CHAPTER I

GEOGRAPHICAL BACKGROUND OF KURSEONG TOWN

INTRODUCTION

The location of settlement and their internal structure are often influenced to a considerable degree by their terrain configuration. Urban development is greatly influenced by geomorphic changes. The construction of a town creates a new landscape, which includes a massive modification of the circulation of energy in the form of water and materials. The foundation of the buildings and roads, the cliff-faced slabs and elongated plains of the town have to be designed to be stable on the rocks and soils beneath them. Thus, the site of a town may be due to a combination of landscape factors (Chandler, 1976; Douglas, 1983; Legget, 1973; and Coates 1974).

Planning for geomorphic change is a major task for urban land managers (Douglas, 1983). Urban planning always involves some assessment on land capability either in terms of the terrain condition or limitations or in terms of the suitability of land for a particular use. Physiographical information contributed to the formulation of 'master development plans' in Poland by considering geological, topographical, hydrological, climatic and biological factors along with land capability map (Rozcyeka, 1964). From these basic information, a land zoning map may be prepared, indicating land suitability for such uses as low and high density housing zones, industrial, commercial, open spaces and recreational uses. In the U.S.A., guidelines for urban land use planning are provided by the soil conservation service on the basis of soil surveys. A similar approach has also been provided in the U.K. while the New South Wales Soil Conservation Service carries out surveys specifically for urban land capability evaluation as a part of a system which combines basic data on geology, landforms, drainage and climate to derive urban land capability class and sub-class (Hannam and Dicks, 1980).

1.1 GEOLOGY

The Himalayas is geographically a complicated mountain system. The complexity of structure and metamorphism that the rocks have undergone has posed challenging problems for correlation of the different rock formation on a regional scale. Geological investigations in

Darjiling and the adjoining regions began in the middle of the last century. In 1854, J. D. Hooker reported the geological findings of his extensive travels spread over the two years – 1848 and 1849. He traced the regional domal picture of the gneiss and observed the overlying sedimentary bedding. But the systematic geological examination of the Darjiling area was first done by Mallet in 1874. He classified the metamorphic rocks of Darjiling and western Duars into the Daling "series" and the Darjiling gneiss.

Since then, several officers of the Geological Survey of India as well as many scientists have recorded local observations. Among them Ray (1945) has differentiated progressive zones of metamorphism of Daling series and the Darjiling gneiss. Ghosh (1950) has carried out a detailed geological mapping of parts of the Darjiling Himalayas. M.B. Pande and S.S.Saha (1982) have also studied the Darjiling Himalayas extensively.

The generalised sequence of the various geological formations of the Darjiling Himalayas is given in the table below.

Table 1.1: Chronological orders of various geological formations.

Recent	Sub-aerial formations Alluvial deposits	Younger flood plain deposits of the rivers and nalas comprising of sand, gravel, pebble etc. and soil covering the rock.
Pleistocene	Raised terraces	Sand, clay, gravel, pebbles, boulder etc. representing older flood deposits
Pliocene to lower Pleistocene	Siwalik. Thrust (Main boundary Fault)	Micaceous sandstone with silt stones, clays, lignite, lenticals, etc.
Permian	Gondwana	Quartzitic sandstones with slaty bands, seams of graphite coal, lamprophyne sills and minor bounds of limestones.
	Thrust Daling series	Slate, chlorite-sericite, schist.
Precambrian	Darjiling gneiss	Fine grained angen and bonded gneiss of ten garnetferous mica, schist with extensive intrusions of biotite, hornblende and tourmaline granites, golden silvery mica schist's, carbonaceous mica schist, coarse-grained gneiss.

Based on Mallet (1874)

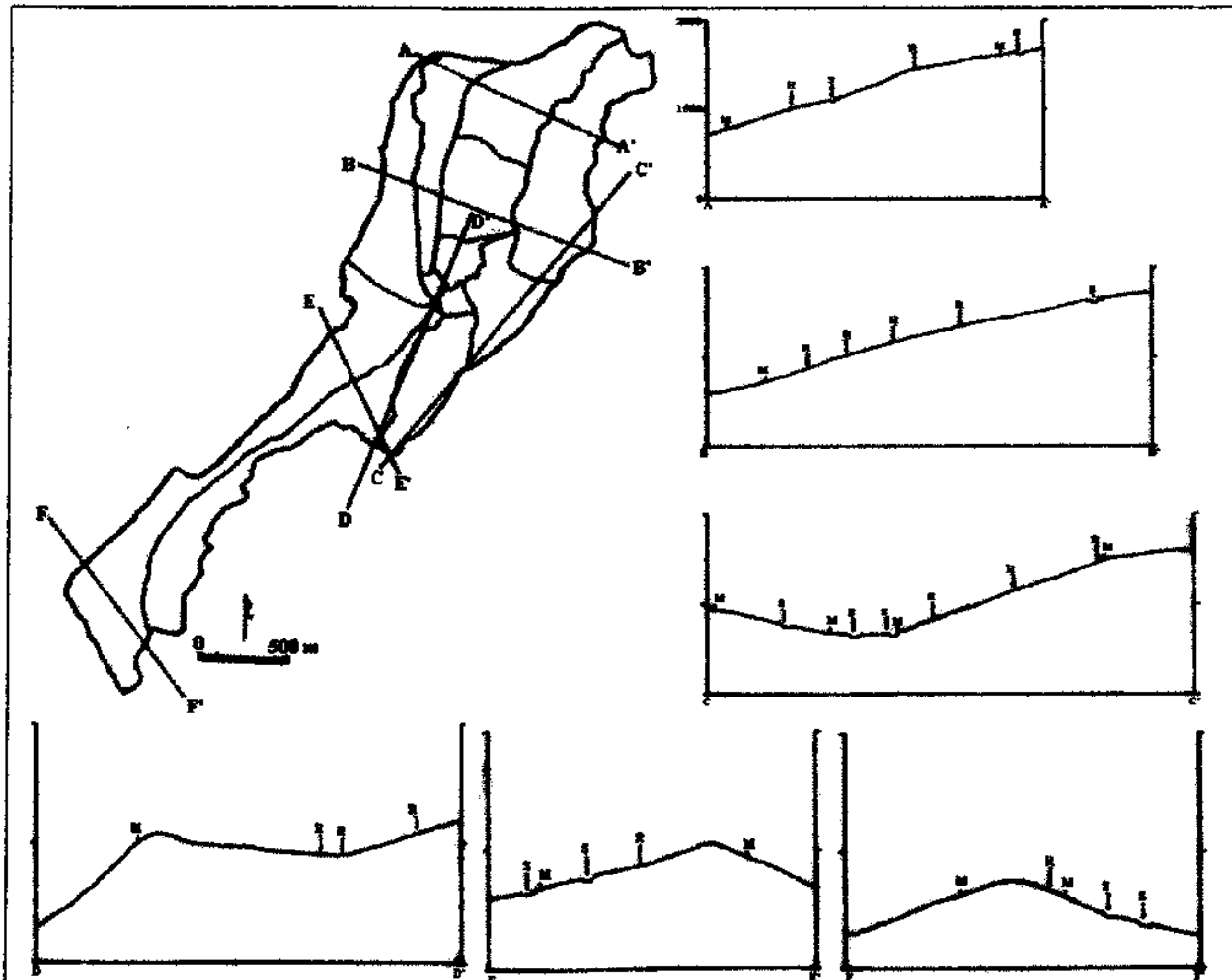
Morphology of the area is well defined. The mountain ranges rise steeply above the vast stretch of North Bengal Plains (Terai and Duars). The sub-Himalayas are made up of Siwalik deposits of the Tertiary Age. Although, from regional considerations, the Siwaliks have been reported to be missing over certain stretches of the sub-Himalayas, good exposures of the Siwalks occur in the Darjiling foothills, with a well-preserved section along the Tista River. Northwards, the coal bearing lower Gondwana formations comparable to the Damudas of Peninsular India and Daling group of rocks (pre-Cambrian) succeeds the Siwaliks. Further north, the Dalings are succeeded by Darjiling gneiss.

Darjiling gneiss occupies the higher reaches of the hills, and comprises the greater part of the district, including Kurseong town. The coarse grained gneiss is found mostly as schistose, and at places with gneiss's texture. The rock has a very coarse texture due to influx of a considerable amount of quartzo-feldspathic materials. From Darjiling to Kurseong, gneiss is continuous. The dips are uncertain and irregular, but vary from 40 degrees to 65 degrees northerly near Kurseong and southerly near Darjiling.

The gneiss is highly micaceous and is composed of colourless or grey quartz, white opaque feldspar, muscovite and biotite. It varies in texture from fine grained to moderately coarse rock, lenticular layers of different degrees of coarseness being commonly inter-bonded. It contains bands and lenses of pegmatite and apatite. These rock types are associated with sills of epidorite, which probably represent the basic sill intruded prior to the deformation. The accessory minerals present are kyanite, sillimanite and garnet. Kyanite and sillimanite are not always present though the rocks have attained the respective grades of metamorphism. The Darjiling gneiss is highly foliated and the foliation dips being generally from north to north-west and the amount of dip ranges from 30 degrees to 50 degrees.

The rocks of Daling series and Darjiling gneiss groups are thrust over the Gondwana and represent sediments, which have undergone metamorphism. Petrological studies show a gradual increase in metamorphism from the Dalings to Darjiling gneiss, the topmost member of which is the sillimanite gneiss, which is indicative of the higher grades of metamorphism over those of a lower grade. The Darjiling gneiss, due to the extensive development of the alumino-silicate minerals, suggests metamorphism of argillaceous sediments.

The geomorphic configuration of this hilly tract is the joint product of geological foundation and fluvial processes, although slope-wash, in particular mass movement and related phenomena also played a very significant role in the final shaping of the landform. The jointed structure of resistant gneissic rocks coupled with conspicuous chemical weathering (mainly hydrolysis) produces a thick mantle of soil and regolith, thereby reducing the shearing resistance of the country rocks significantly. The river valleys, mainly fed by springs, are narrow and steep. However, during flood discharge, they exhibit a tremendous power to erode as well as to transport a huge amount of debris. Such geomorphic processes have definitely played an extremely significant role in the evolution of the regional geomorphology. Thus it is



Height in metres	M - Municipal Boundary	R – Road	S – Stream

Fig. 1.1: Cross-sections showing Relief of Kurseong town.

apparent that the complexity of geomorphic evolution of the area, presents a compound landscape in which two or more geomorphic processes have played important roles in the development of the existing topography.

1.2 RELIEF

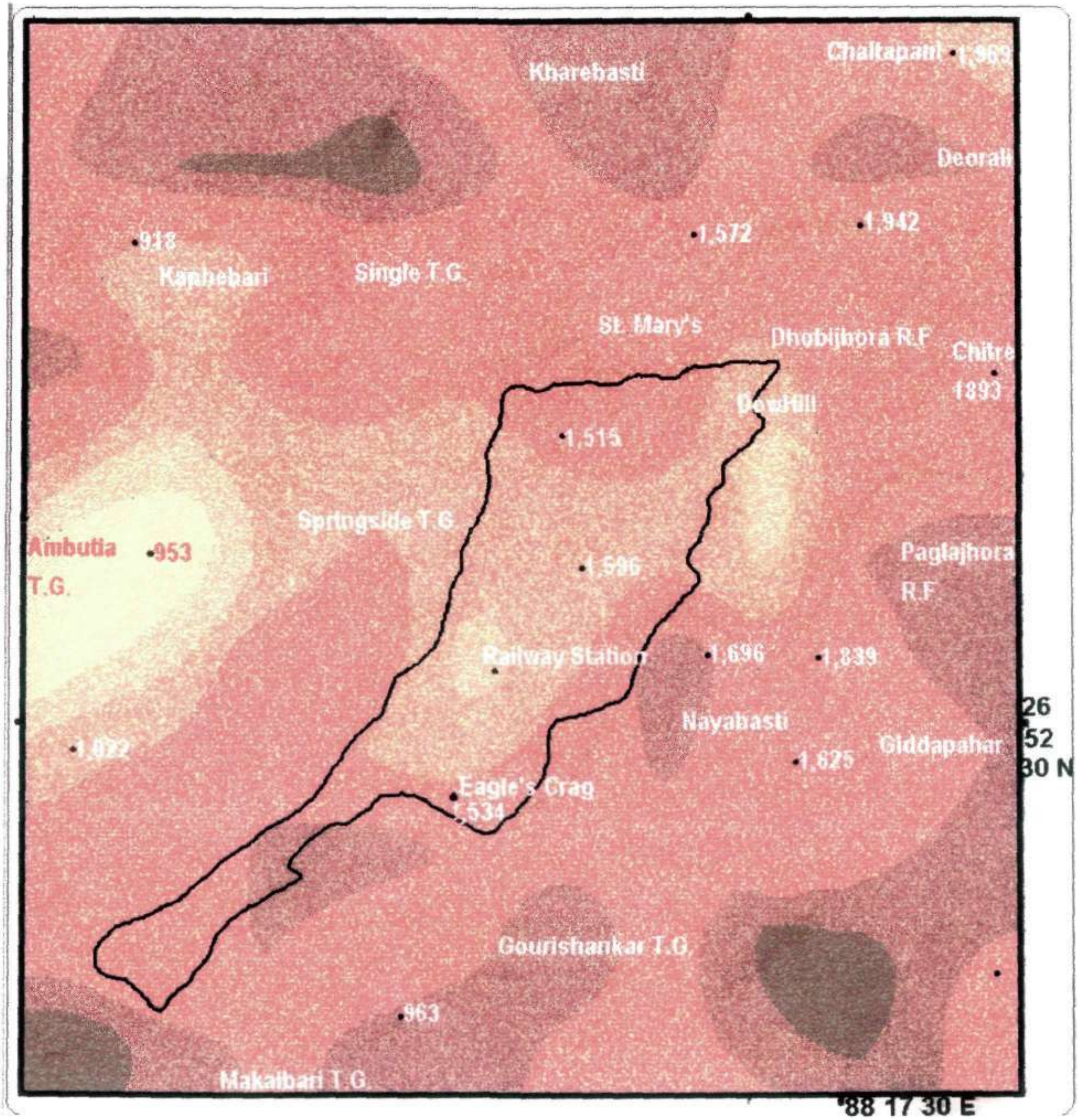
In Kurseong town, the steepness and stability of the hill slopes may be regarded as the most important geomorphic limiting factors for urban development. Nature of parent materials, legacies from the past as well as the level of human interference seem to be the important limitations. Such limitations may be overcome by using the appropriate engineering techniques. However, if the limitations are not recognised before construction commences, the new structure may later be damaged or even destroyed, with great costs to the occupants, landowners, neighbouring properties and the community at large. For proper recognition of foundation sites and soil limitations these ought to be a vital part of urban planning as a natural component of the urbanisation processes.

The cross-section along different lines on Kurseong town (Fig. 1.1) shows the degree of the slopes in different parts of the town. It reveals that some of the slopes especially along cross-sections C-C', D-D' and E-E'are not suitable for settlement and vulnerable to landslides.

1.2.1 Slope analysis

Slope may be defined simply as 'an angular inclination between different elevation'. The slope gradient defines the stage of development of a landscape (Stralher, 1956). A number of schemes of slope analysis on the basis of contours found in topographical map have been evolved by a number of prominent geomorphologists. The average slope of the study area has been evaluated by Wenthworth's method (1950).

On the basis of Wenthworth's method, a slope map of Kurseong town and its environs has been prepared (Fig. 1.2). This shows that the entire area can be broadly divided into 4 broad zones. The highest average slope (39°30′) has been identified in the extreme southwestern part of the town, while the lowest average slope (4°20′) has been found west of the town. However for a better understanding of the geographical distribution of the major slope zones, the following classes are put forward.



Less than 5°	5° to 10°	10° to 15°	15° to 20°
20° to 25°	25° to 30°	30° to 35°	above 35°
• height in metres	T.G. - Tea garden	R.F. reserved forest	

Based on Wenthworth's method.

Fig. 1.2 : Slope zone map of Kurseong town and its environs.

Class I (less than 10°): Areas of low slope are in the western part of the town and the Ambootia Tea Garden is located here.

Class II (10° to 20°): Areas of moderate slope are in a major part of the town, at Springdale T.G. and Chaitapani.

Class III (20° to 30°): Areas of moderately high slope are found in the northern, eastern and south-eastern part of the town, at Kharebasti, St. Mary's, Chitre, Giddapahar and Gourishankar T.G.

Class IV (above 30°): Areas of high slope are found in the northwestern part of the map, southern part of the town, and at Pagla jhora area and Makaibari T.G.

From the analysis it can be concluded that most of the hillside slopes and valleys are characterised by moderate to steep slopes, which is an indicator of the youthful stage where moderately active erosion processes have not yet been able to turn the steep slopes into gentle ones.

1.3 DRAINAGE

The circulation of water in Kurseong town like in any other urban environment involves two inter linked systems: (i) the man-modified hydrological cycle and the man-created artificial water supply and (ii) waste water disposal system. The natural circulation of water is modified by the nature of urban surface, which encourages rapid run-off and decreases infiltration (Jens and Mc. Pherson, 1964; Douglas, 1976 and Kuprianov, 1977). Urbanisation affects sream channel, often causing water to flow through cities at higher velocities (James, 1965 and Lull and Sopper, 1969). Leopold (1968) summarizes the hydrological effects of urbanisation under four major headings: (i) a change in total run-off, (ii) an alteration of peak flow characteristics, (iii) a decline in the quality of water and (iv) a change in the hydrological amenities of streams.

Most of the jhoras, except Dhobikhola and Hussain Khola, are non-perennial in nature. The jhoras like Hussain Khola, Tekbir Busty jhora, Debisthan jhora, Bhagwabati jhora Kanti jhora and Ramlal jhora originates in the Dow Hill Ridge and flow towards the west. They all

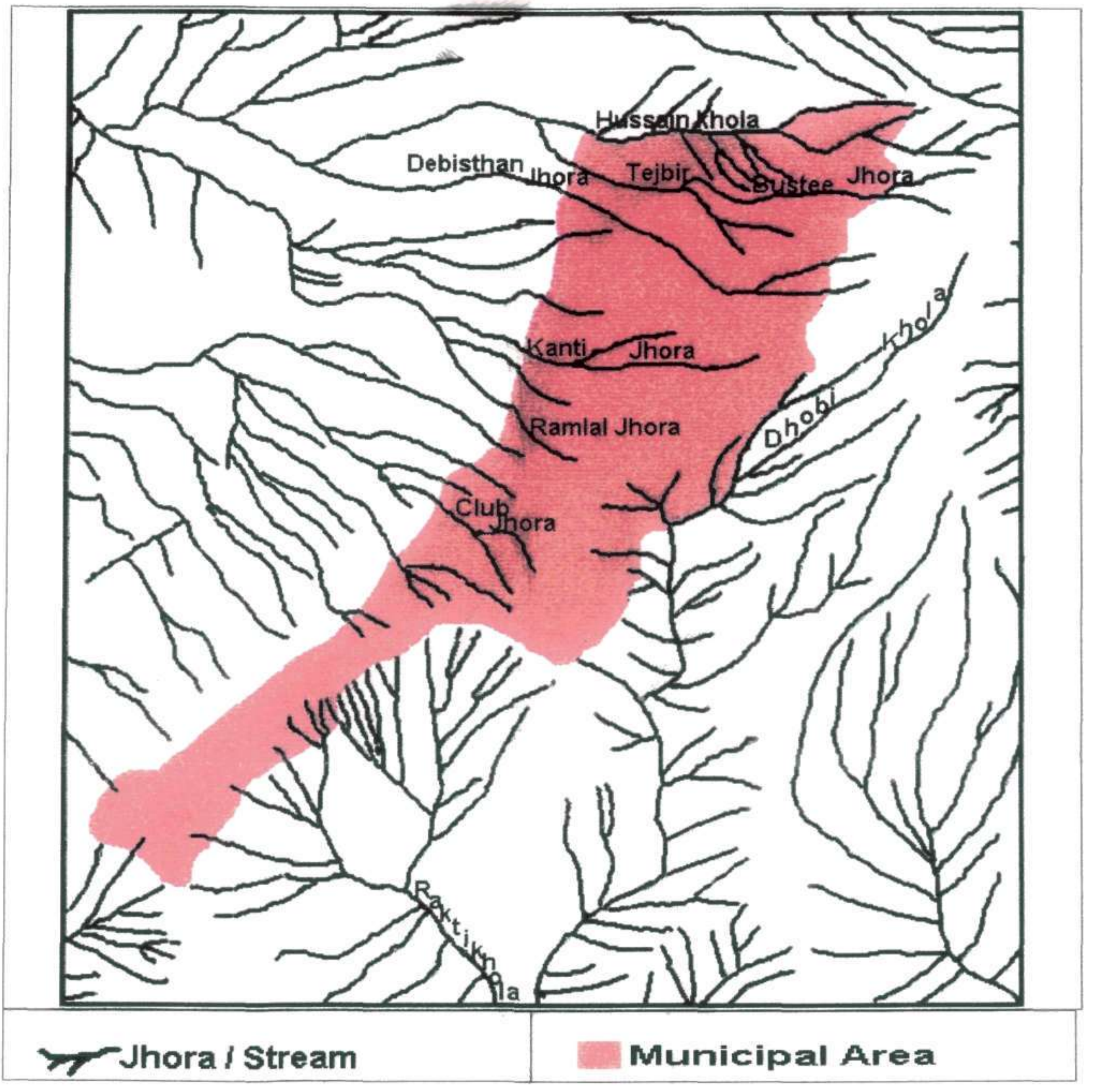
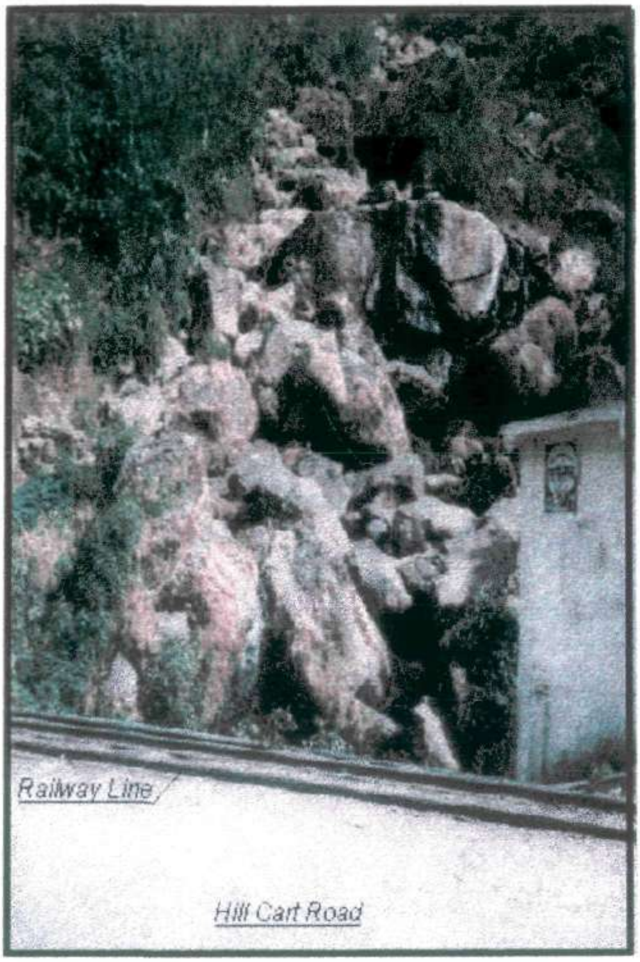


Fig. 1.3 : Drainage system in Kurseong town and its environs.

join the Rinchingtong Khola, a tributary of river Balason. The Dhobi Khola (Pic. 3) flows towards the south (Fig. 1.3). The local population for drinking and washing purposes uses the water of these jhoras especially near the source. These jhoras also act as natural drains for carrying storm and sewer water. Extraction of buildings materials is also common in some of these jhoras. The topography of Kurseong is, as such, that contrary to water logging problem as it is in the plains, it poses the problem of scouring and erosion of jhora beds and gullies, which ultimately lead to landslides.



Pic. 3 : The Dhobi Khola.

1.4 CLIMATE

In any hill town extreme climate is not suitable for habitation but the climate of the town is moderately favourable for habitation and human activities. The climate of the town is similar to that of Darjiling town but it does not suffer from severe winter or a treacherous drop of evening temperature as in Darjiling. The meteorological report of 1995 (Table 1.2) shows that highest temperature was recorded in August with mean maximum of 25.1°C and mean minimum of 17.2°C. Lowest temperature was recorded in January with mean maximum of 10.6°C and mean minimum of 5.2°C (Fig. 1.4 a).

Table 1.2 : Meteorological data of Kurseong town (1995).

Months	Temperature in centigrade		Rainfall in mm	Number of rainy days
	Maximum	Minimum		
January	10.6	5.2	14.2	1.4
February	11.3	7.1	28.2	2.5
March	15.2	9.8	43.7	3.1
April	19.8	11.3	107.4	7.0
May	21.4	12.2	273.8	14.3
June	24.6	15.7	825.7	22.4
July	24.8	16.1	1,040.6	27.0
August	25.1	17.2	903.7	25.9
September	24.5	16.4	633.0	19.9
October	22.7	12.7	158.7	6.3
November	17.1	8.4	17.0	1.1
December	13.1	6.5	6.3	0.6
Annual	13.9	9.1	4,025.3	131.4

Rainfall is generally heavy in Kurseong town during monsoon and its annual rainfall in 1995 was 4025.3 mm. July was the rainiest month with 1040.6 mm of rainfall (Fig. 1.4 b) and the total rainfall during the four months (June to September) was 3403 mm. This shows that about 85 percent of the total rainfall occurs during these four months. There were about 131 rainy days in 1995. Due to its location near the forest and at a higher altitude, rainfall at Dow Hill is greater than at the centre of the town. During monsoon the weather is generally foggy but from October till April weather is usually dry, clear and fog free. The atmosphere is highly

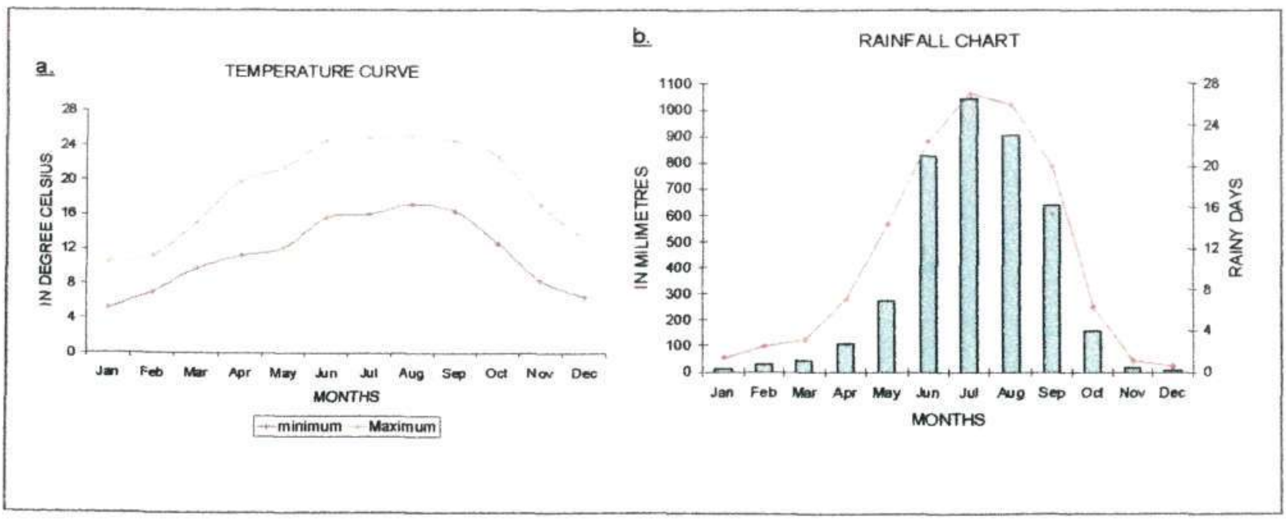


Fig. 1.4 : (a) Temperature curve and (b) Rainfall chart of Kurseong town (1995).

humid through out the year and relative humidity was 75 percent in winter and 93 percent in summer in 1995.

During the period November to May upper winds over the Himalayan region are predominantly westerly. With the setting in of the monsoon, however, there comes a conspicuous reduction in wind speed persisting until the approach of winter. Surface winds in Darjiling district have usually an easterly component. From November and throughout the winter prevailing wind direction is east-northeast. In the spring and unto June there is a tendency for a west or southwest component to enter and in the monsoon (June to September) prevailing direction is east-southeast.

1.5 SOIL

Previously the area was covered by forest but later on tea plantations came up due to suitable climate and edaphic conditions. Thus soil is very important for the growth of agriculture as well as the town.

The soil of the upland is usually red and gritty while that of the plains is dark and more fertile. Red and yellow soils have developed on the gneiss and schist in the higher slopes of the Darjiling Himalayas. The greater portion of the hilly area lies on Darjiling gneiss, which most commonly decompose into a stiff reddish loam but may also produce almost pure sand or stiff red clay. The colour of the red soil derived as it is by meteoric weathering from gneisses and schist is due more to wide diffusion than to high proportion of iron content. The type of soil is mainly siliceous and aluminous, with free quartz as sand. It is usually poor in lime, magnesia, iron oxide, phosphorous and nitrogen, but fairly rich in potash, some areas being quite rich in potassium derived from the muscovite and feldspar present in the gneiss.

The podzolic soils in the hilly areas are suitable for the cultivation of tea. Parent material variations exert a stronger influence on soil characteristics of the Darjiling Himalayas than climate or vegetation. In this area, there is a topsoil of about 3 to 5 meters near the crest of the ridges, but the thickness decreases downwards and the lower slopes are generally covered with boulders rolled down from the top. On the Darjiling gneiss there is a cover of reddish, sticky soil. The soil everywhere is residual, i.e. derived by the weathering of the underlying rocks. Weathering is selective in the Darjiling gneiss and proceeds along some susceptible bands i.e. mica rich bands in preference to quartzose bands and also along joint and sheer planes. As a result, blocks of fresh rocks are generally found encircled on all sides by highly weathered rocks of the nature of clay. The clay is found mixed up with grains of quartz, feldspar and flakes of mica. This has got an important bearing on the landslides.

1.6 FLORA AND FAUNA

The north-eastern part (Dow Hill) of Kurseong town is covered by reserved forest (Pic. 4). The richness and variety of vegetation in Kurseong region received a vivid description in the Himalayan journals of Sir Joseph Dalton Hooker as far back as in 1854 with "the oak flowering, the birch bursting into leaf, the violet chrysosplenium, stellaria and arum, vaccinium, wild strawberry, maple, geranium and bramble. A colder wind blew here; mosses and lichens carpeted the banks and road sides…one mass of blossom, specially the white orchids Calegynes, which bloom in a profuse manner, whitening their trunks like snow".

Pic. 4 : The reserved forest at Dow Hill.

Plant life in the town no doubt differs significantly from what had been in the past, but the higher riches of the town and its surroundings even today retains all those old sylvan beauties in the deep forest of chestnut, oaks and laurels and a thick spread of Cryptomaria Japonica (Dhupi). The Cryptomaria Japonica, which now predominates the district, was introduced from China and Japan by Mr. Fortune and passed on to Dr. Anderson for planting in nurseries at Jalapahar, Darjiling.

The Table 1.3 takes a look at the history of forest plantation in the Dhobijhora Reserved Forest (a part of Bara Shibkhola Forest).

Table 1.3: History of forest plantation in Dhobijhora Reserved Forest

Year of plantation	*Plan and species planted*	*Result*
1886	Copressus Funebris, Thuja Orientalist,Cryptomaria Japonica	Successful.
1882-91	Champ, Katus and Oak	Not very satisfactory. By far Champ did the best
1904-17	(Hatt's Plan) Coppice Felling (30yrs rotation). Plantation of Buk, Kayla, Katus, Mitha Champ, Arkanla	Coppice growth disappointing.
1922-37	(Baker's Plan) This area formed short rotation (30yrs) or fuel working circle. Clear felling and plantation with Taungya. Species planted: Maya, Champ, Tarsin, Kawla, Malata, Lali and Chiple Kawla, Oak, Eucalyptus, Cyprus, Utis (planted 13 times) and Dhupi (planted 14 times).	Soil erosion increased. Utis began to die off. Dhupi, due to its rapid growth, became valueless as timber or as fuel. Original forest crop destroyed.
1940-53	(3rd Working Plan) The area came under the hill fuel-working circle. Clear felling of Dhupi and restocking the 'clear-felled' areas with other species. 60years rotation. Retention of Coppice shoots and removal of dead or fallen Dhupis on 10-year cycle were to be followed.	Planted crops got suppressed and killed by vigorous Coppice shoots of undesirable plants. Theft, illicit felling or lopping and negligence of tending operations, etc. made the plantations patchy. Regeneration of valuable species was unsatisfactory.

The needle like leaves of Dhupi trees contain acid and as such the soil underneath become acidic with accumulation with falling leaves and this acidic soil doesn't allow any amount of undergrowth below these trees. As long a the land is under the Dhupi cover there is less fear of land slip or soil erosion, but once the forest is clear, the land during rain becomes prone to erosion and land slip as the soil particles being acidic in nature and have little binding capacity. Moreover the absence of undergrowth also helps in this process of soil erosion.

The fauna of this area was highly varied and interesting. But with growing population and poaching, the animal life of hill forest is fast disappearing. Leopards (Panthera Pardus), which were so common in the past, are not seen now. Species of orange-bellied Himalayan squirrels, Indian Marten, Assamese Macaque, Rhesus Macaque and Jackals (Cannis Aureus) can normally be seen.

The list of avi-fauna of this area is interesting. It includes Himalayan Whistling Thrush, Black Drongos, Tickll's Warblers, Spotted Babblers, Blossom Headed Parakeets, Hodgson's Pied Wagtail, White Tailed Nuthatch, Blue Rock Thrush, White Capped Red Start, Yellow Backed Sunbird, Rufous Turtle Dove, Himalayan Barred Owlet and White Throated Fantail Flycatcher.

CONCLUSION

The growth of urban life is one of the striking developments in the history of mankind but this growth in itself is greatly influenced by geomorphic changes. The geology of the Himalayas is a complicated one and is the joint product of geological foundation and fluvial processes. F. R. Mallet was the first to classify the rocks of the Darjiling Himalayas in a systematic manner. The region around Kurseong town is mainly made up of Darjiling gneiss, which is highly micaceous. The town has moderate to high slopes, which in turn helps in fast flowing of jhoras resulting in scouring of jhora beds and landslips. The jhoras flowing through the town not only provides drinking water but also act as natural drains for carrying sewer water.

The southwest monsoon winds bring heavy rainfall to Kurseong town. The difference in altitude has resulted in having two different temperature zones in the town. The Dow Hill is much more wetter and colder than the town centre. The Darjiling Himalaya is mainly covered by podzolic soils that helped in the growth of tea plantations. Dow Hill is forested mostly with Cryptomaria Japonica, which was introduced in the Darjiling Himalaya after clearing the original forest has no value as timber or as fuel and moreover has not enriched the soil.

The historical development of Kurseong town and its different phases of growth will help in better understanding of its demography and its relation with the district. The growth of population, the different communities, their sex ratio and rate of literacy and status of working population will give an insight into the characteristic of the town.