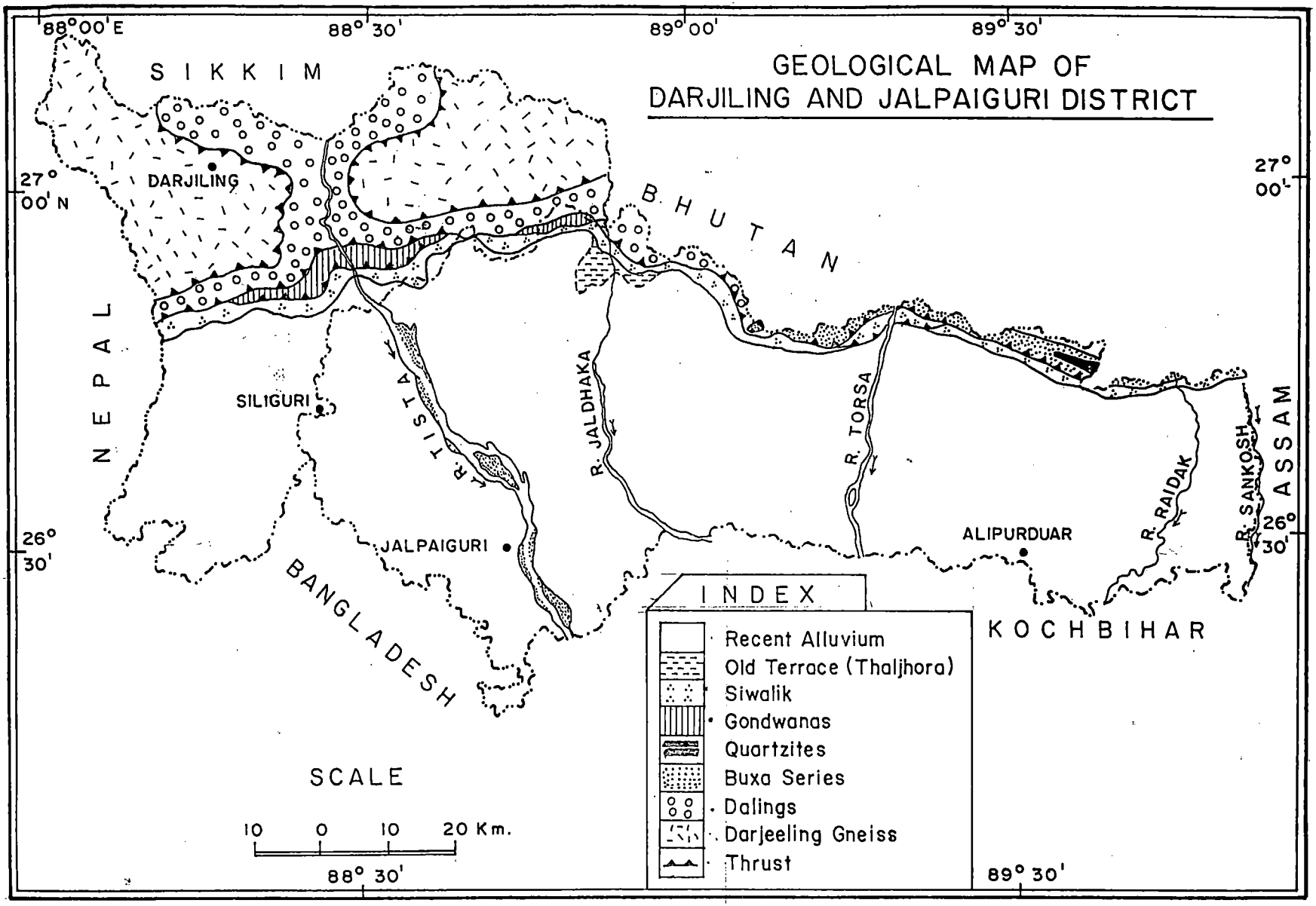

Fig. 1·1

Based on A. Gansser, 1964

Table 1.2
Geological succession of the study area

Name of series.	Geological age	Lithological character
Recent alluvium	Recent	Coarse gravel near the hills. Sandy loam to clay loam further south.
Old alluvium	Pleistocene	Boulder deposits along with gravel & sand beds.
	---- Thrust----	
Siwalik	Tertiary	Micaceous sandstone with siltstone, clay, lignitic lenticles etc.
	---- Thrust----	
Damuda series	Carboniferous-Permian	Sandstones, grey shales & coal (lower Gondwanas), carbonecous seams which have been metamorphosed at places to quartzite, slate & carbonaceous or even graphitic schists, particularly near the contact zones with the Dalings.
	---- Thrust----	
Buxa Series	Paleozoic	Chlorite-schists, slates, quartzite and dolomites. Best development in Buxa hills.
	---- Thrust----	
Daling series	Late Paleozoic	Slates, phyllite, banded haematitic quartzite and schists (mica, graphite, epidiorite, talc, chlorite schists).
	---- Thrust----	
Darjeeling gneiss	Pre-cambrian	Well foliated gneiss, composed of colourless or gray quartz, white opaque flespar, muscovite and biotite. Kyanite and Sillimanite occasionally present.

Based on A. Gansser, 1964.

1.3. PHYSIOGRAPHIC DIVISIONS

The study area exhibits a wide variety of landforms. Their genesis, mode of formation and morphological forms are also diverse in nature. Geomorphologic history was characterised by successive catastrophic events of accelerated erosion and deposition during the post-Pleistocene period. Physiographically, the study area may be divided into 3 major divisions (Fig. 1.2)

1.3.1 The Hills

The hilly region is restricted within Darjeeling and in the extreme north-eastern part of Jalpaiguri district. The region extends northwards into Sikkim and Bhutan, west-wards to the Napal, east-wards the divide line runs along the international border between India and Bhutan and southwards bounded by the 300 metre contour line. The lesser Himalayas run east to west direction within this region. The axis of the lesser Himalaya is marked by the water divide running east-west roughly through the middle of the region. Most of the rivers are flowing through straight courses according to the slope aligment . There are only four small fragments of the mountainous region in the east, which is situated along the northern border of Jalpaiguri district. The Jainti-Sinchula range (700 -1600 metre) is situated in this region. The hills rise abruptly from the piedmont plain (120 -300 metre) and the elevation increase northwards upto 2200 metre at the Mahaldiram ridge, with a further increase upto 3665 metre at Sandakphu Massif. Within these, there is a mosaic of micro-topographic units comprising of convex ridges and deep- cut valleys (Lama , 1994). The hilly region may further be sub-divided into 2 sub-units, namely high hills and low hills.

1.3.2. The Piedmonts

The piedmonts locally known as *terai* west of river Tista and *duars* east of river Tista , covers an area of 7254.0 sq. km. It includes the tilted plains at the base of the Himalaya bounded by the 300 meter contour line to the north and 66 metre contour to the south. It includes the entire Siliguri sub-division and northern part of Jalpaiguri district. This is formed due to the coalescing of several alluvial fans within the catchment area of the river Mahananda, Tista, Jaldhaka, Torsa, Raidak and Sankosh. The northern part of the *duars*

is made up of fluvio-slope wash deposits of the Quaternary period. Rivers and streams which have cut gorges have also given rise to terraces, across the undulating and low plateau like drift deposits thereby, forming a typical landscape, overlooking and often merging with the plains to the south.

1.3.3 The Plains

This region is located mainly in the district of Jalpaiguri . Perceptible gentle gradient of land is a significant feature of this region. Rivers flow through meandering courses and floods are common during the rainy months. Bed load is deposited close to the channel and suspended load with finer silt and clay accumulates in back swamp area of the flood plain from the river channels. However, in areas where flooding is infrequent, lateral accretion and channel deposition are more significant in the formation of flood plain.

1.4 DRAINAGE

The study area is endowed with an intricate network of river systems. Most of the rivers are considered to be highly notorious for their unpredictable nature, letting loose fury of flood and problem of extensive and regular bank erosion, shifting course that render thousands homeless during rainy season. The majority of the rivers of *terai* and *duars* originate in the Himalaya to the north and northwest and flow along south to southeasterly direction (Fig. 1.3). As many of the rivers originate from the same hill, flood often occurs simultaneously and the rivers coalesce to from a single vast sheet of water.

The upper catchment area of these rivers has mostly been deforested and the clearings of the steep slopes have been used for the extension of settlement, agriculture, plantation and communication, disrupting the overall hill slope hydrological balance (Sarkar, 1989). As a result, during heavy and concentrated rainfall, innumerable landslides are caused transporting huge amount of sediment to the rivers. Most of such landslides have never been treated scientifically with proper protective measures and as such those are in the habit of expanding their territories during monsoon (Bhutia, 1999). This often adds more and more silt to the rivers, which are incapable of transporting the loads efficiently under the existing hydrological conditions, especially areas beyond the foothill zone.

1.4.1 Drainage basin and sub-basins

The major drainage basins and sub-basins of Darjeeling and Jalpaiguri district are tabulated in the table 1.3.

Table 1.3

Drainage basins and sub-basins of the study area

Drainage Basin	Sub-basins	Major rivers
Brahmaputra Basin	Sankosh	Sankosh, Gadadhar
	Torsa	Torsa, Pana-Alaikuri Dima-Kaljani, Jainti, Raidak
	Jaldhaka	Dharla (west) Jaldhaka, Diana Mujnai, Dharla (east)
	Tista	Rammam, Great Rangit Tista, Nor-Neora-Dharla
Ganga Basin	Mahananda	Mechi, Balason,Mahananda

1.4.1.2. The Brahmaputra Basin

The rivers belong to the Brahmaputra system are the Sankosh, Raidak I, Raidak II, Torsa, Jaldhaka and the Tista, drain about two third of the total geographical area of the districts. The followings are the major sub-basins of the Brahmaputra system.

The Sankosh sub-basin : The river Sankosh originates from the Bhutan Himalaya, marks the eastern boundary of North Bengal. The sub-basin occupies only 295.0 sq. km. area or 3.15% of the geographical area of the region.

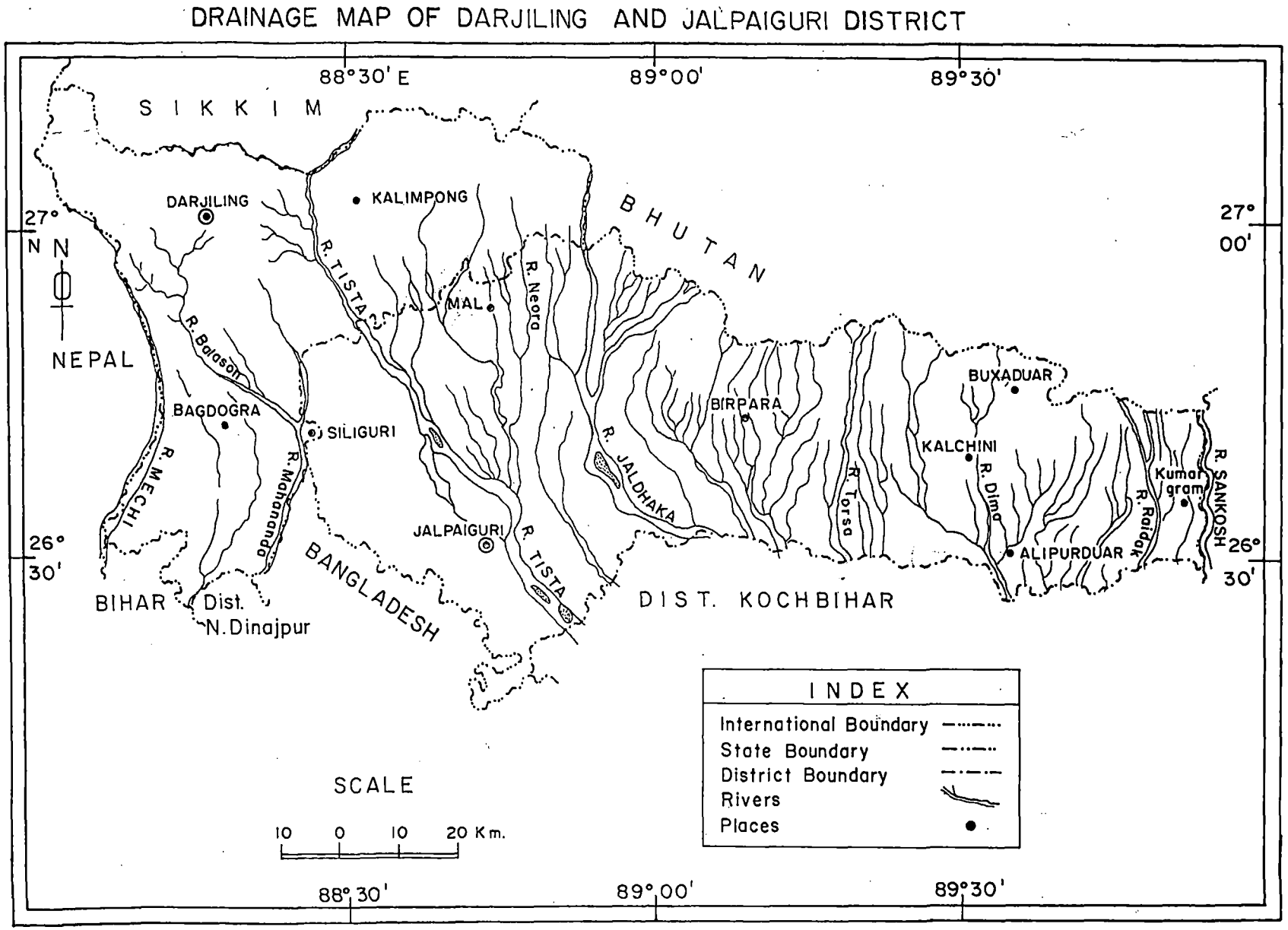
DRAINAGE MAP OF DARJILING AND JALPAIGURI DISTRICT
88°30' E
89°00'
89°30'
SIKKIM
DARJILING
KALIMPONG
BHUTAN
27° 00'
N
NEPAL
R. TISTA
R. Neora
MAL
R. Balasan
BAGDOGRA
SILIGURI
R. MECHI
R. Mahanada
BIRPARA
R. JALDHAKA
BUXADUAR
KALCHINI
R. Dima
R. Torsa
Kumargram
R. Raidak
R. SANKOSH
ALIPURDUAR
26° 30'
JALPAIGURI
R. TISTA
BANGLADESH
BIHAR
Dist. N. Dinajpur
DIST. KOCHBIHAR
INDEX
International Boundary
State Boundary
District Boundary
Rivers
Places
SCALE
10 0 10 20 Km.

Fig. 1·3

The Torsa sub-basin: This sub-basin drains by the rivers Raidak I, Raidak II, Gadadhar, Kaljani, Jainti and Torsa. All these rivers originate in the Bhutan Himalaya. The Torsa is the trunk stream of this catchment, originates from the upper most part of the Bhutan Himalaya and fed by both rain and snow melt water.

The Jaldhaka sub-basin : The Jaldhaka river originates from the Bhutan-Tibet border in the High Himalayas. It receives Murti and Diana in the northern *duars* and further south it receives rivers like Kumlai, Gilandi, Dim Dima, Mujnai and Burhi Torsa and finally joins the Brahmaputra in Bangladesh.

The Tista sub-basin : The river Tista originates from the Tista-Source Glacier (Tista Kanyse) or, Pauhurni Glacier near Khangehung Lake (Lat. 27°59′N and Long. 38°48′E) at an elevation of 7128 meters at Sikkim. It meets Brahmaputra (Jamuna) at Kumarganj in Bangladesh at an elevation of 23 mitres. Streams originating from the Sikkim-Darjeeling Himalaya are converging into the main channel of the Tista in its upper catchment area, i.e., Rammam, Great Rangit, Rangpoo, Rilli, Jit, Nor etc. The Tista river system, flanked by the Mahananda and the Jaldhaka on either side present a spectacular convergent cum divergent drainage pattern. The convergent pattern terminates around 90 metre contour line, subsequent to which the character assumed to be one of divergent from where the rivers are spreading out. While, the 300 metre contour line is curving upward indicating convergence of drainage, the 66 metre line in the extreme south is systematically curved downward indicating large scale fanning out or, divergence of the channels.

1.4.1.3 The Ganga Basin

The Ganga basin occupies about one third of the total geographical area of districts and is drained by the river Mahananda.

The Mahananda sub-basin : This river originates from the lower Darjeeling Himalaya, receives first major tributary the Balason near Siliguri town. The Mechi is the important tributary has its catchment in the northern hilly region and also makes Indo-Nepal boundary.

1.5. CLIMATE

The climate of the area is specially noteworthy because of it's position, the wide differences in altitudes, the powerful effect of the south-western monsoon against the Himalayan barrier and the peculiar configuration of the ridges and valleys which deflect or allow rain bearing winds that affect local temperature and rainfall. Large latitudinal extent and physiographic variations of the area have brought diversity in climate with contrasts in meteorological conditions resulting in the development of greater degree of seasonality. Indian Meteorological Department, Tea Gardens, Forest Department and Agriculture Department record climatic data mainly rainfall and these have constituted the main source of information regarding the climate of the study area.

1.5.1 The seasons

The study area experiences five dominant seasons but their duration and extent are not similar. The year may be divided into five seasons namely summer, rainy, autumn, winter and spring.

1.5.2 Rainfall

Rainfall in the area follows the typical monsoon pattern. It occurs mostly during the four months from mid-May to mid-September and is followed by a prolonged dry seasons. Sometime, the monsoon beings later and ends earlier and is also less certain and less uniform. Prolonged drought and severe heat in the plains affect the growth of vegetation and their regeneration. Many parts of the study area enjoy a warm rainy season which is advantageous for the growth of vegetation. Records of rainfall are available from stations, for the period ranging from 20 to 60 years. On account of the diverse physiographic nature of the study area, there are sharp variation in rainfall between the different stations. It is generally heavier in the southern face of northern hilly track (4455mm. at Kurseong, 4147mm. at Sonada and along the extreme north-eastern part of Jalpaiguri district-Raimatang 4639 mm., Chuapara 4597 mm. and Kumargram 4244 mm.) while the amount is maginally less in the foothills and plains (3336 mm. at Alipurduar, 3327 mm. at Malbazar and 3119 mm. at Siliguri). The spatial distribution of mean annual precipitation has been depicted in the Fig 1.4. The south-west monsoon contributes about 85% of the annual

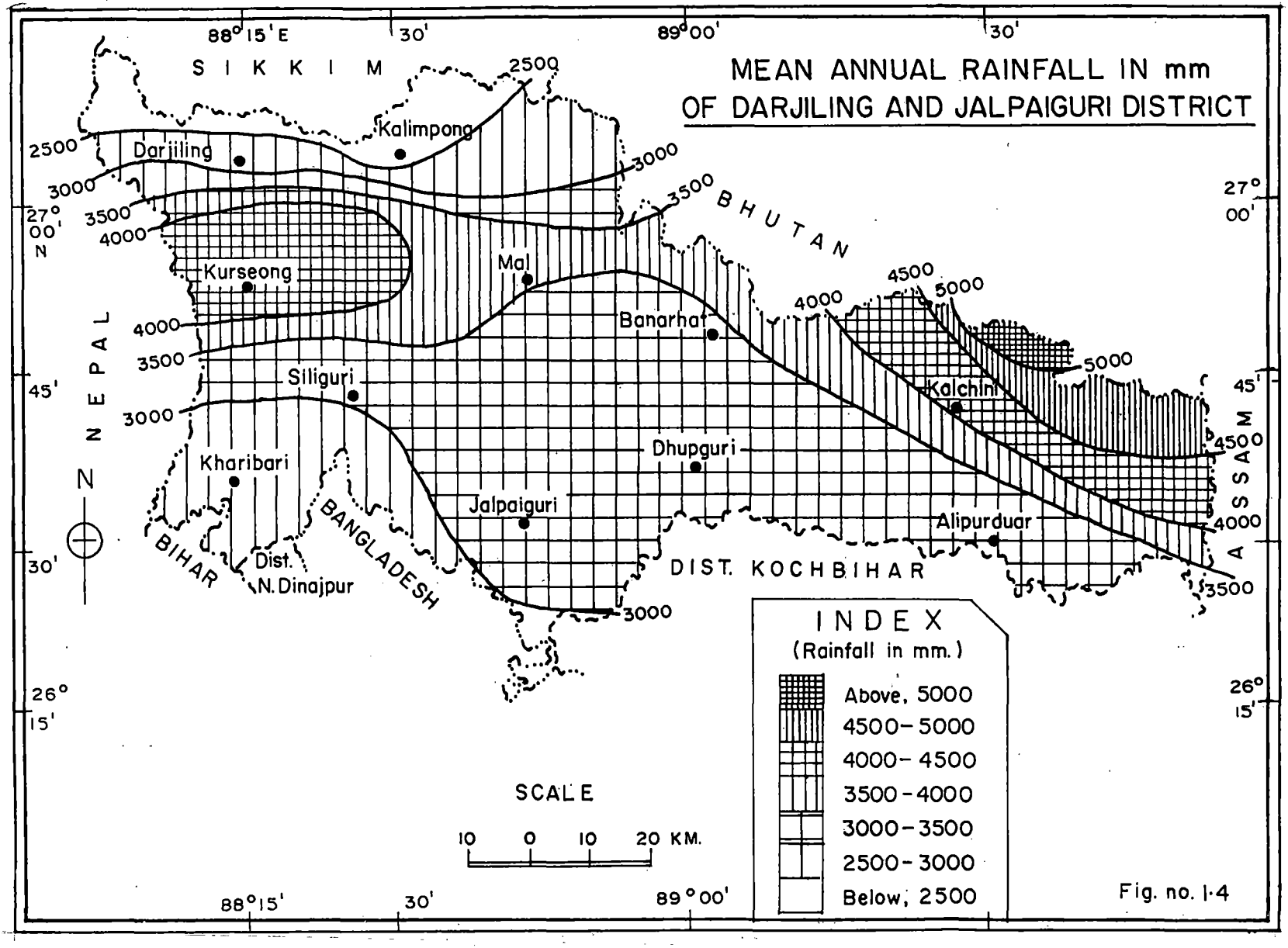
MEAN ANNUAL RAINFALL IN mm
OF DARJILING AND JALPAIGURI DISTRICT
88°15'E
30'
89°00'
30'
SIKKIM
Kalimpong
Darjiling
Kurseong
Mal
Banarhat
Siliguri
Kharibari
Dhupguri
Jalpaiguri
Kalchini
Alipurduar
BHUTAN
NEPAL
BIHAR
Dist.
N. Dinajpur
BANGLADESH
DIST. KOCHBIHAR
ASSAM
27° 00' N
45'
30'
26° 15'
2500
3000
3500
4000
4500
5000
INDEX
(Rainfall in mm.)
Above, 5000
4500-5000
4000-4500
3500-4000
3000-3500
2500-3000
Below, 2500
SCALE
10 0 10 20 KM.

Fig. no. 1·4

precipitation. The variation in the total rainfall from year to year are not much. On an average, there are about 120 rainy days. Annual rainfall of the area varies from 2000 to 5000 mm. The heaviest rainfall in 24 hours recorded was 864 mm.at Hasimara during 1993.

1.5.3 Temperature

Due to physical diversity the study area experiences temperature ranging from below freezing point in the hills during winter to about 35° C in the plains during the summer. The climate varies from moist-tropical to dry tropical in the plains and from sub-tropical to temperate in the mountains of the north. Temperature records (maximum and minimum) for different areas shows that May and June are generally the hottest months throughout the entire study area with maximum temperature recorded 22° C at Darjeeling and 39° C at Jalpaiguri. December and January are the coldest months having minimum temperature record as 2° C at Darjeeling and 6° C at Jalpaiguri. Siliguri is the hottest place in the study area with mean annual temperature of 29° C, while the coldest place adjoins Ghoom, where mean annual temperature has been recorded to be 9.6° C. A map has been prepared for a better understanding about the spatial distribution of mean annual temperature. (Fig. 1.5)

1.6. SOILS

Two main kinds of soils namely zonal and azonal are found in the districts. The zonal soils are found in the northern hilly region, alluvium in the plain represents the azonal group. Variations in the micro-environments in respect of relief, drainage, climate etc. have led to the formation of different types of soils.

1.6.1 Soils of the Hills

Due to differences in altitude within a short range, differences in soil properties are observed in the hilly parts of Darjeeling and Jalpaiguri districts. Highly acidic soils (p^H 4.5 to 5.0) are found in considerable parts of Mirik, Kurseong, Darjeeling , Pulbazar, Sukiapokri, Jorebungalow and Kalimpong sub-divisions due to the presence of coniferous trees at higher altitude. Organic carbon in these soil ranges from 0.5 to about 1.20.

Texture of the soil has been identified as sandy loam to clay loam. In Kalimpong sub-division, however, soils are less acidic and in Gorubathan the soils are sandy loam to clay loam in texture.

1.6.2 Soils of the plains region

Soils of the plains region are classified into the following groups.

The Piedmonts: The alluvial fans of the piedmont plains at the base of the mountains are principally accumulation of the coarser materials of heavy mountain wash, e.g, boulder, gravel, pebble, sand , etc. This soil (known as *bhabar* in north west India) is deep and coarse at the base of the mountains. It is azonal soil with low percentage of organic carbon, K_2O , P_2O_5 and acidic in reaction.

The Plains: Soil texture changes towards the south, along the floodplains of the large rivers comprising the southern part of Jalpaiguri district. Soil texture is relatively coarser towards the north but finer towards the south. The soil is mostly acidic (p^H 5.0 to 6.5) due to leaching. The K_2O , P_2O_5 contents are also low at most places, however, higher amounts have been found at isolated pockets of Jalpaiguri district.

1.6.3 Soil taxonomic units :

The systematic study of soils in West Bengal was taken up as early as 1898, when four main soils groups occurring extensively, were differentiated. At the beginning of 20th century, "Soil fertility" became the central theme of agricultural research and soil study in West Bengal. According to Soil Taxonomy, Murthy and Pandy (1983) prepared a soil map through NBSS and LUP, based on soil variation related to relief or physiography in different climatic zones. National Bureau of Soil Survey and Land Use Planing in co-operation with the Department of Agriculture, Government of West Bengal has published soil map of West Bengal in four sheets in 1991. This is perhaps the most comprehensive and descriptive map of West Bengal's soil. The soils of the study area (Darjeeling and Jalpaiguri district) have been classified on the basis of the above mentioned study. The following table (1.4) represents the major taxonomic order, sub-order, great group's which have been identified so far in the study area. 2 taxonomic soil

orders, 6 sub-orders and 8 great group have so far been identified in sub-Himalayan North Bengal. These are discussed below :

Entisols : These soils have little or no evidence of pedologic profile development either due to short duration or receiving of new deposits of alluvial at frequent interval from the higher tracks (Sarkar 2000). The only evidence of pedogenic alteration in these soils is a small accumulation of organic matter in the upper 30 cm. of soil profile. Entisols may have an ochric or anthropic epipedon. The entisols of the study area have a variety of soil moisture and temperature regime. Three sub-orders - Orthents, Fluvents and Aquents have so far been identified in the study area (Fig 1.6)

Inceptisols : These soils have altered horizons that have lost bases or iron and aluminium but retain some weatherable minerals, they do not have an illuvial horizon enriched either with silicate clay that contains aluminium or with an amorphous mixture of aluminium and organic carbon. The common diagnostic horizons that they may have are an umbic or ochric epipedon, a cambic horizon, a fragipan and a duripan. Inceptisols develop mainly in the fine textured parent materials. These are mostly found in the northern hilly part of the study area. Two sub-orders have so far been identified (Fig 1.6). -Aquepts, Umbrepts and Ochrepts.

Table -1.4

Major taxonomic orders, sub-order and great groups of soils in the study area.

Orders	Sub-orders	Great groups.
ENTISOILS	Orthents Fluvents Aquents	Udorthents, Udifluvents Fluvaquents, Haplaquents
INCEPTISOLS	Aquepts Umbrepts Ochrepts	Haplaquepts Haplumbrepts Dystrochrepts, Eutrochrepts

1.7 NATURAL VEGETATION

The sub-Himalayan North Bengal still possess some of the excellent natural vegetation of the country. The most remarkable feature of forest of the study area is the wonderful variety

of species that it contains. Few places in the world in which so many different type of forest exist within so small an area . It is perhaps, in fitness of things that forest conservancy and scientific forest management was initiated in this part of the country, a hundred years ago. Altitude, aspect, geology and climatic factors have influenced the forest types . The study area although, suffered extensive and heedless deforestation since the British occupation, yet it seems to be one of the most densely forested tract in the state with natural, semi natural and man-made forest . Details about the natural vegetation of the study area will be discussed in chapter 2.

1.8 DEMOGRAPHY

The study area supports a population of 50,09,104 (as per Census, 2001) which constitute 6.24 percent of total population of the state. The decadal population growth (1991-2001) shows an increase of 21.52 and 23.54 percent in total population of Jalpaiguri and Darjeeling district. The average literacy rate of the study area is 68.22 percent. The average density of population, as per census 2001 is 528.5 persons per sq. km. The area contains a polyglot language. In the hills Nepali, Hindi and in the plains Bengali are spoken by a great majority of the inhabitants but there are a great number of other languages. Main tribes of the study area are Rava, Mech, Garo, Munda, Uraon and Kharia. They reside mostly in Tea gardens and forest village of the *terai* and *duars* region. Details about the demographic picture is shown in the table 1.5, 1.6 and figure1.7.

Table - 1.5

Decadal population growth (in percent) since 1951 in the districts.

Sl. No.	District	Percentage of decadal variation				
		1951-61	1961-71	1971-81	1981-91	1991-2001
1.	Darjeeling	35.90	25.16	31.08	26.91	23.54
2.	Jalpaiguri	48.27	28.76	26.55	26.44	21.53

Source - Census 2001, Government of India.

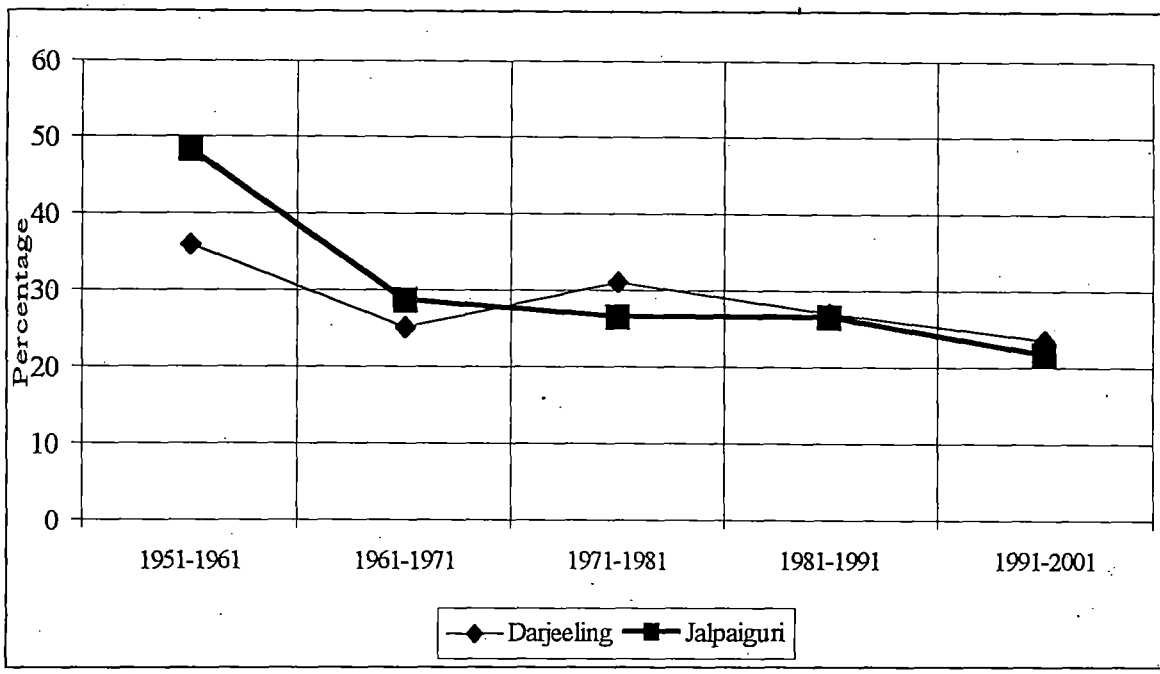

Fig 1.7 Decadal population growth.

Table No 1.6

Demographic pattern in the districts

District	Population	Male	Female	Sex ratio (number of female per male 1000	Population rank in 2001 (W. B)	Population density per sq.km.	Literacy rate (%)
Darjeeling	16,05,900	8,26,334	7,79,566	943	17	510	72.87
Jalpaiguri	34,03,204	17,53,278	16,49,926	941	10	547	63.62
Total	50,09,104	25,79,612	24,29,492	–	–	---	---

Source - Census 2001, Government of India.

1.8.1 Socio- economic condition :

Nearly 80 percent of the population resides in rural areas. The great majority of the population is dependent on agriculture, either as cultivator tilling their own field or as

agricultural labourers. A share of population is also employed in tea garden. Major portion of total agricultural land in the study area is under share cropping or "barga" cultivation. The daily wages in the form of cash or kind are considerably raised. Although the over all land for cultivation is limited in the study area, it's redistribution in favour of small farmers had an impact in increasing agricultural production (Bagchi, 1990). Further the involvement of the rural poor has been ensured in an organized manner in the process of planning. The local panchayats being essentially elected representatives of the rural people and are responsible for planning and implementation of rural development programmes at different levels. In forestry sector, panchayats also play an important role in motivating and implementing the Social Forestry and Joint Forest Management Programme. There are an overall increase in production of rice, milk, egg, poultry meat, fish etc., mainly due to involvement of people through panchayats and providing other inputs like credit, seeds, fertilizer, irrigation etc. The most important industry is the manufacturing of tea, which is also the major contributor to the economy of the area.

1.8.2 Demographic profile in forest village of the study area

Forest Conservancy in Bengal was started in 1864. The idea of conversion of high forests by means of planting was conceived as early as 1867 when baffled by the problems of natural regeneration. Shortage of labour was the main constraint in taking up the plantation activities. The artificial regeneration by taungya or agrisilviculture was prescribed in the working plans for hill areas of Darjeeling district drawn up in 1892 and that for plains areas of Jalpaiguri district in 1920 by Mr. Monsoon and Mr. Shebbeare respectively. This opened up the door for establishment of Forest Villages deep inside or in the fringe of reserve forests for easy availability of work force at nominal cost. Settlers are drawn from landless villagers from nearby places. They comprised mostly of tribals e.g. Rava, Mech, Garo, Munda, Uraon, Kharia etc. Some reserve forest land was cleared so that they could cultivate such lands for raising cereals and vegetables. At some places they are provided with hutments for habitation. On an average, one Forest Village was set up in each felling series and they used to be relicated from one felling series to other, depending upon the annual felling area. The Forest Villagers braved extremely inhospitable living and working conditions for the lure of these small concessions. They are primarily instrumental in raising more than 800 sq. km of plantations containing economically valuable timber species worth over Rs. 10,000 million at current prices.

An agreement are generally drawn annually setting out terms and conditions for their stay and various forestry works. In each "agreement" forest villager are provided with 0.6 ha. of cultivable land in the hills and 1.0 ha. of land in the plains. Each such villager are also permitted to raise agriculture crops over 0.44 ha. in current year`s and one year old plantations . They are also entitled for free firewood for personal consumption and facilities of grazing their cattle in high forests and in plantations over 5 years age. They are also permitted to collect specified number of poles and a cart load of thatch for repairing their houses where permanent houses are not built. In lieu of these services, the forest villagers are required to raise 0.4 ha. plantation every year free of cost. Presently forest villages are paid wages for plantation works, nursery and timber operations as decided by Minimum Wages Act.

There are in all, 168 forest villages in West Bengal distributed in the three districts of North Bengal, namely, Darjeeling, Jalpaiguri and Coochbehar. Demographic pattern of forest villages in the districts of Darjeeling and Jalpaiguri is given in table 1.7.

Table 1.7

Population of forest villages in the study area.

Division	No. of Registered Family	Total Population	Area under possession of forest villages (in sq.)	Population density (per sq km)
Jalpaiguri	419	5034	9.15	550.16
Wild life- II	32	355	1.00	355.00
Baikunthapur	151	1546	2.91	531.27
Cooch Behar	474	6653	8.36	795.81
COBSF	60	419	1.01	414.85
B.T.R	959	14583	15.88	918.32
Kurseong	483	5270	2.89	1823.52
Kalimpong	786	6862	8.22	834.79
Darjeeling	510	6257	3.51	1782.62
Grand Total	3874	46979	53.02	886.06

Source - Annual Report 1998 - 99, Forest Department, Northern Circle, West Bengal.

1.9 LAND USE

Land use pattern of the study area is controlled by the relief, drainage and soil condition. The land use characterstricts are related with the broad physiographic divisions. Out of 9376 sq.km. (Geographical area), the forest lands total 3037 sq. km., which is equivalent to 32.39 percentage of the geographical area. Agriculture is the mainstay of rural people. The major land use types of Darjeeling and Jalpaiguri district is shown in the table 1.8 and figure1.8

Table 1.8

Land use pattern in the districts

Sl No.	Districts	Area sq.km.	Forest (1)		Current Fallow (2)		Net area sown (3)		Others * (4)	
			sq.km	in %	sq.km.	in %	sq.km.	in %	sq.km.	in %
1.	Darjeeling	3149	1455	46.21	86	2.73	1434	45.54	174	5.52
2.	Jalpaiguri	6227	1582	25.41	40	0.64	3241	52.04	1364	21.91

* Others include fallow land other than current fallow, culturalble waste land, permanent pastures and grazing, barren and unculturable land and non-agricultural land.

Source :- District Statistical Hand Book, 1996-2000 and Forest Report, 1999.

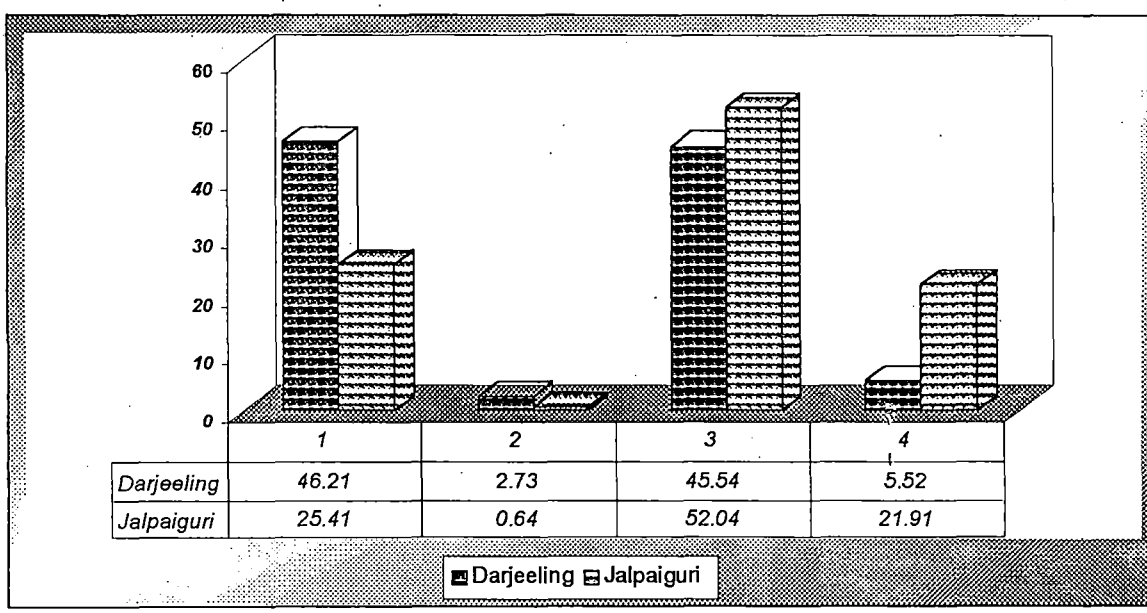

Fig 1.8 Major land use pattern of the study area.

1.10 CONCLUSION

The study area is composed of different types of rocks which are highly weathered, fractured, jointed and have a tendency to produce slope instability during intense rainstorm. Topographically, the area is divided into three broad zones, the hilly tract, piedmont and the plains. Geological structure and drainage pattern are primarily responsible for such topographical segments. The study area possesses a fair amount of natural vegetation but their distribution is not uniform. 32.39 percent of the geographical area is covered by forest. The most remarkable feature of forest of Darjeeling and Jalpaiguri district is the wonderful variety of species that it contains. Few place in the world in which so many different type of forest exist within so small an area. The area is unique for the study of forest resource where different types of forests are existed for comparative analysis. The diversified land use pattern is another advantage for investigating land use input and output under different usage. It also help to understand the importance of the forest of the study area. The area on an average receive 3000 mm. precipitation annually.

REFERENCES :

Annual Reports (1998-2000) : Forest Department. Govt. of West Bengal.

Bagchi, K.K. (1990) : Evalution of land tenure system in the Dooars region of North Bengal. Unpublished Ph.D. Thesis, University of North Bengal.

Bhutia, P.T (1999) : Environmental degradation : problems and prospects- A study in Kurseong sub-division of Darjeeling Himalya, Unpublished Ph.D. Thesis, Universityof North Bengal.

Census District Hand Book : Darjeeling 1981, 1991 & 2001.

Census District Hand Book : Jalpaiguri 1981 , 1991 & 2001.

District Statistical Hand Book (1996-2000) : Darjeeling & Jalpaiguri, Bureau of Applied Economics and Statistics, Govt. of W.B.

Gansser ,A (1964) : Geology of the Himalayas, Inter Science Pub.

Lahiri, A.(1941) : Geology of Buxa Duar, Quart.J.Geol. Min.Soc. India.

Lama, Sangita (1994) : Urban geomorphology of Darjeeling town. Unpublished Ph.D. Thesis, University of North Bengal.

National Bureau of Soil Servey & Land use planning (1995) : Soil map of West Bengal, ICAR Nagpur, Govt. of India P 1 - 4.

Sarkar,S. (2000) : Soils of West Bengal. Genesis and Classification. Geographical Thought, North Bengal University. P 55 - 70

Sarkar,S. (1989) : Some consideration of soil erosion hazard in Darjeeling district (west of river Tista), Geographical Thought, North Bengal University. P 45 - 54

Sen, Bikram (Census-2001) : Provisional population totals, Director of Census Operation, West Bengal.

Starkel, L and Basu, S.R.(ed) (1999) : Rains, Landslides and Floods in the Darjeeling Himalaya, INSA, New Delhi