CHAPTER- 8

Development Programmes and its Environmental Impact

8.1 Introduction

The early developer of Darjeeling identified appropriately that developing communication with rest of the country is the key to develop the newly annexed hitherto inaccessible terrain. The then Darjeeling hill area was mostly uninhabited only dotted with few settlements of Lepcha community. The means of communication in Darjeeling hills up to 1835 were very rudimentary. A few narrow rough tracks through forests and occasional cane bridges over torrents were all that existed at the time of Grants memorandum of 1830 that mentioned only two routes then existing northward from the plains into Sikkim. One was the *Nagree Pass* and the other by the *Sabbook Golah*. A third route by the Mahananda was mentioned as having been deserted and over grown with jungle.

The pioneers who came to poem up Darjeeling after it had been ceded in 1835 were confronted with an arduous journey from Calcutta before they reached the hills. The first step to introduce modern communication in the district was taken in Journey 1838 when the trace of the Calcutta road to the east of the hill on which Jalapahar Cantonment stands now was completed by Lt. George Lloyd in 1839, Lt. Napier of the Royal Engineers was deputed to prepare a lay out of Darjeeling town and to construct a road from Siliguri to Darjeeling. The project was carried out between 1839 and 1842, at an expenditure of rupees eight lakh and the road, latter known as the old military road. It is still seen winding its way from Pankhabari to Kurseong and then on to Dow Hill, Senchal and Ghum having 300 bridges and culverts. This road was not suitable for wheeled traffic and the development of Darjeeling and transportation of heavy military stores led to the construction of Cart Road to Darjeeling from Siliguri. The work was begun in 1860 the section from Kurseong to Darjeeling was opened to traffic in 1864 and the whole road completed in 1869.

The British construction engineers also understood the hazard potentials of such construction activities on the steep slope of the Himalayan immature geology. Moreover, transportation of bulky and heavy consignment became increasingly difficult by the existing narrow and serpentine road. The opportunity came in 1878 when Siliguri became connected with Kolkata by railway. Mr. Franklin Prestage, Agent of the Eastern Bengal Railway, foresaw the utility of a rail link between the hills of Darjeeling and the plains. He submitted a

scheme for the construction of a two feet gauge railway line from Siliguri to Darjeeling. His scheme was mainly driven by hard economic considerations viz. the huge difference in the cost of essential commodities between Darjeeling and Siliguri, the need to carry out tea for export and the inability of the existing road to handle the growing traffic. Prestage received the final sanction for his project on 8th April, 1879 and formed the Darjeeling Steam Tramway Co. The idea of operating the line as a steam tramway was soon abandoned and on 15th September and in the year 1881 the company adopted the designation of Darjeeling Himalayan Railway Co. (DHR), which remained effective till today. The line between Siliguri and Kurseong opens to the public in August 1880 and by June 1885 the railway line extended to Darjeeling bazar. By the year 1915, another branch opened from Siliguri to Kalimpong Road (Gielle Khola) i.e., the Teesta Valley Line.

The genesis of the DHR is significant both economically and in engineering terms, the DHR broke new grounds in India in both domains. It was the first railway in India built exclusively with Indian capital, the immense reduction in transport costs to and from Darjeeling guaranteed plenty of traffic and hence a good return on the investment thus facilitating its financing, which ran to Rs. 28 lakhs. Moreover, the journey time from Calcutta to Darjeeling was reduced from 5-6 days to less than 24 hours. This was a crucial factor in enabling the development of Darjeeling as a hill station and a bustling holiday destination.

Thus, it is not surprising that the DHR has achieved worldwide fame for a number of reasons. It serves as a gateway to the Himalaya, the world's loftiest mountains and a land of mystery and imagination. The spectacular landscape unfolds as this 2 feet gauge railway labours uphill at about 10 mph, criss crossing the Hill Cart Road. Darjeeling is an old hill station and has attracted visitors and writers from all over the world. It is famous for Darjeeling tea. Perhaps the UNESCO inscription on DHR (5th December 1999) is the fittest adjective to *the Darjeeling Himalayan Railway is the first example of a hill passenger railway. Opened in 1881, it applied bold and ingenious engineering solutions to the problem of establishing an effective rail link across a mountainous terrain of great beauty. Kit is still fully operational and retains most of its original features intact.*

The Darjeeling hill was experienced massive development activities during the following years. Development of infrastructure facilities followed by life supporting activities attracts huge migration mostly from Nepal and other parts of the country. With the early

success of tea cultivation, large scale tea estates established. Thus, the topography and land use of Darjeeling hills transformed significantly.

The aim of this chapter is to assess the different development programme that have undertaken in Darjeeling hill areas under their true chronological perspective with a view to find out their respective environmental impact. Data for the study has been obtained from both primary and secondary sources. The growth of population during the past one hundred year has been accessed from the census of India reports. District gazetteer, statistical hand books, reports from various line departments have been consulted to gather information relating to the development programme and to find out their respective impact.

8.2 Development Road Network and its Impact

When the British annexed Darjeeling hill there was no proper road and bridge, however there were small paths, trails and kutcha roads existed where the bullock carts use to ply carrying the goods beside pack-ponies or human carriers were consequently most generally used for transport.

Table 8.1 Major roads network in Darjeeling hills during the British period

No.	Road from	To	Length in km
1	Siliguri	Sevoke	19.3
2	Sukna	Adalpur	4.9
3	Matigara	Darjeeling Hill Cart Road	3.3
4	Matigara	Kurseong via Pankhabari	21.7
5	Panighatta	Dhudiajhora	3.9
6	Siliguri	Darjeeling	77
7	Siliguri	Rhenok	79
8	Sivok	Tipprapara	16
9	Tista Bridge	Rangpu	21
10	Jore bunglow	Riyang/ Rambi	19.3
11	Bagdogra	Ghum	74.2
12	Algarah	Minglass	38.6
13	Mitabari	Kurseong	25.8
14	Kurseong	Mirik	25.7
15	Darjeeling	Tista bridge	35.4
16	Manibhanjan	Jhepi	25.6

Source: Collect orate, Darjeeling, Govt. of West Bengal

During British period the most important road in the district was the cart road winding through the hills from Siliguri to Darjeeling. This road was 79 km long, which is one of the best mountain road in India, the road belongs an average breath of 7.5 meter and a ruling

gradient of 1:31. The construction of the road was begun in 1861, in order to replace the old military road which was too narrow and steep for carts. By the year1865, the upper section from Darjeeling to Kurseong a length of 31.2 km containing 300 bridges had been completed in 1869, the road from Pankhabari to Kurseong also was fully completed which was about 9 km long.

Table 8.2 Roads constructed by PWD Darjeeling construction Division during third Plan.

No.	Name of roads and location	Length
1	Approach road to Tista bridge	0.44 km
2	Road from 6th Mile of Ghum Peshok road to Tista valley Via Takdah and Rungli Rungliot	19.3 km
3	Darjeeling Pulbazar Bijanbari road	
	(a) Bijanbari Pulbazar section (b) Darjeeling Pulbazar section (c) 4 Miles section in Chonton area	1.7 km 19.3 km 4.1km
4	Matali Rongo road - Gairibas Rongo section	10.2 km
5	Mirik Panighatta road Balasan bridge – Mirik section	25.6 km
6	Extension of Peshok – Mangpu road to Surrel Bunglow	5.2 km
7	Jorebunglow- Sukhiapokhri (Village road)	12 km
8	Mirik - Panighatta road including Balasan bridge	5.7 km
9	Peshok Mangpu road	8 km
10	Kumani - Naxal khola road	5.5km
11	Naxal khola Gairibas road	3.3 km
12	Khunia to Rangpo Cinchona plantation	13.5 km

Source: PWD Darjeeling construction Division

Next in importance came the Tista valley road, which was the highway for travelers and merchants going to Sikkim and Tibet, the total distance of road is 55.5 km from Sivok to Rangpu on the boarders of Sikkim. Road was constructed from Darjeeling to Tista bridge which was 27.2 km long, latter road constructed from Tista to Kalimpong and Kalimpong to Algarah. Another important road was that leading from Ghum to Simana busti on the north west of the Darjeeling hill. This was a good cart road 16 km long leading along the Ghum range through the dense forest clothing its southern slopes. It passes through Sukhia pokhari (12 km from Ghum) and 5 km further on terminates at Simana busti on the Nepal frontier. Other important roads of British period were from Kurseong to Matigara via Pankhabari (18.5 km) and Naxalbari to Garidhura (65.6 km) and in the east of the district from Rikisum via Minglass and Gorubathan. The table 8.1 shows the important road network in Darjeeling hills during the end of British rule. The railway line from Siliguri to Darjeeling 82 km started in 1879 and on 3 July 1881 the Railway line was officially opened to Darjeeling. In 1915

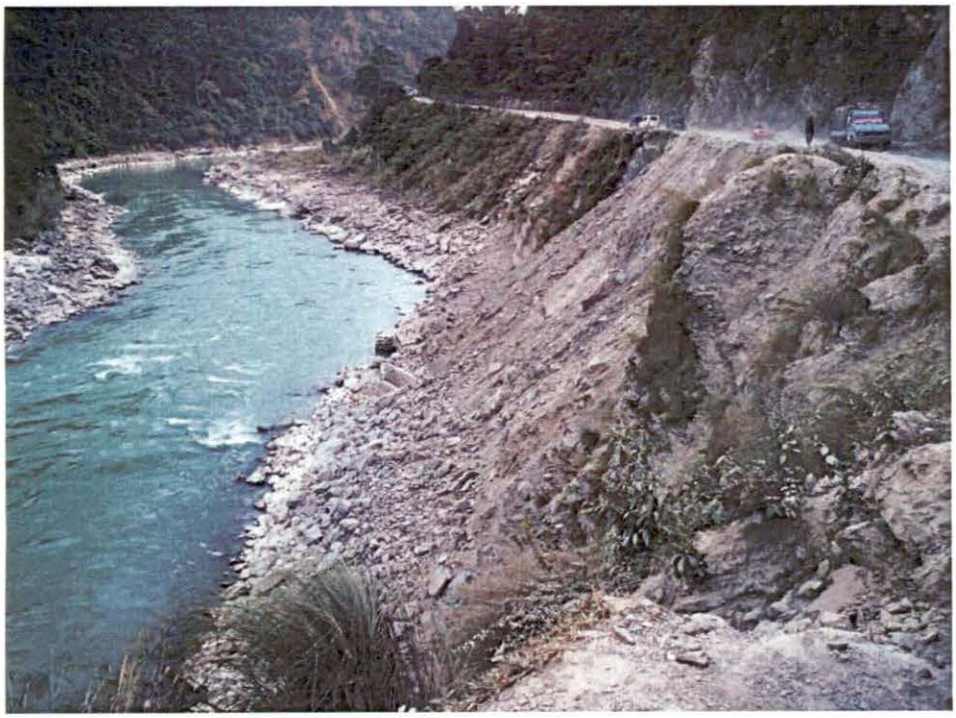
another branch the Tista valley line was opened from Siliguri to Kalimpong road last station was Giel Khola.

Darjeeling construction division of PWD initiated need based road construction in Darjeeling hill area and during the 3rd Plan period 133.84 km long road was constructed across the hills. During this period in addition to connect strategic locations large rural settlements were also connected. The table 8.2 depicted the details of the newly constructed roads during the 3rd Plan period.

In the year 1972, the Darjeeling hill area Development Council was established for the overall development of Darjeeling hill area, since then some development works were started all over the district. The development of communication in all the hill areas of Darjeeling includes the construction of arterial roads rural link roads in order to provide adequate marketing outlets for rural surpluses and to open up the rural hinterland for developmental activity. The constructions of the arterial roads were taken up mainly by Darjeeling Highway Division of the P.W. Roads department. During the period 1980-84 this department had completed the construction of around 60 km of arterial roads while major works over a length of around 60 km had also been taken up under the state plan which included Bijanbari-Jhepi- Lodhoma road (30 km), Rangpu-Rambi Bazar road (12 km) and up gradation of Sukhiapokhari- Manrybhanjyang road (8km). The major schemes that had been taken up from central assistance were Sukhoapokhari-Nagari road (14 km) Gairibas-Sandakphu- Phalut road (7km), Mirik-Simanabusti road (21km), Nagari-Dhajia road (7km). Improvement of Maneybhanjyang-Rimbik Road (21km), Mirik bypass (3 km) and Baggora-upper Mamring road (6.0 km), the P.W.D Darjeeling Division during the same period had taken up work on the road from Murdhahattta to Hill cart road at Naya Busty, Kurseong and the up gradation of Rangit road from Lebong to Majitar. During the period 1980-84 an amount of Rs.486.54 lakh had been provided for the development of arterial road communication in the hill areas of Darjeeling.

While constructing the above roads several kinds of trees and bushes were destroyed along with some valuable medicinal plant. During construction of such roads nobody care about the destruction of forest wild animal insects and environment.

Photograph 8.1 The Hill Cart road the life line of Darjeeling near Lower Paglajhora is under threat of existence



Photograph 8.2 The NH 31A the life line of Sikkim along the Tista valley become highly vulnerable

8.2.1 Forest road

In the tea gardens, the roads were kept up by the tea estates concerned and in the reserved forests which occupied over one third of the total area of the hills they were maintained by the forest department. Many roads were constructed and maintained by the forest department i.e., Sukhiapokhri to Maneybhanjayang, cart road from Simkona to Lalkhoti in the Darjeeling forest division; the old military cart road from Ghum to Kurseong in Darjeeling and Kurseong forest divisions, Sukuna-Sivok road in the Kurseong forest division, Rissibum- Labha cart road and Dalgaon Tar cart road in the Kalimpong forest division. In 1961 the Kalimpong forest division was alone maintaining 316 km of roads and pathways which in 1967 increased to 439 km comprising 152.3 km of motor able and cart roads, 247.1 km of bridle tracks and 39.6 km of footpaths and trails.

Table 8.3 Roads constructed during the DGHC Period in Darjeeling hill

No	Darjeeling Sub-division	Length (km)	No	Kalimpong Sub-division	Length (km)
1	Pokriabong- Pulungdong	5.0	1	Delo – Tourist view point	2.50
2	Sukhiapokhri to Ramji	2.5	2	Bhupalay to Today	12.0
3	Lingay Fatak to Tamsang	4.5	3	Pedong to Muddum khola	7.0
4	Kashingdara to Rangbhang	3.0	4	Muddum khola to Kagay	4.0
5	Rimbik to Srikhola	3.0	5	Pedong to Keshyone	3.0
6	Kaijalay to Relling	5.5	6	Samather to Mungpong	3.0
7	Dhajia to Marma	4.0	7	Lava to Ladam	6.0
8	Gopaldhara T.E.	5.0	8	Bong Church to Devithan	1.0
9	Kolbong to Goak	3.0	9	14th Mile to Ramlal School	1.0
10	Rangbhang Busty	4.0	10	Suntalay to Neem	2.0
	Total	*39.5*	11	Sakyong to Tendrabong	1.0
Roads in Kueseong Sub-division			12	H.L.Dikshit road- Samalbong	4.0
1	Mahanadi to Sivitar	5.0	13	Kagay to Maria	2.5
2	Koila Godam to Turuk	6.0	14	Furun to Kamzer	3.0
3	Deorali to Mazwa	5.0	15	Kagay to Ladam	5.0
4	Singel T.E. to Kafaubari	7.0	16	Ghattaytar to Samdung	3.5
5	Munda T.E.	2.0	17	Upper Fagu to Nim	6.3
6	Kurseong to Pandu Busty	1.5	18	Relli to Deorali	7.2
7	Mid Kharay to Lower Kharay	1.5	19	Relli to Charkhol via Singi	22.0
8	Dhuday to Mirik	6.0	20	Sangsey to Tarkhola	12.8
9	Turuk Busty	3.0		*Total*	*108.80*
	Total	*37.0*			

A total length of 60.8 km of hill motor roads and cart roads was constructed in this Division under various development schemes between 1955-56 and 1967-68 (table 8.3). Another 118.9 km road was constructed within Kalimpong forest division between 1967-68 and 1980-81 i.e., Chunabhatti-Lolaygaon road via Nimbong (40 km) to link up to with the

existing Labha Lolaygaon road, extension of Samsing motor able road to Tempola (4.8 km), Labha- Paktham road via Kolbong and Khampong (9.7 km), Dalimkot- Pastin road via Ambyok and Pankhasari (32.2 km), Paren-Tangta road via Chi chu valley (32.2 km). Construction of roads in the other two forest division has also been taken up in order to reach more and more untapped forest wealth. Some of these roads are Labha-Rishila, Samsing hill, Batasia- Palmajua road etc.

8.2.1 Impact of road construction

There have been constructed about 200 km of road since 1988 to till this date with in 3 hill Sub- division where approximately 800000 m^3 of debris dumped down the slopes and valleys resulting to irreparable environmental damage inclusive of destroying habitat of wildlife and creating sound, soil, water, and air pollution.

In these road construction maximum agricultural land as well as tea garden have been damaged as per report there have been damaged the some area of virgin forest land and Cinchona plantation area also. The maximum road gradient varies from 1:8 to 1:12 and in some places in Darjeeling hill roads are very steep. Due to construction of road some places like Todaytangta, Muddum, Kagay where the loose areas have not been projected properly. So that rain water had damaged the nearby agricultural lands during monsoon. The emphasis has not given for the protection of land and reforestation works have not been taken as the last of forest area have been deforested.

The most of the roads are made up to consolidation stage some are left in soling stage some are left after earth cutting, the further maintenance of road such as surface repairing drain clearance works have not done in most cases. Such man-induced disturb slopes often yielded during the monsoon months and thereby aggravating the hill slope degradation (Photograph 8.1 & 8.2).

Roads are serious threat for biotic environment of Darjeeling hill areas. The rapid and unscientific haphazard development of roads in Darjeeling hill areas are affecting endangered species of flora and fauna. Road construction in hills generates a huge amount of debris which is one of the major cause of environment degradation. It is estimated that one kilometer road construction in Darjeeling hills on and average yielded 4000 to 8000 m^3 of debris from the excavation. The direct impact of road construction occurs in the form of forest cutting and damage of many species of small plant. The effect of the construction work

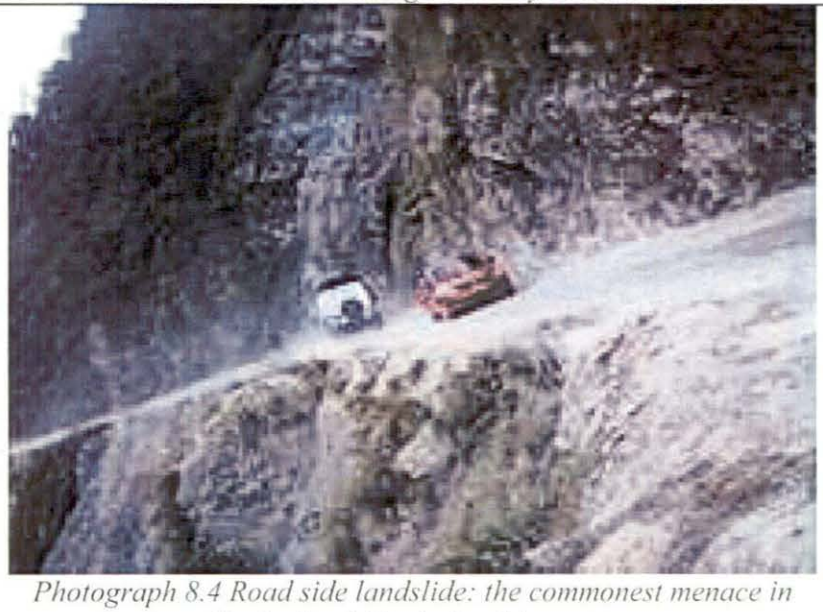
can be seen in the form of landslides, boulder falls and damage and cutting of land. Thus construction of road induced landslide destroyed the natural beauty and vegetative cover in many areas. In Darjeeling hill areas most of the interior village area shows the excavated land for road construction and huge amount of debris slide down in the valleys resulting in overall environmental degradation (Photograph 8.3 & 8.4).

With the introduction the NREGY scheme in 2007 in hill area of Darjeeling about 415 km of village roads have constructed in all the 8 CD blocks (Table 8.2). Field observations reveal that the construction of village roads done without having scientific and engineering investigation and planning. As a result, irreparable damage caused to the already degraded environment of rural Darjeeling hills causing further deforestation and innumerable landslides caused in hitherto unaffected areas. In addition to roads many Jhora training work, drains, play-grounds have also been constructed without proper consideration of the possible environmental consequences as a result jhora expansion, drying up of water sources in addition to landslides. It is also observed that several natural habitats of animals and birds are also experiencing the shortage of drinking water in hilly region. It is estimated that during the process of road construction under NREGY scheme alone produced 2.905 million m3 of debris. It is also interesting to mention that on and average all the blocks in Darjeeling hill area are affected considerably which ultimately acted as instrumental in horizontal expansion of degradation in all over the Darjeeling hills.

Table 8.4 Construction of village roads under NREGY scheme since 2007

No	Name of CD Blocks	Road length (km)	Debris produced (m^3)
1	Darjeeling Pulbazar	62	434000
2	Jore Bunglow-Sukhia Pokhari	53	371000
3	Rongli- Rongliot	46	322000
4	Kalimpong I	65	455000
5	KalimpongII	63	441000
6	Gorubathan	41	287000
7	Kurseong	59	413000
8	Mirik	24	168000
	Total	415	2905000

Photograph 8.3 Construction of motorable road near Rimbik caused innumerable landslides along the newly constructed road.



Photograph 8.4 Road side landslide: the commonest menace in Darjeeling hills during Monsoon.

During field survey it was seen that several perennial water sources had been dried up, especially it was so happened due to up gradation and degradation of road surface, and some where existing water sources were buried due to covering the waterway by debris. This had been noticed in Dokan dara to Sangsey road, Pedong to Kagay road and along Paren to TodhayTangta road. It was also noticed in Darjeeling Sadar where the construction of road from Kaijalay to Kolbong and 6th Mile to Takdah where several plants have been destroyed during construction of such roads as the above roads falls under forest area. It is also seen that

in the name of development of Tourism industry in the Darjeeling hills, transport business has grown enormously. Many new roads are being constructed as the new tourist spots are being connected with better facilities and services.

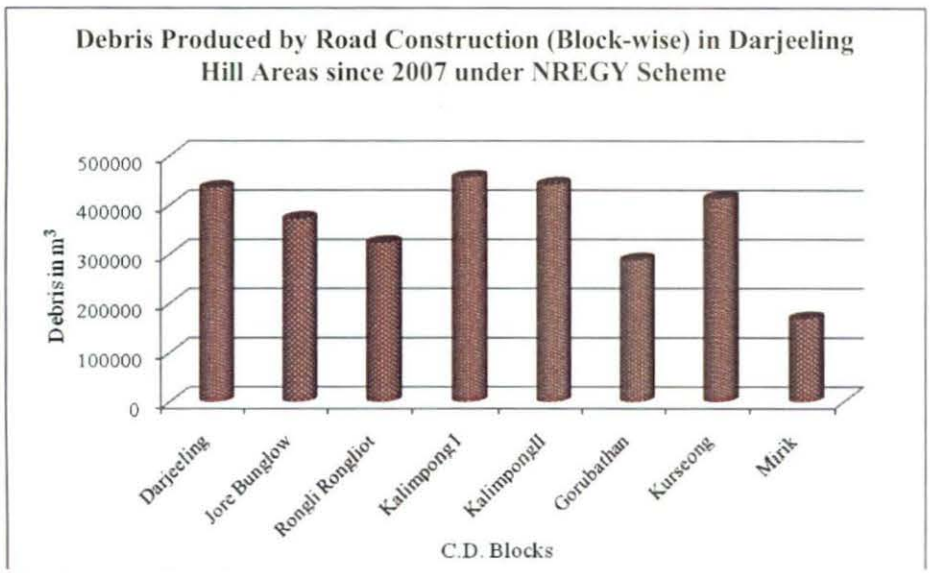


Figure 8.1 Debris produced by road construction in different blocks of Darjeeling hills

The figure 8.1 shows block-wise distribution of debris production due to new road construction in rural area under NREGY scheme since 2007 vis-à-vis environmental impact of so called implementation of development programme in most casual manner. It is found that such impacts are found more prominent in Kalimpong I & II, Darjeeling-Pulbazar and Kurseong blocks while least in Mirik block.

The people of Darjeeling, Kurseong, Kalimpong, Mirik, Gorubathan, Tindharia, Sukuna etc. has caused indiscriminate deforestation along with the construction, extension of road leading to tourist centres, tea garden, Cinchona plantation, agriculture fields and other cultural activities which in terms have eaten up a considerable portion of the hills in order to accommodate ever expanding and varied occupancies. Mis-use of the steep slopes at the cost of environment damages had brought incalculable miseries to humanity. Natural calamities in the form of landslides, occasional droughts which were not so widespread before have become a regular occurrence.

8.3 Development of Settlement and Urban centres and its Impact

Development of settlement and urban centers vis-à-vis concentration of population with diversified economic activities in Darjeeling hill areas have been taken place since the

second half of the last century. The so called prosperity of Darjeeling has also invites deadly impact of environmental degradation, traffic congestion and the problem associated with public goods and services. Unregulated migration from the rural areas for employment, services and better livelihood put tremendous pressure on the existing urban infrastructure particularly space for construction of dwelling houses, toilets, scarcity of drinking water, air passage, light etc. As a result marginal and unsuitable land hitherto kept as natural buffer zone since the time of British annexation has been occupied in most cases illegally for residential and commercial purposes. Thus already dwindling greenery of the hills has been further declined inviting accelerated landslide and associated problems. It is also interesting to note that many pieces of cultivated land in rural Darjeeling hills have been converted to waste land due to migration. The agricultural production has also been affected in addition to livestock rearing.

Table 8.5: The growth of population in major urban centers in Darjeeling hill area

Year	Census population					
	Darjeeling Municipality	Decadal growth	Kalimpong Municipality	Decadal growth	Kurseong Municipality	Decadal growth
1901	16924	-	1069	-	4469	-
1911	19005	12.3	7880	29.84	5574	24.73
1921	22258	17.12	7944	0.81	6445	15.63
1931	21185	- 4.82	8776	10.47	7451	15.61
1941	27224	28.51	11958	36.26	8495	14.01
1951	33605	23.44	16677	39.46	11791	37.95
1961	40651	20.97	25105	50.54	13410	14.43
1971	42873	5.466	23430	-6.67	16425	22.48
1981	57603	34.36	28885	23.28	18008	9.64
1991	73062	26.84	38832	34.44	26758	48.59
2001	107197	46.72	42998	10.73	40998	49.56

Source: Census Report, 2001

Three major urban centres in the Darjeeling hills namely Darjeeling, Kalimpong and Kurseong have been experiencing phenomenal growth during the past 100 years (table 8.5). Population of Darjeeling municipality has been increased from 16,924 persons in 1901 to 107,530 persons in 2001, Kalimpong municipality recorded an increase of population from 1069 in 1901 to 42,998 in the year 2001. The population of Kurseong municipality was 4469 persons in 1901 and increases to 40998 persons in 2001. In fact, the population growth in Kurseong is the least among the urban centres in Darjeeling hills (figure 8.2).

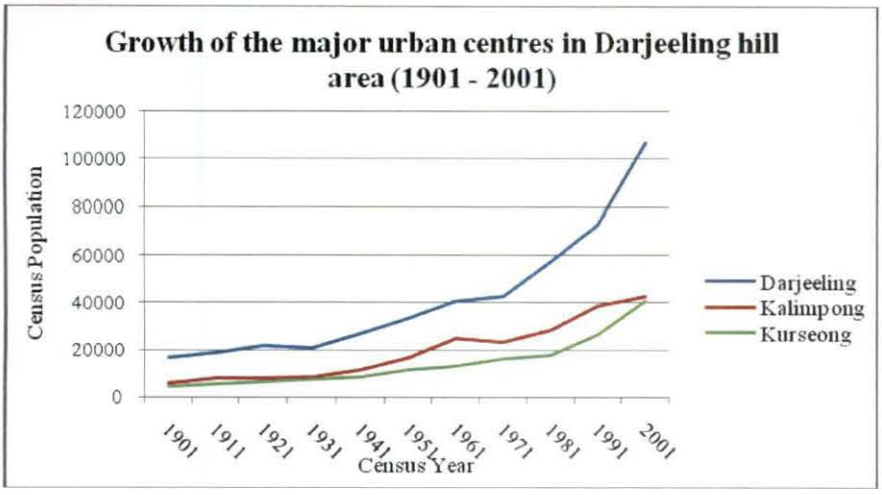


Figure 8.2 Growth of major towns in Darjeeling hills

The decadal growth of population in urban centres of Darjeeling hill areas is rather interesting and depicted in figure 8.3. It is observed that Darjeeling and Kalimpong towns have been experienced negative growth during 1921-1931 and 1961-1971 respectively. It is also observed that all the urban centers have experienced two phases of massive growth i.e., 1931 to 1951 and again 1971 to 2001.

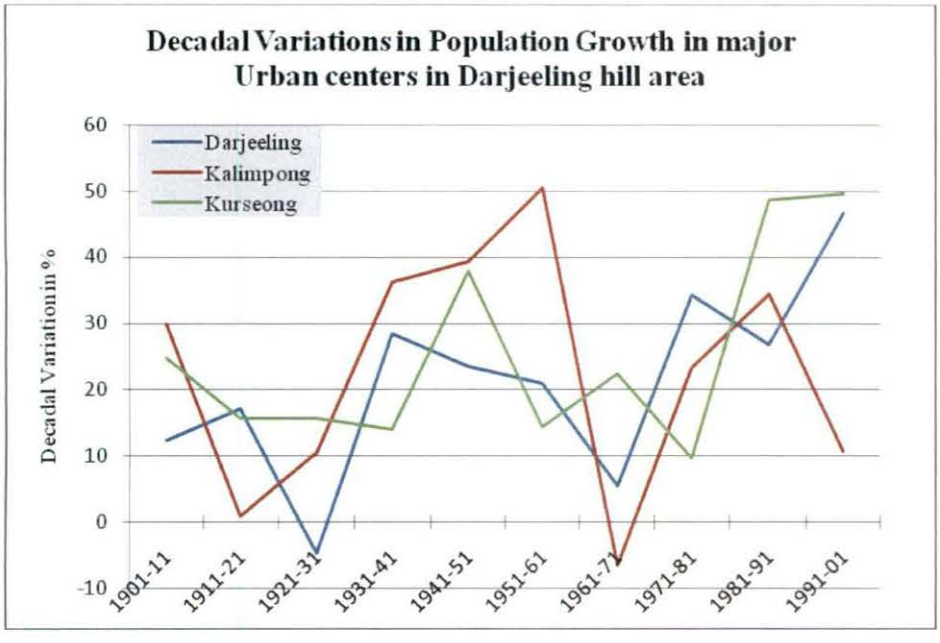


Figure 8.3 Decadal variations in population growth in major hill urban centers

The growth of Darjeeling town is most spectacular among the urban centers in Darjeeling hills which recorded an increase of 633% during the past 100 years (1901-2001). In this context, it is important to note that the early developer of Darjeeling town planned to

develop the urban attendant infrastructure for the town for an estimated residential population of 25000-30000 persons. By the end of the century with 4 times more residential population in Darjeeling town exerting tremendous pressure to her existing urban infrastructure. Every sector of basic urban facilities has been found collapsed and thereby putting tremendous stress to the delicate environment system of Darjeeling town and its environs. Among the worst affected sectors, water supply in Darjeeling town is noteworthy. An attempt has been made in the following section to apprehend the impact of unregulated population growth in Darjeeling town on its water supply system.

8.3.1 Water supply system in Darjeeling town

Water supply in the Darjeeling hills is entirely depend surface water i.e., spring/jhora. Long pipelines were laid down across the hills connecting many settlements for the supply of water during the lean months. With the drying up of sources, over one half of such pipelines in fact fail to supply water during the most crucial period of Mach-May.

The Darjeeling town is supplied with drinking water from twin Senchal lakes (South lake with capacity of 13 million gallons built in 1910 & North lake with capacity of 20 million gallons built in 1932) having its source from 26 nos. of perennial springs in the Senchal catchments area. The total capacity of these two lakes is 33 million gallons. Water filtration is done through gravity pressure filters situated at Jorebungalow filter house and from there water is further supplied through large conduits to the reservoirs built at St. Paul having capacity of 2,35,812 gallons and at Rockville having capacity of 1,14,000 gallons. The whole distribution network is run by operating over 90 valves, not only near the main tank at St. Paul and Rockville but also at many places in town. The third lake with capacity of 15 million gallons was constructed in the year 1978 at Singdhap. Considerable volume of water also supplied from the Rambi line and local jhora/spring like Bakshi Jhora, Laldighi Jhora, Bhagyakul Jhora, Bhotay, Giri Jhora etc.

8.3.1.1 Genesis of Problems

The early developer of Darjeeling town understood the importance of water supply in proper perspective and develop Senchal watershed cum reservoir for the purpose hundred years back which till today considered as the backbone of the urban water supply in Darjeeling. Over the years, increase in population (figure 8.2) induced increase in demand and only after half a century another serious effort was initiated at Singdhap reservoir which

found partially crippled thanks to poor quality of work. The hundred years old distribution system was never revamped rather manipulated, repaired and extended at the expanse of its efficiency. As a result, even conservative estimates showed over 20% precious water wasted or misused.

Sources of water in the Darjeeling hills are available mostly in the form of spring/jhora; these springs directly depend upon the natural preserves in respective watershed and rainfall. It is very much essential to preserve the catchments area, which feeds such springs. Indiscriminate deforestation and misuse of land within the catchments caused drying up of many such perennial springs a conservative estimate put the figure of over 50% of the during the last century. The rapid land-use transformation accelerates the decaying processes.

8.3.1.2 Present Status of Water Supply

The drinking water supply system in Darjeeling town consists of 26 nos. of springs from the catchment of Senchal Wildlife Sanctuary 15 km away from the town. The water is arrested in an arrester tank and fed to the masonry conduit line (8 km in length) brings water by gravity in twin Senchal lakes with a capacity of 33 million gallon. From these lakes water filtration is done through pressure filters situated at Jorebunglow filter house from where water is conveyed through large water mains to reservoirs at St. Pauls' tank (capacity 235812 gallons) and two tanks at Rockville (capacity 114663 gallons). Drinking water is distributed from these reservoirs over the town through subsidiary tanks located at various places and also directly through 19 nos. of distribution mains of different diameters.

The existing water supply installation of Darjeeling town was designed to cater a population of 20000 only. Since then, several new water installations like Khong Khola station, Rambi water line, Sindhap lake, Bakshi jhora, Bangla Jhora etc. were added but this could not cope up with the rapid in population as a result, water scarcity becomes the rule of the day since the last three decades during December-May. Situation became even more complicated during the last decade due primarily the drastic fall in the volume of water in the watershed. The estimated water availability from different sources at present, during the dry period may be as follows:

The estimated water demand for 202,255 persons (inclusive of 60,000 floating population) is 2730,442 gallon per day keeping in mind a minimum requirement of 10 gallons/head/day. The total storage capacity is just enough for supplying 15 days of water

requirement leaving 75 days in lean season dry.Thus, the present storage capacity of drinking water for Darjeeling town could cover only 13.5% of her total requirement. Besides these the century old water distribution network of Darjeeling town is run by manually operated valves which are liable to the problem of perennial leakage and misuse. Illegal tapping and unscientific connections have further aggravates the already problematic distribution system. The age old Senchal reservoirs show numerous micro-cracks and fissures allowing seepage of water. While, the newly constructed Sindhap lake has been found to be partially crippled due to sub-standard construction.

8.3.1.3 Future Requirement

The present population (2008) of Darjeeling municipal area as estimated to be 142,255 (based on projection) and another 60,000 floating population, a total of about 2.02 lakhs of population for whom water has to be provided especially for crucial dry season i.e., February to mid-June. In view of rapid growth of Darjeeling town a population projection is attempted (figure 8.4).

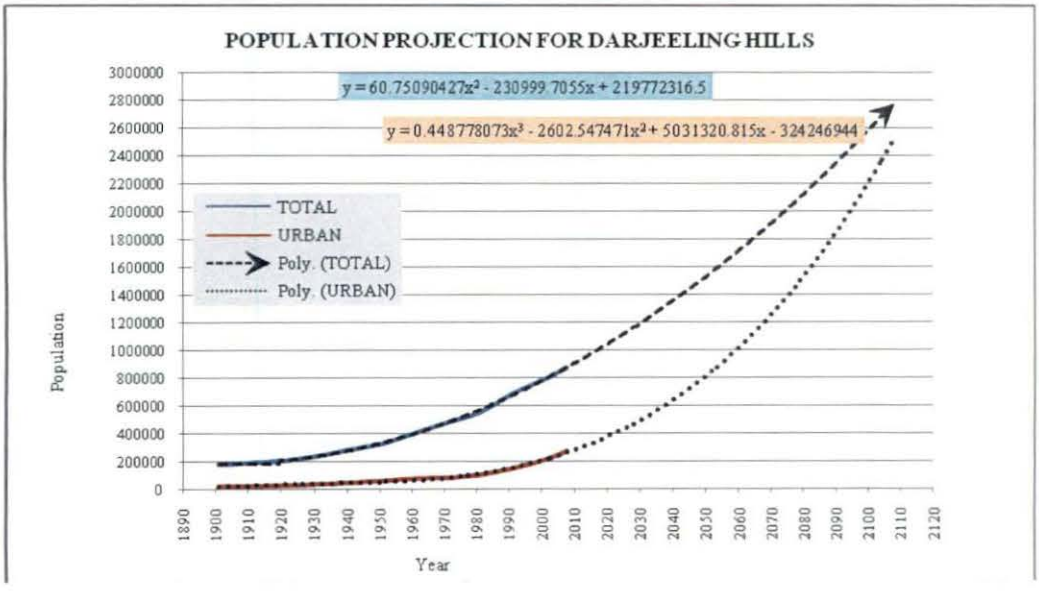


Figure 8.4 Population projection for Darjeeling hills

Only 11.58% of the actual water demand is being met through the Municipal Water supply system of Darjeeling town at present. Without having any other alternative source for drinking water (except bottle water), the citizen of Darjeeling have had to face the ever

increasing severity in fetching a bucket of water (non-potable) at the cost as high as Rs.100/- during the time of crisis.

The projected demand vs. supply of drinking water curve has been depicted in figure 8.5 and table 8.6. It reveals that the drinking water demand only in Darjeeling town has increased from 1.35 million gallon/day in 1991 to estimated 4.0 million gallon/day by the year 2021. Total increase of 196% has been registered between the periods 1991 to 2021 i.e., an annual increase of 6.5%.

To keep pace with the increasing demand and to ensuring gradual improvement of situation it is suggested (based on mathematical model) an annual increase of 11.6% in storage and supply of drinking water in Darjeeling town.

Table 8.6 Projected water demand and supply in Darjeeling town

Year	2008	2011	2021	**Water Supply in Gallon/day**	2009-10
Population*	202,255	227,279	320,000		
Water Demand in Gallon/Day				Conduit @6000 gallon x 24hours	144,000
Domestic demand @10 gallon/day/head	2022,550	2272,790	3200,000	Khong Khola Pumping Station @5000gallon x12h	60,000
Industrial/Commercial demand @10% of total	202,255	227,279	320,000	Sindhap lake @1000 gallon x 10hours	100,000
Public Utility demand @5% of the total	101,127	113,640	160,000	Rambi line @1500 gallon x 24 hours	36,000
Fire demand	Not available	Not available	Not available	Bakshi Jhora, Laldighi Jhora, Bhagyakul Jhora, Bhotay, Giri Jhora	32,000
Loss/waste/leakage etc @20% of the total	404,510	340,919	320,000*	Loss en-route @15%	55,800
Total (gallon/day)	2730,442	2954,628	4000,000	Total	316,200

* Inclusive of estimated floating population

It would be a herculean task for the concern authority to keep pace with the ever increasing demand and to arrest the increasing gap between the supply and demand in Darjeeling hills in general and in Darjeeling town in particular. It requires not only to augments source of water supply but also revamping of the existing distribution and supply system and imparting maximum possible transparency into the entire system. GIS based drinking water supply system (DWSS) armed with necessary database would be of extremely helpful not only in need based distribution and monitoring but also to keep necessary

surveillance in technical, financial and administrative management of the water supply system in Darjeeling hills.

Rapid urbanization is thus continuously disturbing the natural state of equilibrium of the region, semi urban nodes are in a state of continuous influx and the rural setup has undergone drastic changes. In spite of greater congestion the delicate balance of man- nature interface could have been maintained, had the people been more conscious about the vulnerability of the less stable Darjeeling Himalaya. Landslides became most rampant and regular causing tremendous stress to the day to day activities of urban life and livelihood.

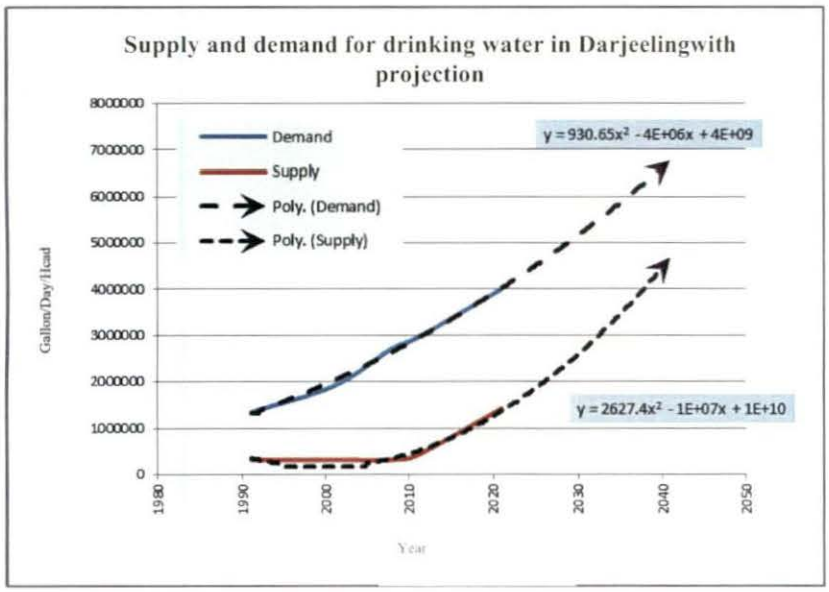


Figure 8.5 Demand and supply of drinking water in Darjeeling

Even through the town suffer great economic loss due to landslide every year. There has been complete lack of perception of the problem among the local people and also to the tourists. It is a common practice to dump debris an adjacent slopes during construction and clearing of roads. These unconsolidated extra burdens are virtually unstable. They obstruct easy flow of surface run off. Water passes through the regolith and increases pore-water pressure resulting into landslips. The something happens when the sewage lines are chocked with garbage.

The problem reaches dangerous proportions when the residing population almost doubles itself during the tourist season. Darjeeling itself is a major tourist centre of global scale, multiplying tourist inflow without adequate infrastructure is rapidly leading to the point of urban collapse.

8.4 Development of Public Utility Structures and its impact

When the British took over the Darjeeling in 1835 and Kalimpong in 1865, public utility structures was practically unknown. Darjeeling in 1835 had a collection of 20 huts with a population of 100 persons. In 1840, town consisted of the Kutchery and 30 others buildings i.e., Mount Pleasant, One Tree House/Beechwood , Bryanstone etc. all residence cum office of the British officials. Perhaps St. Andrew's Church constructed in 1843 was the first public utility building in Darjeeling town. This was followed by Loreto Convent (1847); Jalapahar Convalescent Depot (1848); Hindu Mandir (1851); Jumma Masjid (1852-62); St. Paul's School (1864); Old Cemetery and Jail (1865); Jalapahar and Katapahar Cantonments (1867); Planter's Club (1868); Union Chapel (1869); Bhutia Boarding School (1874); Ghoom Monastery (1876); Lloyed Botanical Garden (1878); Victoria Boy's School, Kurseong (1879); Brahma Mandir (1880); Eden Sanatorium (1883); Lowis Jubilee Sanatorium (1887); St. Josheph College (1888); Lebong Cantonment (1888); St. Mary's Training College, Kurseong (1889); St. Helen's Convent, Kurseong (1890); Railway Station (1891) etc.

8.4.1 Education Infrastructure

The early British developer of Darjeeling indeed tried to develop the modern education infrastructure of Darjeeling at global standard and accordingly number missionaries boarding schools and convents were constructed. In Kalimpong, Dr. Graham's Homes School was established in 1900, which was occupied more than 500 acre of land. It is seen that the missionary's schools had occupied more or less 20 acre of land by each school during that period. Similarly Loreto School, St. Robert's School, Bethany School, Mount Hermon School in Darjeeling Sadar and Goethel's Memorial School, St. Helen's School, St Alphons's School, St. Joseph's Girls School in Kurseong and St Augustine's School, S.U.M.I. Institution, Kalimpong Girls' High School, St Joseph's Convent in Kalimpong were established and constructed during British period.

Table 8.7 Education Infrastructure in Darjeeling hill sub-divisions in 2006-2007

Sub-division	Pry. School	Middle school	High School	H.S. School	General College	Professional & Tech. College	Non formal education
Darjeeling	564	28	37	23	6	5	890
Kalimpong	333	19	25	12	2	3	431
Kurseong	268	6	34	09	2	4	388
Total	1185	53	96	44	10	12	1709

During Independent period there had been constructed a number of government schools, municipal board schools, government aided schools, private schools were established in Darjeeling hill areas. In 1966, there were altogether 420 primary Junior Basic School in the rural areas of the hill region of Darjeeling district under different management. Table 8.7 shows the status of different educational infrastructure as it was during 2006-2007.

Among the other public utility infrastructure in Darjeeling public library, hospital and health centres, family welfare centers, agri-marketing centres are more important. During the year 2008-2007, Darjeeling hills housed 100 public libraries with free reading rooms and 984 mass literacy centres under continuing education programme. The health infrastructure available in Darjeeling hills has been tabulated in table 8.8

Table 8.8: The health infrastructure in hill sub-divisions of Darjeeling district in 2006-07

Name of Sub-Divisions	Hospital	Rural Hospital	Block Pry. Health Centre	Pry. Health Centre	NGO/Private Nursing Home	Total	Total Bed
Sadar	2	1	2	6	4	15	487
Kalimpong	1	0	3	6	6	16	484
Kurseong	2	-	2	10	-	14	595
Total	5	1	7	22	10	45	1566

For The agriculture department had taken up a programme for marketing the agricultural surpluses through the regulated market and sub-market yards from the state plan budget. This programe was consists of infrastructure development and provision of transport facilities, under the former principal market yards were being developed at Kalimpong, Darjeeling and Bijanbari and Sub-market yards were constructed and developed in the rural areas of Kalimpong and Darjeeling. Rural transport facilities have been augmented each of the eight hill blocks of Darjeeling district through providing with a truck to facilitate the transport of farmer's product from village to market.

8.4.2 Pisiculture

Successful implementation of Mirik lake fishery project particularly the rate of fish growth encouraged the Fishery department, Government of West Bengal to introduce the scheme of Jhora fisheries in the hill areas. The project involves an area of 1500 sq ft. in hill terrace along streams where small water body thus created be utilized for fish rearing. A modest beginning was made in 1980-81 with establishment of 9 units in Kalimpong increased

to 339 units in the hill areas of Darjeeling by the year 1990-91. Out of which 82 were in Bijanbari block, 23 in Sukhiapokhri block, 2 in Rongli-Rongliot block, 75 in Mirik block, 65 in Kalimpong I block, 73 in Kalimpong II block and 19 in Gorubathan block. By the beginning of 1990s it was gradually understood that the initial success has not been thoroughly scrutinized and negative impact becomes more and more prominent. It is now ascertained that all most all jhora fisheries scheme had been leakage and thereby damaging nearby arable land and households in the hill areas.

8.4.3 Rural development programme

The different programme for rural development in hill areas of Darjeeling were being executed through the Panchayati Raj Institutions (PRI's) as in the rest of the state. Centrally sponsored programme like National Rural Employment Programme, Integrated Rural Development Programme, Rural Housing and Rural Water Supply, SGRY, NREGY etc. The PRIs and line departments in the hill areas of Darjeeling during 1980-84 have completed 348 small irrigation and channel construction schemes, 483 flood control and anti-waterlogging schemes and 272 schemes for land reclamation and soil conservation. The Panchayat bodies under the NREP had executed 13 schemes, under RLEGP, 628 schemes for construction and repair of village roads had had been taken up, 8 panchayat buildings had been constructed, 357 schemes for repair and construction of Primary schools and 269 schemes under welfare of schedule caste and schedule tribe had also been completed.

Under the Rural Housing Programme, 290 huts had been constructed for landless indigent persons, during the same period financial assistance from central assistance had been utilized for rural link road development in order to provide sufficient marketing outlets to the rural surplus. The zilla parishad had taken up the construction of seven bridges and twenty one roads during 1980- 84 and BDOs have completed 84 pony roads, 33 bridges and 30 culverts during the period of 1980-84. Several other public utility structures in tourism, public health engineering, social and community services have been executed during the period. After panchayat election of 1995, the panchayat and rural development department constructed 112 nos. of new gram panchayat buildings in 3 hill sub-divisions. Approach roads leading to gram panchayat office also had been constructed.

8.4.4 Environmental Inpact

For the development of public utility structures it can be said here that the construction of school, colleges, community halls, hospital, dispensaries, road construction, water reservoirs are the essential and indispensable things for the people. But the authority concerned did not take any care for the misuse and overuse of environment. The forest and land have been destroyed more than its actual requirement and inhumanly they destroyed the forest as well as habitat of animals and birds. They never thought for reforestation and habitat of wild animals.

The deep-rooted poverty and ignorance have become chronic over the period of time. Besides, the people are living under a state of acute infrastructure deficiency. The socio-economic distress has not been reflected in the day to day living among the hill people of Darjeeling, perhaps an in-depth house-to-house survey in the rural villages will reveal the real picture as to how people are struggling for their livelihood. The remote villages are still traveling a daylong walk for shopping in the towns. The farmers have to walk day long to sell their produce in the nearest town. The situation becomes worse during the rainy season when frequent large scale landslides and other forms of mass wasting take place in the hills. During this period a large number of villagers lose their lives. Safe drinking water, educational institution, primary health centres, power supply etc. face similar fate in the rural hills.

8.5 Development of Hydroelectric Project and its impact

The turbulent river system of Darjeeling hills has long being acclaimed as major potential source for hydroelectric power. Sidrapong located a few kilometer from the Darjeeling town hosted the first hydroelectric power generating station in the country established in the year 1897 and proud enough to declare still operational.

Although, most of small and medium size rivers in Darjeeling hills are rain fed and do not have enough perennial and constant supply of water needed for generating hydroelectric power yet, they are capable to host mini and micro-hydroelectric power generating station. There were 5 mini/micro hydroelectric power generating stations in the district with a total installed capacity of 9.778 MW another two major hydroelectric power generating stations is not under operation stage (table 8.9). With a view to exploiting the immense potentiality of the water power of the Jaldhaka river medium sized hydroelectric generating station was set up at Paren in Bhutan boarder, and it started supplying electricity since March 1967. Under the first phase of the scheme about 27 MW had been generated, which was increased to 36 MW under the second phase which was completed in 1983.

Table 8.9 Hydroelectric Power Generating Stations in Darjeeling hills

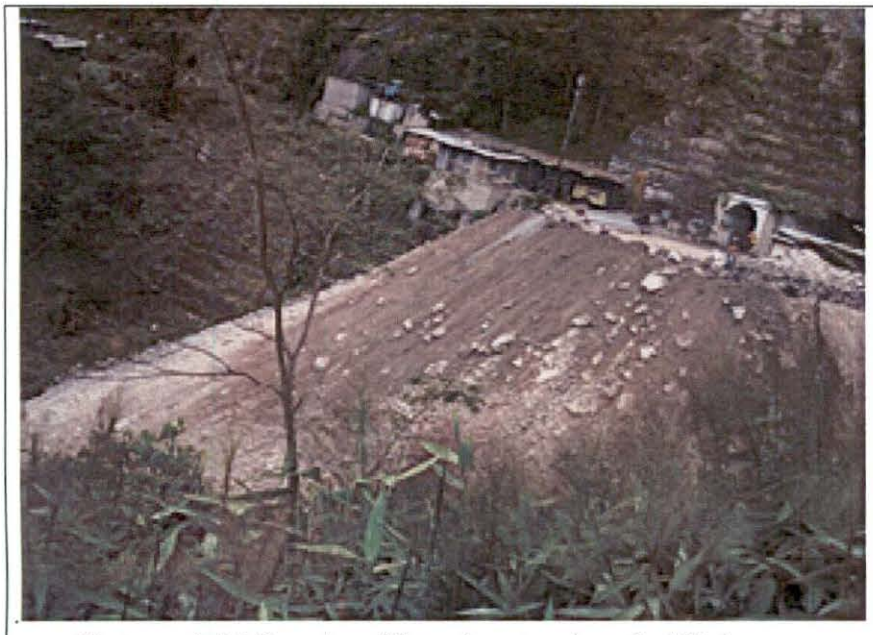
No	Hydroelectric Projects	Installed capacity in MW	Planned capacity in MW
A	**Mini/Micro-Hydroelectric power generating stations**		
1	Rinchington	2x1 = 2.0 MW	
2	Little Rangit	2x1 = 2.0 MW	
3	Mungpoo Kalikhola	3x1 = 3.0 MW	
4	Sidrapong	3x0.11= 0.33 MW	
5	Fazi Hydel	3x0.81= 2.448 MW	
B	**Medium size hydroelectric power generating stations**		
1	Jaldhaka Stage - I	3x9 = 27.0 MW	
2	Jaldhaka Stage -II		2x4 = 8.0 MW
3	Rammam Stage - I	3x12 = 36.0 MW	
4	Rammam Stage -II	-	3x17 = 51.0 MW
5	Rammam Stage -III	-	3x30 = 90.0 MW
6	Rammam Stage - IV	-	3x10 = 30.0 MW
C	**Major Hydroelectric power generating stations**		
1	TLDP - III	-	4x33 = 132.0 MW
2	TLDP - IV	-	4x40 = 160.0 MW
	Total	72.778 MW	471.0 MW

The Rammam hydroelectric project with a total installed capacity of 207.0 MW was an ambitious aspiration of West Bengal State Electricity Board (WBSEB), Government of West Bengal to harness the mountain torrents was proposed to be set up in four stages of 36MW, 51MW, 90MW and 30MW. The first phase of the project was envisaged to be a 36 MW hydroelectric plant (3 x 12 MW), followed by a 3x30MW project in its second stage. The third phase was envisaged as a 90 MW project (3 x 30 MW). This was to be followed by a 30 MW Rammam ultimate hydroelectric project as the last phase. The first stage was commissioned during 1980s and running well. The WBSEB initiated the construction work for Stage II in 1982 but progress was severely affected over the years owing to political unrest in Darjeeling hills. Only one phase has been commissioned. The other three phases of the projects are yet to see the light of the day.

8.5.1 Impact of mini/micro and medium hydroelectricity projects

The mini/micro hydroelectric projects are normally very small and utilize natural water flow over steep gradient. The land required for developing necessary infrastructure is very limited and as such no reallocation of habitation is needed. As such, the mini/micro

hydroelectric project seldom invites large scale environmental degradation. The local people are also considered such projects as eco-friendly and sustainable. The historical Siderbong micro hydroelectric project is classical example of such kind.



Photograph 8.5 Dumping of Tunnel wastes along the hill slope near Linsebong, Rammam project invite site for future landslide.

Photograph 8.6 Deforestation along with massive cut & fill of hill slope materials is characteristics of a hydro-electricity project

The construction of medium size Jaldhaka and Rammam hydroelectric projects and its attendant infrastructure caused irreparable damage to the delicate physical and biological environment of the project sites and their environs. Large amount of public lands were damaged, people had to shift from project area to other places, the existing forest area were

damaged, large number of flora and fauna were found lost and killed due to construction of project road and construction of building, staff quarter, community hall and other infrastructure. Heavy landslide took place in Rammam hydroelectric project site during 1980-81 threatening the overall stability of pen structure and power house. Jaldhaka project site was also affected by large scale landslide occurrences along the hill slopes along the realigned road to the project sites. Dumping of excavated materials for tunneling in Rammam project along the hill slopes has been found near Linsebong is a real threat (photo 8.5). No mechanism of environment protection has been adopted to check such illogical act of the project authority. Construction of new road to make accessible to the different project related infrastructure sites under Rammam project leads to innumerable number of landslides along the road (photo 8.6) and thereby posing serious threat to the environment.

The socio-economic impact of such medium size hydroelectric projects in Darjeeling hills has been found highly negative. The residential people finds very limited benefit out of rather they are gradually facing more and more hardship in their day to day livelihood activities i.e., loss of arable land, increasing edaphic drought, decline in irrigation water supply, drying up of springs and jhoras along hill slopes etc.

8.5.2 The Tista Hydroelectric Projects

The biggest source of hydroelectric power potential lies with the mighty glacier fed river Tista. The potential was long been understood and the first serious attempt was made during 1940s. However, technical capability couple with economic feasibility became formidable barrier in the way of its implementation. It was only in 2002 the National Hydroelectric Power Corporation (NHPC) a government of India enterprise started to implement two major hydroelectric power generation stations to be located in Darjeeling hill areas. The Tista Low Dam Project Stage III (TLDP-III) at Reyang (Rambhi) and Tista Low Dam Project Stage IV (TLDP-IV) at Kalijhora.

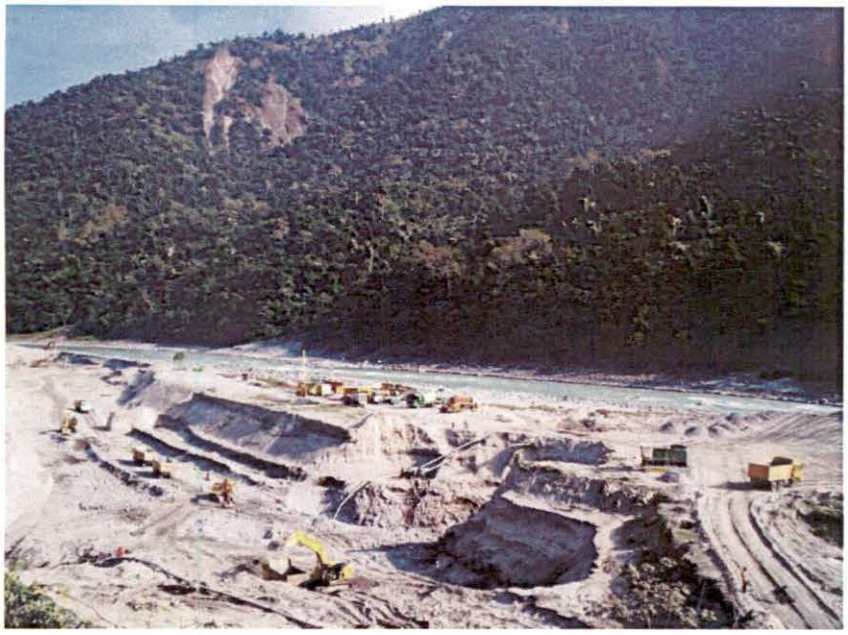
The Tista Hydroelectric projects have been considered as the biggest developmental programme Darjeeling hill ever experienced an estimated investment of Rs.19470.6 million (at 2001 price level). On completion the TLDP –III & IV shall produce electricity at the tune of 132 MW and 200 MW respectively. The project shall bring prosperity in development starve Darjeeling hill in particular and the North Bengal as a whole on one side and the apprehension of the local people and environmentalists/civil society about its large scale and unpredictable adverse environmental impact. Lot of debates on apprehensions and

demonstrations has been taken place particularly on EIA (Environmental Impact Assessment) and EMP (Environmental Impact Assessment) of both the TLDP-III and TLDP-IV. However, the NHPC authority could able to go through with project and its contact is now expected to commission by 2012 after undergoing through rigorous public hearings and mass contact.

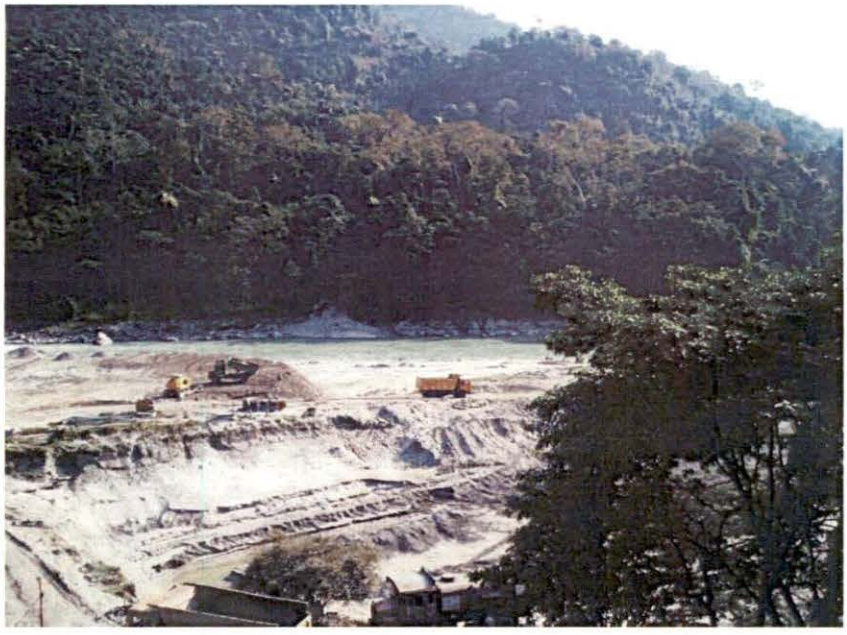
In pursuance of the provision of the Electricity (supply) Act 1948, the NHPC shall exercise all powers vested in a generating company under said Act for the purpose of the aforesaid scheme. Power Grid Corporation of India would provide suitable integrated power evacuation system matching with the commissioning schedule of power plants. This shall be done in consultation with CEA/ WBSEB.

The TLDP - III submerges residence of nine families and that in the TLDP – IV shall be ten families. The NHPC will provide compensation based on the EIA and EMP plan. The water will also submerge forest land and also sections of National Highway 31A leading to Sikkim. The forest submerged will be compensated by compensatory afforestation. The submerged section of NH 31A would be realigned through the Mahananda wild life Sanctuary.

Being situated in on the lap of the highest, youngest and tectonically most active Himalayas, the river Tista is notorious in its erratic behavior especially the devastating flood occurrence that triggered by high intensity rainstorm in October 1968. Moreover the location of TLDP-IV near Kalijhora only a few kilometers from the most active Main Boundary fault (MBF) separating the Indian plate and Tibetan plate makes the project site highly vulnerable. Frequent earthquake in this region (zone IV) and particularly under the light of recent Sikkim earthquake (September, 2011), the environmentalists and civil society members are highly apprehensive. The question arise that in case of dam brake/ dam bursting two important urban centres along with million people along the riverine tract would perished. It was naturally a justified demand from the civil society keeping in mind safety and security of millions to have detail and scientific EIA and EMP to not only safe guard the interest of the people but also to the stability and sustainability of the Tista hydroelectric projects the largest of this kind in North Bengal.



Photograph 8.7 Construction of TLDP Stage III under progress



Photograph 8.8 Construction of TLDP Stage IV under progress

8.5.3. Case study of Helipad at Mirik dome to showcase unscientific planning

The Mirik landslide has been selected as the most suitable case study to high light the issue. The methodology employed by the investigator is a rationalistic one, comprising of the examination of the geomorphologic processes involved in sculpturing the land surface along with the study of the nature and extent of anthropogenic interferences that can either cause or

aid natural hazards. The data for this study has been collected mainly from field survey as well as from compilation of secondary references.

The disposal of talus materials, resulting from the excavation of hill slopes and hill tops for so called development purposes, and in many cases into jhoras and kholas is a common practice in the study area. This particular case exemplifies how such an action has initiated a series of landslides that have affected the road communication, agricultural fields and threatened the fluvial environment of the river Marma, an important tributary to the river Balason.

The Darjeeling Gorkha Autonomous Hill Council in 1995 undertook an ambitious project of constructing a helipad in Mirik area to boost tourism. The Mirik dome was selected for the purpose and operations to cut the dome and level the area started in a war footing by engaging heavy bulldozers and hundreds of labourers. (Bhutia, 2000). The excavated materials were thrown downhill into the area, which formed the source of Marma Khola ignoring the consequence of such heedless action. The project was abandoned in 1996 due to its unfeasibility, but the damage was already done, as landslides occurred immediately during the following monsoons resulting in the disruption of communication and loss of agricultural areas along the banks of the jhora.

The follow up study as shown in table 8.10 reveals how unscientific and irrational activities of man can cause irrevocable damage to the environment. The dumping of excavated materials into the source of Marma khola has initiated landslides along the entire tract of the khola, causing a series of chain reaction leading ultimately into deterioration of the hydrological regime of the river Balason. In Mirik unscientific developmental activities, without taking into consideration the fragile nature of the Himalayan ecosystem has lead to serious environmental degradation. The impacts of such activities have been adverse and if not heeded, could lead to extensive damage to both human life and environment.

It is thus necessary that extensive studies are carried out and analysis of the impact of development activities be made, before undertaking any such activities in this region. Under the prevailing conditions of environmental degradation in the study area, it has become absolutely necessary to have a comprehensive plan to offer every remedial measure, for each and every kind of adverse environmental effect of development projects. This would also help to adopt precautionary measures that are pertinent and need to be followed, before undertaking any development activity. These have to be taken up seriously and followed

carefully if the development activity is to have the minimal adverse effect on the ecology of the region.

Table 8.10: Morphology of Mirik landslide

Pre slide conditions	Post slide conditions (1997)*	Post slide conditions (2009)** post Aila	Remarks
1.Rocks: Moderate to highly decomposed jointed granite, gneiss interbedded felspathic veins. The rocks are dipping at an angle of 20 to 60 towards NE – SW, NNE-SSW and EES and WWN. A number of joints have been identified.	1.Length of Scar: 270m 2.Width of scar: Max: 95 m Min: 10 m Ave: 52.5m 3.Depth of scar: Max: 5.1 m Min: 0.3 m Ave: 2.7 m	1.Length of Scar: 340m 2.Width of scar: Max: 105 m Min: 12 m Ave: 63.5m 3.Depth of scar: Max: 7.2 m Min: 0.3 m Ave: 3.75 m	Within a short period the link between Mirik and the hospital will be affected. Immediate proper storm water draining system and protective walls are recommended
2.Altitude 1620 to 1690 m	4.Shape: Triangular	4.Shape: Triangular	
3.Slope Convex (25 to 30)	5.Total area affected: 14,175 sq.m 6.Total volume of materials displaced: 38272.5 m3	5.Total area affected: 21,510 sq.m 6.Total volume of materials displaced: 80962.5 m3	
4.Natural Vegetation: Scattered shrubs. Landuse: Tea garden is situated just below the threatened area. Mirik to hospital Road passes through this affected area.	7.Process responsible for the landslide: Removal of basal support by toe cutting makes the stage ready for the slide. Spontaneous liquefaction due to heavy rainfall and cutting of ridge tops for the helipad has actually provided the so called trigger mechanism.	7.Process responsible for the landslide: Removal of basal support by toe cutting makes the stage ready for the slide. Spontaneous liquefaction due to heavy rainfall and cutting of ridge tops for the helipad has actually provided the so called trigger mechanism.	Ridge top cutting materials were thrown along these natural streams downslope. These unconsolidated materials have undergone massive gully erosion during the monsoon months. Such stream actions along with continuous toe cutting has actually invited disastrous landslide along the upper valley of river Marma, a tributary of the Balason.
5.Soil Colour: Top: 10YR 4/4 (Dusky red) Mid: 2.5YR 4/4 (Reddish Brown) Base: 5YR 4/3 (Reddish Brown)	8.Modified slope: Concave and irregular (12 to 60) 9.Type of slide: Debris flow 10.Special features: a number of gullies have developed, incisions have also been noticed.	8.Modified slope: Concave and irregular (12 to 65) 9.Type of slide: Debris flow 10.Special features: a number of gullies have developed, incisions have also been noticed.	

*Based on P.T. Bhutia, ** Field observation by the investigator

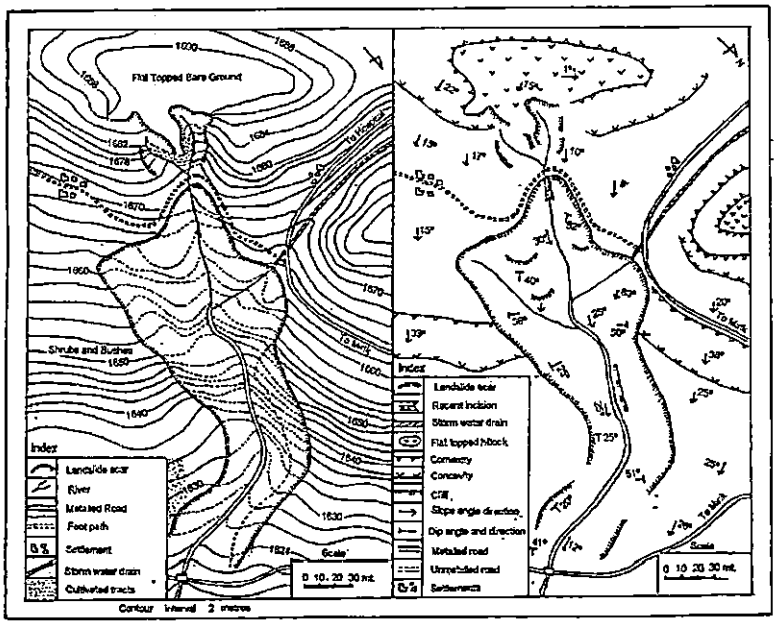


Figure 8.6: Geomorphological map of Mirik landslide (Based on P.T. Bhutia, 1998)

In the case of the Mirik landslide it becomes imperative to plan the land uses scientifically – not just in terms of socio-economic importance but also for strategic planning. This calls for the compilation of all relevant information and building up of a comprehensive database for landuse planning purpose in order to prevent half-baked faux pas in the name of planning new infrastructure for tourism. With decentralized decision- making being one of the major tools for successful planning, local level participation is highly necessary. Thus a whole hearted effort has to be initiated by involving local residents in the field of data generation, data preservation and data utilization for all future land use planning. Arbitrary and baseless plans should be avoided at all costs. The faux pas at Mirik also points to the fact that certain legal changes are also needed in the area of resource management covering the land and water resources, which are both scarce commodities in the hills. More specifically, changes in building rules in municipal area, slope ordinances controlling allowable activities in different slope areas and controlled drainage of the region should be considered a priority for legal intervention. Intense rainfall and cloudbursts as has been seen so often in recent years, can and has had devastating impact in the hills. It is of utmost urgency that watershed and catchment management have to be adopted for regulation of drainage and effective utilization of extra water resources in the Darjeeling Himalaya.

8.5.3.1 Environment Impact

Keeping in mind the above mention aspects of the Tisa hydroelectricity project the NHPC initiated independent implementation of Environmental Impact Assessment (EIA) and Environmental Impact Management (EMP) individually for both the TLDP-III and TLDP-IV. An attempt has been made in the following sections to assess various environmental impact of the Tista hydroelectric project in Darjeeling hills in particular and the sub-Himalayan North Bengal as a whole.

The significant and visible increase in landslide occurrences along the NH 31A the life line for Darjeeling and Sikkim from Sevoke to Tista Bazar during the past few years may be considered as one of the worst negative impact of Tista hydroelectric projects. Movement of frequent heavy vehicle for construction purpose is primarily responsible for such an unusual increase of slope failure. Gigantic cut and fill processes has been undertaken at both project sites along with diversion of the mighty river Tista for the construction of Dam and powerhouse shall be responsible for serious disturbances of hill slope hydro-geomorphic stability (Photograph 8.7 & 8.8). In fact, the mammoth project activities caused irreparable damage to the pristine landscape of the lower Tista valley. Ever increasing scars starting right from the foothills of Sivok to Tista Bazar in fact bear mute testimony of the true environmental impact of the much publicized Tista hydroelectric project in Darjeeling hill area.

The river Tista carries huge amount of bed and suspended load, perhaps one of the highest at global scale. During the construction stages there is every possibility to increase such load movement manifold and thereby may indulges unpredictable fluvial adjustment. Couple with this ever increasing landslide occurrence shall also produce large amount additional silt load to the river which ultimately affect the proposed dams in terms of reducing their life span and/or caused catastrophic dam brake. Special attention shall be given to the catchment area treatment with an aim to reduce silt production to be transported to the parent river.

Among the major identified impact management to be adopted to ease out the adverse environmental impact of the Tista hydroelectric projects are summarized below:

i) Catchment area treatment plan shall be of high priority to check soil erosion and slope failure within watershed shall have the following objectives:

a) to treat the severe and very severely degraded area as identified in EIA,
b) to stabilize various unstable areas using several engineering and bio-engineering measures and
c) to increase the life span of the project by reducing sitation in the reservoir.

ii) Rehabilitation and resettlement plan for the identified and would be affected families/establishment as identified in EIA document.
iii) Compensatory afforestation
iv) Reservoir rim treatment plan shall be executed to identify potential weak/slide zone followed by RRT work to offer stability of reservoir side
v) Fisheries development plan including installation of fish ladder to facilitate fish migration
vi) Bio-diversity conservation plan
vii) Wild-life management plan
viii) Free fuel provision for the local/affected households/labourer
ix) Saftety and health management plan
x) Eco-tourism development plan.

8.6 Conclusion

Since the independent the development of various projects such as transport and communication, irrigation and agricultural, water supply, sericulture, fishery etc. were taken place in the Darjeeling hill area. Local inhabitants are also receiving opportunity to exploit benefit out of such development projects. It is only during the last few decades the man has begun to exploit the vast and varied natural resources like flowing water through the rivers like Tista, Rangit, Rammam, Balasan and the Jaldhaka. At several places these rivers have been tapped and plugged to generate hydroelectric power, to construct dams to generate power and to irrigate the agricultural land to benefit the inhabitants. As a result, rapid urbanization has been taken place in Darjeeling hill areas. The rural Darjeeling has also been experiencing rapid population growth during the past couple of decades. The Darjeeling hill has been considered as environmentally sensitive and susceptible and thereby has limited carrying capacity. Thus, the unregulated developmental activities couple with uncontrolled population growth invites the most unfortunate story of premature degradation in almost every sphere of her environment.

The problems of environment management are diverse in nature that requires special attention. The development of urban centers and settlement in Darjeeling hill also invited large scale landslide occurrences. It is clearly understood that acceleration of landslide occurrences since the beginning of the last century was essentially due to human encroachment in the form of illogical and unregulated growth of settlement, infrastructure and livelihood activities. The construction of railway track, road, bridges, culvert and other development works took place at cost of slope cutting often accelerated the processes of soil erosion and mass movement. Extensive landslide damages was reported in 1899, 1910, 1932, 1942, 1943, 1944, 1950, 1954, 1968, 1980, 1991, 1993, 1996, 1998, 2004, 2009, 2010 and 2011.

The land use of Darjeeling hill during the time of the British annexation was dominated by rich temperate forest in the high altitude, dense mixed jungle in the middle hills and gregarious tropical forest in the lower hills dotted with grassland and shrubs and bushes. Massive land use transformation has been taken place since the British annexation. Vast clear felling was reported at the early stage especially during the establishment of tea plantation. This was followed by selective deforestation that was taken place during the implementation of almost every developmental programmes.

The Darjeeling hill is endowed with a wide range of plants and in fact one of the centers of origin of certain important agricultural and economic plants. Exotic plants like rhododendron, wild rose, conifers, rare herbs and food crops should be genetically upgraded to meet the requirement of food. The temperate Himalayan belt offer great potentials for forage grasses and legumes, as such the natural grasslands of low productivity can be replaced with highly productive by farming systems. These untapped grasslands resources of the hill region can perhaps make large contribution to its economic development. As the prosperity of a nation is determined by its capacity to utilize and conserve its resources it is therefore, necessary to undertake suitable steps based on the physical and biological environment to formulate plan for sustainable development of biological resources of Darjeeling hill areas.

The varieties of wild animals and birds have threatened and some are extinct due to implementation of different development projects, such as construction of roads, construction of hydroelectric projects, township, community halls, tourism projects etc. The concerned animal resources department as well as forest department should take necessary steps

regarding conservation of such threatened species. The maintenance and development of roads, irrigation, schemes, water reservoirs and various rural employment generating and income generating programmes in the hilly terrains should be implemented under close supervision and monitoring mechanism considering environmental impact assessment of each of them.

Darjeeling Himalaya suffers from a vicious cycle of development process along with burgeoning population. There has been a constant increase on the area under subsistence crops followed by an increased dependency on livestock farming. Such sequence intensifies the demand on the fragile mountain land resources. Excessive encroachment of forest land to meet the mushrooming demand for fodder, fuel wood, and other requirements has led to unprecedented damage to forests, livestock grazing more often in this fragile environment has led to overgrazing leading to create barren land. Tourism in the area is another factor that has its share in the degradation and polluting the environment. Besides, the physical isolation, economic backwardness, social heterogeneity and unstable politics have a bearing on the social life of the hill folk which is often ventilated through disbelief, frustration and demand for linguistic and political autonomy.

8.7 References

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