
A B S T R A C T

ABSTRACT

In the town of Darjiling, problems arising from Urban development are most serious as here growth is uncontrolled and planning is primitive or absent. Being aware of the situation, the present researcher has taken up the challenge to study its landforms and their related processes, materials and hazards, in ways that are beneficial to planning, development and management of this once beautiful hill town. This work is self-evidently related to the present-day conditions and commonly these conditions present problems and provide hazards to the human use of hilly terrain so that they are of utmost interest to environmental managers and users.

Geologically Darjiling town is composed of highly metamorphosed Darjiling-gneiss which are composed of foliated gneisses, mica-schist and occasional bands of flaggy quartzites and granulitic rocks. These are well jointed ($40-70^\circ$ E-W) and highly foliated rocks ($28-55^\circ$ SSE-NNW).

In Darjiling town the mean **temperature** is about 5.6°C in the cold season and increases to 15°C in May. From June to September the temperature remains more or less steady about 15.6°C . **Humidity** and **rainfall** in general is high from June to September. During winters Darjiling experiences occasional snowfall.

The most remarkable feature of the **forest** of Darjiling is the

different variety of species that they contain. However the dominant type of vegetation found is the temperate type. Most of the trees grow up to a great height, the principal being Oak, Magnolia, Chestnut, Maple, Birch, Uttis and the most commonly found is Dhupi (*Cryptomiria japonica*) which is not an indigeneous plant but was brought from Japan.

The soils of Darjiling hills are usually red and gritty. Red and yellow soils have developed on the gneiss and schist in the upper slopes of Darjiling Himalaya, as the gneiss gets decomposed into a stiff reddish loam. The colour of the soil, is due to metcoric weathering of gneisses and schists and it is because of wide diffusion rather than the high proportion of iron content. The podzolic soils in the hilly areas are suitable for the cultivation of tea. Parent material variation exert a stronger influence on soil characteristics than climate or vegetation.

The geomorphological set-up of Darjiling town and its environs along the crescentic ridge of the Singalila Range offer a fantastic scope to the geographers to study a special type of man-environment relationship. The altitude of the town varies from 2,300 m at Jalapahar to 1670 m above sea level near the Jail. The Katapahar-Jalapahar-Birch Hill - Lebong spur forms the main ridge of the town. The urban centres are mainly concentrated along this ridge and the western spur of the ridge. Occasional ravines, deep-valleys and innumerable springs dissect the landscape. The geomorphic configuration of this hilly tract is a combined effect of the geological foundation and resultant fluvial activities. The average slope of the town is 20° but on the eastern side of the

ridge, the slope exceeds to 40° and along the ridges the slopes decreases to about 15 to 20° . There are 7 major and 27 minor springs within the urban centre. A Morphometric Analysis of the town has been attempted under the following headings : (1) Morphometric Properties, (2) Morphometric Variables, (3) Regional Dispersion, (4) Pair-wise Relationships and (5) Multiple Relations among Morphometric Variables. The streams of the basin are young and are still extending their lengths with the consequent increase in relief ratio, drainage density, elongation ratio and streams gradient to adjust themselves with the existing terrain typified by variations in lithology, structure, relief, vegetation etc. Thus the region under study is on the verge of entering the stage of late youth.

Darjiling was truly a nature's domain till the British occupation. The steep hill slopes and valleys with a scanty population of 100 in 1800 was densely covered by natural vegetation and thereby had no major **soil-erosion problem**. The cutting of trees, clearing the land mainly for tea plantations and construction of houses accelerated soil erosion, mass-movements and landslips. The worst affected parts of the study area is the eastern slope of the main ridge i.e. Toongsoong, Alubari and Manpari which have already been deforested and densely settled along with a skeletal soil. Immediate afforestation, scientific terracing and drainage facilities should be provided along the northern Birch Hill, Tukvar eastern Lebong spur and Chotta Rangit Valley to check further degradation. Although, the ridge tops i.e. Jalapahar-Katapahar, Lebong and Birch Hill have no immediate degradational problem, yet these regions need to be brought under

the conservational measures, keeping in mind the long term consequences of soil-erosion.

Rapid urbanisation and the uncontrolled growth in population (71,479 persons in 1991) has turned Darjiling town, once famous for its natural beauty, into a concrete jungle without paying any need to its ecological balance. Sliding which was a minor physical phenomena a hundred and fifty years ago, has now become a routine feature ruining Darjiling town and its environs.

The causes and mechanisms behind various types of slips and slope failures during the last 100 years have been carefully identified to demarcate the landslip prone areas and to provide corrective measures and ensuring an all round protection against this menace. Thus man must be made aware of the possible dangers that he is inviting, due to his careless dealing with nature. It is true that one has to make room for the growing population and in this pursuit he has to utilise every piece of land available. But the precautions that have to be adopted should not be neglected. Above all the most important priority would be to develop mass-awareness among the citizens as well as the tourists, so that they become aware of the possible dangers that they are inviting by disturbing the local ecological balance.

Throughout its evolutionary processes the town of Darjiling which at present covers an area of 10 km² with a population of 71,479 has continuously modified many of its pre-urban landscapes. Reckless deforestation, unscientific cut- and-fill activities along hillslopes for urban purposes have undoubtedly disturbed the geo-

environmental processes operating in this high-altitude ecosystem. Chief among the geomorphic limitations exerting decisive control on urban land-uses in Darjiling town are climate-induced processes, hill-slope stability, gradient and slope-length, soil characteristics and topographic locations. On the other hand, urban influences on geomorphology are mostly constructional "cut-and-fill" activities. For instance human induced landforms are striking in and around the Mall, Bazar area, Lebong - St. Joseph's, Dhobitola and Toongsoong area. The consequences of such large-scale urban expansion and deforestation, seem to be detrimental for the hydro-geomorphological processes operating in the Darjiling hills. Large scale mass-wasting, water-scarcity, unabated soil-erosion and disastrous landslips are rampant every year. The local government should impose regulations prohibiting construction on slopes beyond a certain gradient. Assessment of suitable sites for further urban expansion should be done with the aid of detailed geomorphological maps; analysis of break of slopes, bed rocks and soil mantle, mass-movements, drainage characteristics and slope length/gradient etc.

The circulation of water in Darjiling town like any other urban environment involves two interlinked systems : (1) man-created artificial water supply and (ii) the waste water disposal system. The urban hydrological system collects water from the natural hydrological cycle, delivers it to the point of use and discharges it back to other sectors of the natural hydrological cycle. The water supply of Darjiling town is drawn from the Balason Catchment (i.e. Senchal lake) and after use discharges into the tributaries of the Rangit river - a major channel of the great

Tista Basin. The urban landscape of Darjiling town exerts an ever increasing influence upon the hydrological cycle, regime, water balance and the quality of surface and ground water. It has been apparent from the analysis of surface and ground water that the hydrological features of the study area depend upon a number of phenomena. The radical change of the surface and the construction of drainage sewerage system, create new conditions of run-off formation, and the speed at which the water disposal is effective into the natural bodies, have become many times greater. The precipitation and evaporation regimes change due to changes in the natural heat regime. The creation of large surfaces of impervious covers influences the natural heat regime and also impedes the natural interaction between the surface and the ground-water. There is also a marked increase in the disposal of storm-water or sewer-water into natural water bodies, creating a new man-made landscape including town-structures, modified natural or new artificial water bodies.

The growth of Darjiling town primarily as a recreational cum administrative centre, intervenes with the original topography in more or less the following three ways : i) by cutting down the elements from the relief, thus deleting natural parameter from the topography; ii) by building ramps and surfaces above the original relief, thereby adding to the existing topography and iii) by reclaiming areas for buildings from an originally unstable environment. Thus, **the impact of the urban development** has gradually endangered the natural eco-system. The population explosion calls for space for dwellings, roads for communication,

water for drinking and domestic purpose and building materials for construction and these are all collected from meagre local resources which eventually become fragile due to such over exploitation. The population enjoying urban amenities in Darjiling town has been chosen as the controlling parameter to assess the degree of development of the town. The degree of illiteracy, however can be used successfully in Darjiling because it is basically education that brings a necessary change in the degree of public perception. To check on the validity of the implied correlation between the two chosen values, the data of the percentage of illiteracy versus urban population enjoying urban amenities have been set out for 26 wards of Darjiling Municipality. The result indicates a negative correlation, with most of the variables lying closer to the best-fit line, thereby, sustaining the correlation of our choice of the two variables.

Urban development is greatly influenced by geomorphic changes. Urban planning always involve some assessment of land capability either in terms of terrain conditions or limitations or in terms of the suitability of land for a particular use.

The assessment of the **Urban Land Capability** zones of Darjiling town is based on the factors like : i) the Geology including rock types, nature, structure and the degree of weathering, ii) the slope and terrain characteristics, iii) the soil including variability of soil, properties and the possible utilizations and to identify the limitations imposed by soil, iv) the hydrological factors including the size of catchment areas, conditions of the existing drainage line, storm-water disposal