

## CHAPTER 9

### Environmental Impact Assessment

#### 9.1 Introduction

Environmental impact assessment is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made." EIAs are unique in that they do not require adherence to a predetermined environmental outcome, but rather they require decision makers to account for environmental values in their decisions and to justify those decisions in light of detailed environmental studies and public comments on the potential environmental impacts of the proposal.

EIAs began to be used in the 1960s as part of a rational decision making process. It involved a technical evaluation that would lead to objective decision making. EIA was made legislation in the US in the National Environmental Policy Act (NEPA) 1969. It has since evolved as it has been used increasingly in many countries around the world. As per Jay *et al.*(2006), EIA as it is practiced today, is being used as a decision aiding tool rather than decision making tool. There is growing dissent on the use of EIA as its influence on development decisions is limited and there is a view it is falling short of its full potential. There is a need for stronger foundation of EIA practice through training for practitioners, guidance on EIA practice and continuing research.

The Darjeeling hill areas have been passing through the processes of development of different degrees and magnitudes since the British occupation since 1830s. The early phase was characterized by massive deforestation, cleaning of forest, shrubs and grassland followed by leveling of ground surface to get sites for construction and development of different kinds. Such a massive interferences into the delicate hill slopes hydro-geomorphic processes was demonstrated the major and devastating landslide occurrences in 1899 which caused massive

destructions of land and property in addition to the loss of nearly 100 people. The following phases of development processes also caused degradation of different magnitude. The post-Independence scenario was dominated by massive influx of population i.e., over 500% increase during the past century which is much higher than the physical carrying capacity of Darjeeling hills. Darjeeling town as for example, the original developer of the town designed its infrastructure to cater 25000 to 30000 people which is now accommodation a few hundred thousand. Thus, the contemporary developmental activities are more need based as people need land to cultivate and for land forest must be cleared some kind of vicious cycle of degradation has been established in Darjeeling hills.

It is true that development activities irrespective to its magnitude and nature have has some kind of effects on the natural environmental system, as they are inseparably linked to each other. However, costs of such developments, not in terms of money but equally or rather more valuable in term of its impacts on the environment must be assessed before initiating such a programme. The concept of environmental impact assessment (EIA) and environmental impact management (EMP) today stand very strong in all most everywhere in the present world.

Any development process is bound to have its impact on the environment. If we trace the history of human being it should be clear that there had been tremendous environmental impacts of industrialization, mining and development of hydroelectric projects had very harmful impact on our environment. Such impact led to degradation of our lands, forests water, air and biological diversity by release of noxious chemical and other factors.

Developments programme and industrialization had been a mixed blessing in Darjeeling hill areas. There was limited economic growth and increase overall standard of living. However, such development activities had been undertaken at tremendous environmental cost. Man has virtually reached a stage where natural resources could not be exploited further and development will have to be achieved without destruction of environment.

In Darjeeling hill areas, in the post independent period, the development activities like construction of roads, water supply project, hydro-electric projects etc. have been undertaken without proper investigation on environmental impact and possible impact management especially to the natural drainage system and flora and fauna of the affected area. It would be

desirable to have such environmental survey of the area before the projects are launched and thus avoid many of the unfortunate environmental maladies.

The objective of environmental impact assessment (EIA) is to ensure that developmental is sustained with minimal environmental impact assessment of developmental projects in various sectors such as heavy road construction, public building, tourist lodges, hydro-electric projects, industries mining and irrigation projects. In order to ascertain the impact of various development projects both on the society as well as on the environment. It is seen that the soil, water vegetation and man in the region have led to drastic changes in the environment thus the main objectives of the environmental impact assessment is to extrapolate the possible impact in years to come.

The overall impact of developmental activities in Darjeeling Himalaya, on the environment becomes evident from the process of degradation that has taken place over the years. Degradation of land and soil through soil erosion and landslides, where water has been the main agent and the degradation of biological conditions through changes in species diversity have resulted from the natural and more so unnatural interactions between man and environment. The direct impact of developmental activities is best understood through impact assessment involving impact identification and case studies. The objective of the impact assessment is to understand the development related factors that have led to the environmental degradation in the region. An attempt has been made to assess the magnitude and the significance of the environmental impact of various development programmes in Darjeeling hill areas in the following sections.

### **9.1.1 Methodology**

A wide range of method has been development (Stover 1972, Munn, 1979, Wood & Lee 1987), Soresen and Mess (1973) are of the view that the present diversity should be considered as a healthy condition in a newly formed and growing discipline. The methods are divided into the following categories:

- Check list
- Matrixes
- Quantitative method
- Network and overlay maps.

The method that has been used is based on the quantified matrix i.e. the Leopold Matrix, developed for the U.S. Geological Survey based by Leopold et al (1971) with relevant modifications. The matrix is based on a horizontal list of 39 developmental activities under 9 broad headings and a vertical list of 58 environmental components under 4 broad and 12 sub-headings. The scope of possible interactions between the developmental activities and the environmental components is wide, as the overall impact is being considered from the time started until date, and therefore the assessment could aid in future planning. In each appropriate cell, two numbers are recorded. The number on the left of the back slash represents the impact's magnitude, from + 10 (very positive) to -10 (very negative). The figure on the right represents the impact's significance, from 10 (very significant) to 1 (insignificant).

## 9.2 Impact identification

Impact identification brings together various developmental project characteristics and base line environmental characteristics with the aim of ensuring that all potentially significant impact (adverse and favourable) are identified and taken in to account in the environmental impact assessment (EIA) process. Among the different states of EIA process i.e. impact identification, impact prediction, impact evaluation, impact communication, impact mitigation, impact presentation , impact monitoring and impact auditing, the investigator of the present study has performed impact identification as it will be possible to locate the places of impact magnitude of various degree with in the Darjeeling hill areas.

Impact identification brings together the developmental characteristics and base line environmental characteristics with the aim of ensuring that all potential environmental impacts are identified and taken into account in the impact assessment. The modified Leopold matrix as mentioned above has been applied for the said purpose and is represented with a “unit example” of **Phuguri** in table 9.1.

To have quantitative value of such impact from the matrix, the present investigator has applied a simple calculation as follows:

$$\text{Impact Magnitude} = \frac{\sum P - \sum N}{TP} \times 100 \dots\dots\dots 9.1$$

$$\text{Impact Significance} = \frac{\sum S}{TP} \times 100 \dots\dots\dots 9.2$$

Where P= positive impact; N=negative impact; TP = total parameters and S=significance.

The matrix has been applied as “check list” in forty different tourism sites within the study area to have an idea about spatial distribution of the environmental impact of developmental activities in the Darjeeling Himalaya. This ultimately helps in producing two different maps: i) impact magnitude (figure 9.1) and ii) impact significance (figure 9.2).

### 9.3 The Impact Magnitude

Figure 9.1 depicts the different zones of the magnitude of environmental impact of developmental activities. It is found that such impact magnitude vary from highly positive (300) to highly negative (-300). Positive impacts of different magnitude have been noticed along the north western extremity of the study area, while negative impacts have been noticed along the most inhabited areas. However, for a better understanding of the geographical distribution of different impacts magnitude, the following classes are put forward:

**Class I: High Positive Impact:** is very evident in two broad zones viz. the north western periphery covering the Singalila Wild Life Sanctuary of the Darjeeling subdivision and the eastern section encompassing the Neora valley of the Kalimpong subdivision. Two much smaller zones exhibiting a high positive impact can also be seen in the southern section along the Sukna/Baikunthapur and Choklong khola regions. A narrow strip in the centre flanks the left bank of the river Teesta from Sevoke to Kalijhora. These zones falling under Class I exhibit a high positive impact chiefly because these areas are still under virgin forest cover and have not been affected by any adverse developmental impact on the natural environment.

**Class II: Moderate Positive Impact:** In the Darjeeling and Kalimpong subdivisions, this Class II zone of moderate positive impact can be observed mostly bordering the Class I zone in a narrow belt in the north western and eastern sections of the study area. This zone is much more pronounced in the southern sections, especially along the foothills flanking the Terai and Dooars areas. In Kurseong subdivision, this zone is very prominent in the central part, along the Mahananda river, Rangtong khola, Manjha jhora and Marma catchments and along the riverine tract of the lower Balason river – extending chiefly through Pubong, arching further east and culmination just above Kalej valley. Towards the south, a wedge like protuberance extends eastwards winding in and around Panighatta. These tracts are still under natural forest cover of different species. A distinct and notable positive impact of silviculture activities can also be observed.

# MAGNITUDE OF ENVIRONMENTAL IMPACT IN THE DARJEELING HILLS

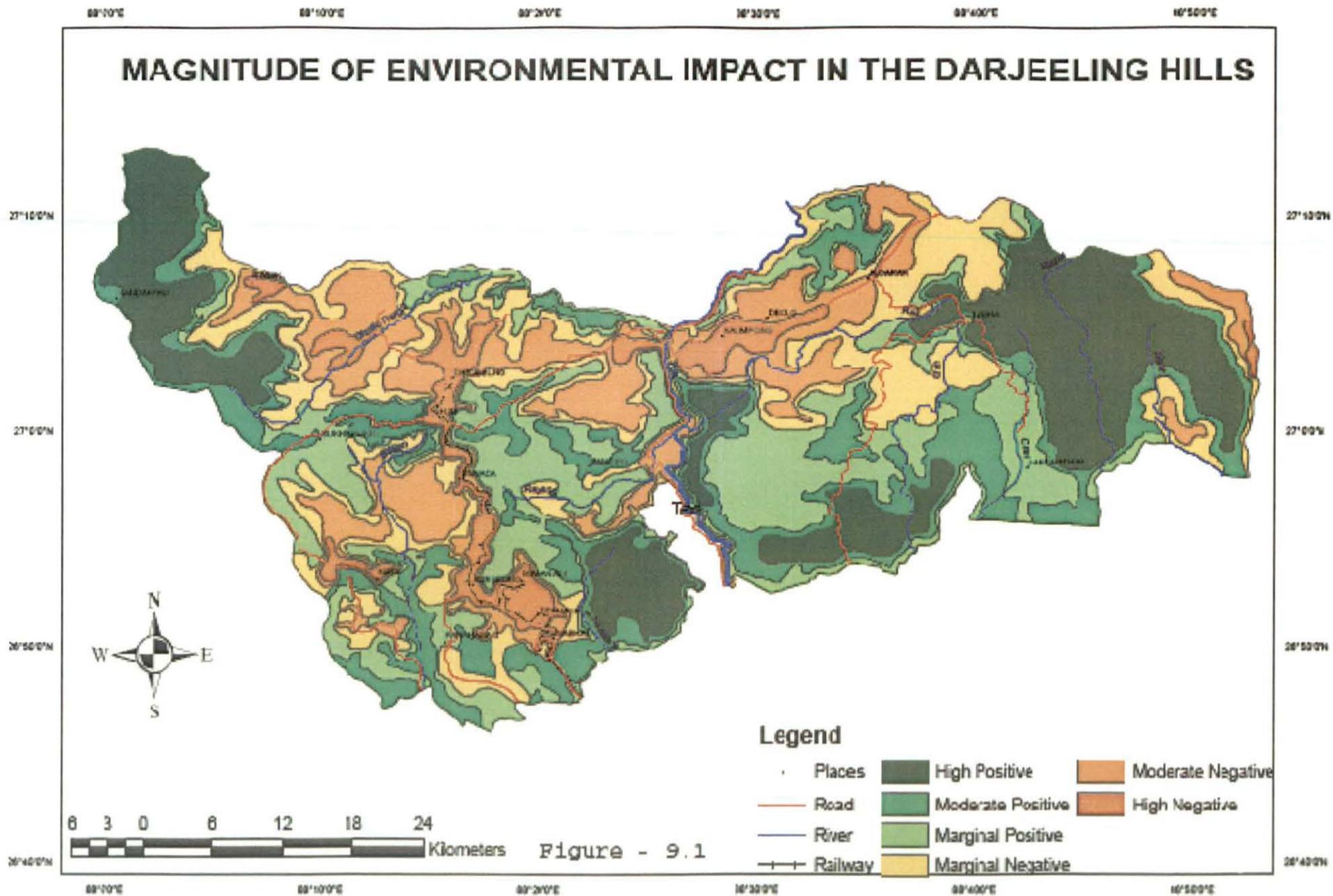


Figure - 9.1

**Class III: Marginal Positive Impact:** predominates along the Mahaldiram range, the Latpanchar cinchona areas in Kurseong subdivision and in the southern and eastern sections of Gorubathan in Kalimpong subdivision. In the Darjeeling subdivision, this zone extends from Tumsong in Kalej Valley to Sonada and Dilaram, and proceeds as an elongated narrow wedge along the Mungpoo and the Nagri Farm environs. The field survey showed these tracts to be mostly under dense vegetative cover of exotic species like *Cryptomeria japonica*, cinchona and *Tectona grandis* etc. The hill and Dooars regions are also dominated by tea plantations, although the large scale plantations show evidence of detrimental effects on biodiversity, these plantations have also shown a beneficial impact on landscape and soil water management since they play a significant role in checking soil erosion and in recharging ground water aquifers. Consequently a marginal degree of positive impact is attained.

**Class IV: Marginal Negative Impact:** covers a large area in the northeastern section of Kalimpong subdivision in and around Algarah and Relli khola. In Darjeeling subdivision, this zone can be traced in a narrow zone south of Jorebunglow and Simana area as it proceeds into the Kurseong subdivision from Mirik through Ambootia and then to Singbulli, Makaibari and Selim Hill. The Khaprail region also exhibits a low negative impact. The catchment areas of Rohini khola, Rakti khola and Rangbang khola also exhibit a low negative impact. In this zone, large scale deforestation for the growth of human settlements and widespread arable farming along with the introduction of tea gardens have destroyed the regional biodiversity, thereby exerting a negative impact on the environment.

**Class V: Moderate Negative Impact:** can be found spread across the study area. In the northern sections this zone extends from Lodhama in the northwest to Dooteriah, Cedar, Seeyok and Margaret's Hope tea gardens in Kurseong. This zone is significant especially in the Mechi-Mahananda interfluvial section. A narrow strip extends from the north of Thurbo eastwards into Marma tea garden. The southern section is prominent in the Simulbari-Longview areas, which are mostly tea gardens.

In this zone, it is apparent that in the northern hilly areas, large-scale deforestation of forests in the steep slopes has induced many unfortunate environmental repercussions like landslides and soil erosion. In the plains, the presence of neglected tea gardens and dense

human settlements, with associated detrimental human activities like rock quarrying and road blasting, unscientific arable farming have had a negative impact on this region.

**Class VI: High Negative Impact:** The most prominent zone of high negative impact has been identified along the Hill Cart road, NH 55 starting from Siliguri, through Rangtong, Chunabhati, Tindharia, Paglajhora, Kurseong, Sonada, Ghum and culminating in the town of Darjeeling. A second prominent zone can be encountered in and around the town of Kalimpong. Smaller pockets can also be identified around Mirik, Soureni Phuguri area as well as the Bijanbari-Pulbazar areas in the north and Pankhabari, Malatar and Lizzipur areas in the south. This zone is characterized by the highest degree of deforestation, excessive human settlements and built up areas. Consequently, haphazard constructions, inadequate drainage, random road cutting and blasting coupled with unsystematic and unscientific land use have established a vicious cycle of degradation leading to a high to a very high negative impact of 'developmental activities' on the environment

#### 9.4 The Impact Significance

The spatial distribution of environmental impact significance has been identified based on the check list (table 9.1). Semi quantitative rating value has been obtained from forty sites chosen and plotted on the map. The impact significance map has been prepared based on interpolation method (figure 9.2). It has been found that the impact significance varies from very high (8) to insignificant (1). The following impact significant classes have been identified:

**Class I: Highly Significant Environmental Impact:** has been identified chiefly along the NH and Hill Cart Road, in an elongated tract from Chunabhati - Rangtong, through Kurseong, Sonada, Ghum to Darjeeling a narrow belt along NH 55, flanking the Tista river widens into a prominent zone around the town of Kalimpong. Smaller zones can be seen along Dilaram-Jorebunglow-Rangli Rangliot area as well as to the southwest in and around the Mirik – Tingling – Phuguri – Thurbo - Soureni and Singbulli area. The Nagari Farm, Ambootia, Makaibari, Selim Hill regions also fall under this zone. These areas have experienced the most devastating impact of developmental activities on the environment. Ever increasing population growth, unplanned developmental activities and the maximum concentration and growth of destinations of mass tourism in these regions are responsible for such a high significance of environmental impact.



**Class II: Moderately Significant Environmental Impact:** is the most widely spread zoned and has been identified in most of the tea garden dominated areas. Large-scale deforestation along hill slopes to set up tea plantations has exerted tremendous stress on the biodiversity of the region and played havoc with the delicate hill ecosystem. The rampant and indiscriminate use of fertilizers, pesticides and herbicides to augment tea production also has had detrimental effects on the quality of land, water and atmospheres of the area. Innumerable unprotected roads, footpaths and trails both for the use of locals as well as infrastructure – built up for opening up destinations of rural and tea tourism cause heavy loss of surface soil and often invite landslides.

**Class III: Marginally Significant Environmental Impact:** is evident in the degraded forest areas and in plantation tracts throughout the study area. It is apparent that in this zone, the reduction of biodiversity coupled with marginal development activities such as minor roads, trails and setting up of rural tourism destinations like Relli, Rishap, Bara Mangwa etc have exerted an adverse impact. However, the natural regeneration of the forest habitats has to a certain extent checked the negative impacts.

**Class IV: Insignificant Environmental Impact:** has been observed prominently in the north western part of the study area around Singalila Wild Life Sanctuary, the Neora Wild Life Sanctuary in the east, the Baikunthapur-Sukna forest areas of Mahananda Wild Life Sanctuary and in a narrow elongated zone of the left bank of Teesta River and in the extreme north a small zone flanking the right bank of Ramman river. Field observations revealed that these areas are still free from any significant development and/or modification impact and are largely covered by dense natural forests. An overview of the matrix suggests high interactions between the components under modification of regime with those of flora, fauna and landuse. The modification of regime brought about by the introduction of tea species and associated management practices along with the impact of tourism that has certain negative impacts on the environmental components, particularly flora and fauna is quite significant.

The development activity having high interaction is land transformation and construction, which has influenced geo hazards like soil erosion and landslides with high magnitude – the impact of which is very significant. This has been clearly revealed in case of landslide caused by construction of roads and other infrastructure.

## 9.5. Conclusion

Environmental impact assessment is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made." EIAs are unique in that they do not require adherence to a predetermined environmental outcome, but rather they require decision makers to account for environmental values in their decisions and to justify those decisions in light of detailed studies and public comments on the potential environmental impacts.

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The EIA experience in India indicates that the lack of timely availability of reliable and authentic environmental data has been a major bottle neck in achieving the full benefits of it. The environment being a multi-disciplinary subject, a multitude of agencies is involved in collection of environmental data. However, there is no single organization in India which tracks the data available amongst these agencies and makes it available in one place, in a form and manner required by practitioners in the field of environmental impact assessment

## 9.6. References

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Table 9.1 Environmental Impact Identification

		I. Modification of Regime								
		<i>Exotic Fauna/Flora Introduction</i>	<i>Modification of Habitat</i>	<i>Alteration of Ground</i>	<i>Alteration of Ground water Hydrology</i>	<i>Alteration of Drainage</i>	<i>Irrigation</i>	<i>Weathering Modification</i>	<i>Burning</i>	<i>Surface of Paving</i>
		<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>e</b>	<b>f</b>	<b>g</b>	<b>h</b>	<b>i</b>
A	<b>1. Earth</b>									
	Mineral Res									
	Soils	-3/4	-3/4	-2/3		-2/3		-1/1	-3/4	-3/3
	Landform								-2/3	-3/4
	<b>2. Water</b>									
	Surface	-3/3	-2/3					-3/4	-2/3	-3/4
	Groundwater	-3/3	-2/3	-2/3	-2/3			-3/3	-1/2	-2/3
	Quality							-3/4	-1/2	
	Recharge									
	<b>3. Atmosphere</b>									
	Quality								-1/1	-3/4
	Rainfall									
	Temperature									
	<b>4. Process</b>									
B	Flood				-3/3					
	Erosion				-2/2					
	Deposition			-2/2	-2/2					
	Compaction									
	Stability									
	Earthquakes									
	<b>1. Flora</b>									
	Trees	-3/3	-3/3	-3/3						
	Shrubs	-3/3	-3/3	-3/3						
	Grass	-4/5	-3/3	-4/4						
	Crops									
	Micro-flora	-2/2	-2/2	-2/2						
	Aquatic									
	Rare Species	-3/2	-3/2	-3/2						
	<b>2. Fauna</b>									
	Birds	-2/2	-2/2	-2/2						
	Mammals	-3/3	-3/3	-3/3					-3/3	
	Fish				-2/2					
	Insects	-3/3	-3/3	-3/3					-3/3	
Micro-fauna	-3/3	-3/3	-3/3					-3/3		
Rare Species	-2/2	-2/2	-2/2					-2/2		

		I. Modification of Regime								
		<i>Exotic Fauna/Flora Introduction</i>	<i>Modification of Habitat</i>	<i>Alteration of Ground</i>	<i>Alteration of Ground water Hydrology</i>	<i>Alteration of Drainage</i>	<i>Irrigation</i>	<i>Weathering Modification</i>	<i>Burning</i>	<i>Surface of Paving</i>
		a	b	c	d	e	f	g	h	i
C	<b>1. Land use</b>									
	Open Space	-2/3	-3/3	-3/3						
	Wet Lands		-2/2	-2/2	-3/3	-2/2				
	Forestry	-4/5	-3/3	-3/3						
	Agriculture	-3/3								
	Grazing	-3/3	-3/3	-3/3						
	Residential									
	Commercial									
	Mining									
	Quarrying									
	<b>2. Recreation</b>									
	Camping	2/2								
	Picnicking	2/2								
	<b>3. Aesthetic</b>									
	Scenery	3/3								
	Wilderness									
	Landscape									
	Reserves	-3/3	-3/3	-3/3						
	<b>4. Cultural</b>									
	Statue									
	Health									
	Employment	4/4								
	Population									
Density	5/5									
<b>5. Man made</b>										
Structures										
Transport										
Utility										
Wastes										
D	<b>1. Diseases</b>									
	Food chain	-2/2	-3/3	-2/2					-3/3	
	Others									

A: Physical and Chemical Conditions; B: Biological Conditions; C: Cultural Conditions; D: Biological Relations

Table 9.1 Environmental Impact Identification ..... Cont.

		II. Land Transformation and Construction									
		<i>Urbanization</i>	<i>Industrial Sites and Buildings</i>	<i>Highways, Bridges, Roads and Rails</i>	<i>Transmission and Pipelines</i>	<i>Barriers including Fencing</i>	<i>Channel Revetments</i>	<i>Recreational Structures</i>	<i>Blasting and Drilling</i>	<i>Cut and Fill</i>	
		a	b	c	d	e	f	g	h	i	
A	<b>1. Earth</b>										
	Mineral Res	-1/2									
	Soils	-1/2		-1/2	-1/1		1/2	-2/1	-5/6	-2/3	
	Landform							-1/1	-5/3	-3/3	
	<b>2. Water</b>										
	Surface										
	Groundwater									-3/3	
	Quality										
	Recharge										
	<b>3. Atmosphere</b>										
	Quality	-1/1									
	Rainfall										
	Temperature										
	<b>4. Natural Processes</b>										
	Flood			-4/4				2/2			
	Erosion			-5/4				2/2			-3/3
	Deposition		-2/2	-3/3				1/2			-2/2
Compaction	-3/3	-2/2	-2/1								
Stability	-3/3		-5/4				1/1		-3/2	-3/2	
Earthquakes			-1/1								
<b>1. Flora</b>											
Trees	-3/3	-1/1	-2/2								
Shrubs	-3/3	-1/1	-2/2								
Grass	-2/3	-1/1	-2/2								
Crops											
Micro-flora											
Aquatic											
Rare Species	-1/1										
<b>2. Fauna</b>											
Birds	-3/4										
Mammals	-4/4	-2/2									
Fish											
Insects											
Micro-fauna											
Rare Species	-2/2	-1/1	-3/3								

		II. Land Transformation and Construction								
		<i>Urbanization</i>	<i>Industrial Sites and Buildings</i>	<i>Highways, Bridges, Roads and Rails</i>	<i>Transmission and Pipelines</i>	<i>Barriers including Fencing</i>	<i>Channel Revetments</i>	<i>Recreational Structures</i>	<i>Blasting and Drilling</i>	<i>Cut and Fill</i>
		a	b	c	d	e	f	g	h	i
C	<b>1. Land use</b>									
	Open Space	-2/3	-1/1	-3/3						
	Wet Lands	-2/2	-1/1	-2/2	-1/1					-2/3
	Forestry	-3/4	-1/1	-3/3				-1/1		
	Agriculture	-3/3	-1/1							
	Grazing	-3/3	-1/1	-3/3		1/1				
	Residential									
	Commercial									
	Mining									
	Quarrying									
	<b>2. Recreation</b>									
	Camping									
	Picnicking							4/4		
	<b>3. Aesthetic</b>									
	Scenery	-4/4	-1/1	-2/2						
	Wilderness									
	Landscape									
	Reserves	-3/3	-1/1	-4/5	-1/1			-1/1		
	<b>4. Cultural Status</b>									
	Health									
	Employment	4/5	3/3	4/4						
	Population	6/6	2/2	3/3						
	<b>5. Man made</b>									
Structures										
Transport										
Utility				4/4						
Wastes		-5/5	-2/2							
D	<b>1. Diseases</b>									
	Food chain	-2/2	-3/3	-1/1	-2/2					
	Others		-3/3							

Table 9.1 Environmental Impact Identification ..... Cont.

	II. External		IV. Processing			V. Alteration		VI. Renewal			
	<i>Surface Excavation</i>	<i>Clear Felling and Lumbering</i>	<i>Farming</i>	<i>Hunting and Grazing</i>	<i>Lumbering</i>	<i>Erosion Control/Terracing</i>	<i>Landscaping</i>	<i>Reforestation, Wildlife, Stocking and</i>	<i>Fertilizer Application</i>	<i>Waste Disposal</i>	
	a	b	a	b	c	a	b	a	b	c	
A	<b>1. Earth</b>										
	Mineral Res										
	Soils	-5/6	-1/2	-4/5	-1/2	-4/5	3/3	-1/1	4/5	-3/4	-3/3
	Landform	-5/3	-2/3				-5/6	-1/2			
	<b>2. Water</b>										
	Surface	-3/3	-4/5	-2/2		-3/3	-3/3	-1/1	4/5		
	Groundwater		-2/3	-2/3		-3/3			5/5		
	Quality			-2/2					2/3	-2/2	-2/2
	Recharge		-4/4						3/3		
	<b>3. Atmosphere</b>										
	Quality										
	Rainfall										
	Temperature										
	<b>4. Natural Processes</b>										
	Flood		-4/4			-4/4					
	Erosion		-5/5			-3/4	4/4				
	Deposition		-3/3								
	Compaction										
	Stability		-4/4	-4/4	-1/1	-3/3	5/5				
Earthquakes											
<b>1. Flora</b>											
Trees		-3/3			-4/4			4/4			
Shrubs		-3/3			-3/4			4/4			
Grass		-2/2			-2/2			-4/4			
Crops											
Micro-flora								2/2			
Aquatic											
Rare Species		-2/2						3/3			
<b>2. Fauna</b>											
Birds		-4/4		-3/3							
Mammals		-4/4		-3/4							
Fish											
Insects		-3/3						3/3			
Micro-fauna		-2/2						3/3			
Rare Species		-2/2		-4/4				3/3			

		III. External		IV. Processing			V. Alteration		VI. Renewal		
		<i>Surface Excavation</i>	<i>Clear Felling and Lumbering</i>	<i>Farming</i>	<i>Hunting and Grazing</i>	<i>Lumbering</i>	<i>Erosion Control/ Terracing</i>	<i>Landscaping</i>	<i>Reforestation. Wildlife, Stocking and Management</i>	<i>Fertilizer Application</i>	<i>Waste Disposal</i>
		a	b	a	b	c	a	b	a	b	c
	<b>1. Land use</b>										
	Open Space			-2/2							
	Wet Lands		-3/3		-4/4	-3/3	3/3		2/2		
	Forestry		-4/4	-1/1			4/4		6/6		
	Agriculture		-3/3	1/1					4/4		
	Grazing								-3/3		
	Residential										
	Commercial										
	Mining										
	Quarrying										
	<b>2. Recreation</b>										
	Camping								3/3		
	Picnicking								3/3		
	<b>3. Aesthetic</b>										
	Scenery										
	Wilderness										
	Landscape										
	Reserves		-4/4				3/3		5/5		
	<b>4. Cultural Status</b>										
	Health										
	Employment			4/4		3/3					
	Population			3/3							
	<b>5. Man made</b>										
	Structures										
	Transport										
	Utility										
	Wastes										
	<b>1. Diseases</b>										
<b>D</b>	Food chain				-3/3					-4/4	
	Others										

Table 9.1 Environmental Impact Identification ..... Cont.

		VII. Traffic			VIII. Waste Disposal						IX. Chemical	
		<i>Railway, Automobile and Trucks</i>	<i>Trails</i>	<i>Communication</i>	<i>Pipeline</i>	<i>Emplacement of Spoils</i>	<i>Municipal Waste and Junk disposal</i>	<i>Septic Tank</i>	<i>Smoke and Exhaust Emission</i>	<i>Spent Lubricants</i>	<i>Fertilizer</i>	<i>Weed and Insect Control</i>
		a	b	c	a	b	c	d	e	f	a	b
A	<b>1. Earth</b>											
	Mineral Res											
	Soils	-2/2	-3/2	-4/5	-1/1	-3/4	-2/3	-2/2	-1/1	-1/1	-2/3	-3/4
	Landform					-1/1						
	<b>2. Water</b>											
	Surface		-1/2	-4/4		-4/4	-4/4					
	Groundwater											
	Quality					-1/2	-4/4	-3/3		-2/3	-3/3	-4/5
	Recharge											
	<b>3. Atmosphere</b>											
	Quality	-4/5										
	Rainfall											
	Temperature											
	<b>4. Process</b>											
	Flood					-1/1						
Erosion					-4/5							
Deposition					-4/4							
Compaction												
Stability					-3/3							
Earthquakes												
B	<b>1. Flora</b>											
	Trees											
	Shrubs											
	Grass											
	Crops											
	Micro-flora											-3/3
	Aquatic											
	Rare Species											-2/2
	<b>2. Fauna</b>											
	Birds											
	Mammals											
	Fish											
	Insects											-4/4
	Micro-fauna											-4/4
	Rare Species											-3/3

	VII. Traffic			VIII. Waste Disposal						IX. Chemical		
	<i>Railway, Automobile and Trucks</i>	<i>Trails</i>	<i>Communication</i>	<i>Pipeline</i>	<i>Emplacement of Spoils /Overburden</i>	<i>Municipal Waste and Junk disposal</i>	<i>Septic Tank</i>	<i>Smoke and Exhaust Emission</i>	<i>Spent Lubricants</i>	<i>Fertilizer</i>	<i>Weed and Insect Control</i>	
	a	b	c	a	b	c	d	e	f	a	b	
<b>C</b>	<b>1. Land use</b>											
	Open Space											
	Wet Lands											
	Forestry											
	Agriculture				-3/3							
	Grazing											
	Residential											
	Commercial											
	Mining											
	Quarrying											
	<b>2. Recreation</b>											
	Camping		3/3									
	Picnicking		3/3									
	<b>3. Aesthetic</b>											
	Scenery											
	Wilderness											
	Landscape											
	Reserves											
	<b>4. Cultural Status</b>											
	Health										-4/4	-3/3
Employment		5/5										
Population												
<b>5. Man made</b>												
Structures												
Transport												
Utility												
Wastes												
<b>D</b>	<b>1. Diseases</b>											
	Food chain											-3/3
	Others					-3/3	-3/3	-2/2				-4/4

## CHAPTER 10

### Summary and conclusions

The Darjeeling hill situated in the northern part of Darjeeling district in the state of West Bengal has its own peculiar historical background. Cool bracing climate of Darjeeling allured the British officials to acquire this land from the Raja of Sikkim in 1835, and made it a safe home including sanatorium for the British civil servants. With the introduction of tea plantation several ethnic races like Lepchas, Bhutias and Nepalese settled as migrant from the nearby hilly areas as worker. Life was quite hard to begin with in this newly opened hill station where these three different ethnic groups had to live together. They had to begin a fresh lease of life under an alien rules and regulations. They were forced to live a kind of life different from what they were leading before.

The environmental degradation in the Darjeeling hills has been demonstrated significantly in terms of contemporary deforestation, soil erosion and landslides leading to the drying up of water sources, flash floods and decline in yields of food and cash crops, fodder, fuel and other minor forest produces. Poverty in the hills is directly related to shortages of resources for basic subsistence particularly in area under the traditional land and water management system and the carrying capacity of land to support the population has already been exceeded.

In the study area human and livestock pressure along with indiscriminate felling of trees for commercial purpose have already led to loss of soil and rapid depletion and destruction of forest cover. Beside, water retention capacity and productivity of land have been adversely affected. These factors have impaired the ecology significantly and also resulted in deterioration in the economic condition for the hill people. Traditional agriculture practices, specially shifting cultivation have also contributed to destruction of forest and soil erosion. Seemingly harmless activity as prolonged grazing by livestock, especially goats and sheep has further exposed many hill areas to serious ecological degradation. Development activities like construction of building, roads, dams, large and medium industries and mining etc. have aggravated environmental problems. Consequently, perennial sources of water like springs and shall streams have dried up in many areas.

The major challenge, therefore, is to devise suitable location specific solution, so as to reverse the process and ensure sustainable development of the growing population and environment of the hill areas. In addition, frequently occurred landslides, edaphic drought, floods, decline in the forest cover, decline in agriculture yield, soil loss, loss of biodiversity etc. have to be addressed in proper perspective to ensure further deterioration of natural resources base in the hill areas. Using dynamite and other explosives for blasting of the rocks for the construction of hydroelectric projects, roads and other infrastructure facilities have had adverse effects on the regional geo-environmental set-up of the Darjeeling hills. The prevailing mining and quarry operators have been destroying vegetative cover and also disturbing delicate hill-slope hydro-geomorphic processes. Construction of tourism infrastructures including tourist sheds, lodges, roads etc. even in potential vulnerable areas during the DGHC period have caused irreparable damage to the environment and responsible for destruction of land resource and biodiversity.

Agriculture is one of the main occupations in rural Darjeeling hills, but it does not give quick and sizeable return like tourism. During tourist season, tourism has become the main source of income as a result, agricultural system has neglected. Prime arable land is being converted for tourism infrastructure facilities. Such activities create dependence system in addition to adverse impact on economy, society and environment. The farmers who are living in the vicinity of these tourist resorts leave their traditional farming and livestock rearing occupation and are carrying out different types of business for prompt and easy economic benefits. In many such developing tourist places tourism has almost overlapped agriculture i.e., Lolegaon, Mirik, Lava, Kaffer, Rishap etc.

The Darjeeling hill area provides a variety of natural resources which have been threatened largely by human negligence and activities. In order to improve and regenerate degraded Darjeeling hill environment, scientific approach involving hazard zone mapping and banning of engineered development activities in such zone, drainage management, protection of slopes through vegetation, application of technology and improved agronomic practices should be carried on priority basis.

The ecological balance can be maintained and improved in Darjeeling hills by reforestation and checking the illegal felling of trees. Law should be enacted to stop indiscriminate timber trade, installation of new cement factories, stone crushers which is turn

cause air water and noise pollution. The mining operation should be allowed only using appropriate technology and essentially after carrying out mandatory environmental impact analysis (EIA) and environmental impact management (EMP) in order to minimize the pollution of atmosphere and to avoid further degradation. Soil and land use inventories need to be taken up on priority basis. To prevent and/or reduce such degradation there should be scientific and well planned growth of tourism in which experts of different disciplines along with local stakeholders should have close involvement in planning. There magnitude of such tourism development should be done keeping in mind the carrying capacity of particulars resorts to avoid negative impact of such activities to the ecosystem.

Application of scientific inputs to agriculture and allied sectors including identification of crops suitable for the agro-climate zones, multipurpose species of trees and bushes to meet requirements of the people from a well-developed small land area is of special importance. This approach is expected to space considerable areas for permanent greening programme like social forestry or horticultural and serves the long-term objectives of enhancing production on sustainable basis. Appropriate technologies to bring about localized self sufficiency and generate alternative means of livelihood as opposed to heavy dependence on forest and livestock rearing can be encouraged.

Use of appropriate technologies to upgrade the traditional productive system like agricultural operations, livestock rearing, arts and crafts, households and cottage industries etc. needs to be encouraged on priority basis. The technologies have to be need based more productive, efficient, low cost and ecologically sustainable.

Extension services should be encouraged to enlighten and educate people on how to enhance productivity of both arable and community land on a sustainable basis in the context of increasing human and livestock pressures. Consolidation of small and scattered land holding would help in improving water and land management and ultimately, productivity of the limited land resource of the hills.

In many hill areas of Darjeeling district land resource are held as common or community property. In such areas people do not make permanent investment and several other problems also originate from this. To overcome those, local communities have to

evolve suitable models of land management that would invite permanent investment and ensure both optimal returns at sustainable manner.

The government agencies may take a fresh look at their plan and non-plan schemes under the backdrop of forest policies, land tenure system, land and water use policies and religious customs to eradicate practices destructive to the environment.

In order to reduce pressure on land, quality of livestock including goats, sheep, pigs and poultry birds has to be improved and their numbers be reduced. There is an urgent need for assessing the bearing capacity of available land for livestock population. The livestock and cattle improvement programmes need to be integrated with fodder and cattle feed development. The land and livestock management system have to improve rapidly for achieving the overall livelihood security.

The productivity of pastures and grazing area needs to be restored and enhanced. The effort should be to meet the requirements of food, fuel-wood, timber and fodder through scientific utilization of scarce hill resources on sustainable basis. Development of non-conventional energy and use of non-wood based sources of energy should be encouraged.

Development of horticulture, sericulture, plantations, especially cash crops having low volume, light weight, high value and long life cycle could play an important role in generating employment opportunities, higher incomes and ecologically sound sustainable development in Darjeeling hills.

Tourism can be organized as an industry with due care taken to avoid exploitative use of scarce local resources especially, water and fuel-wood. Location specific suitable code of conduct for tourist may be evolved so as to maintain the surrounding clean and disease free and to protect environment and respect to local tradition, culture and heritage.

Special care needs to be taken to ensure that hill roads are constructed as per traffic needs, scientific design and specification suited to Darjeeling hills. In such hill areas where the population density is low and the villages are small and scattered over long distances, pony tracks may be promoted instead of metal road to avoid destruction of virgin forest and rich biodiversity.

The hill people have to be made aware of the far reaching implication of environmental degradation and their active participation has to be sought for its restoration. Environmental aspects can be suitably woven into the curriculum of primary and high school classes. The role of NGOs and civil society is also very important in propagation the knowledge and insights of different aspects of contemporary environmental degradation in the Darjeeling Himalaya. Both electronic and print media may also take-up appropriate step to transfer the insights of this peril to the common people. In the recent past some voluntary organizations have been doing commendable work in the hills which may be encouraged, especially those engaged in improving the ecological system besides economic and social condition of the people.

Regeneration and development of the Darjeeling hill environment cannot be achieved without the pro-active and all out co-operation of the people. It will be forthcoming, only if the benefits from improved land, water and forest resources reach directly and equitably to the people themselves.

The Darjeeling hill areas is prone to tectonic and seismic activities, need to be identified under the light of activities like construction of heavy structures, multi-storied buildings, hydroelectric projects and creation of artificial large water bodies. Large projects might endanger the ecological balance and displace large number of people thus need to be very carefully considered before investment decisions are taken. The EIA and EMP must not be done in casual manner what it was done in most cases in the past.

Some corrective steps may be taken-up immediately in order to arrest further environmental degradation in the Darjeeling hills are recommended:

1. Effective population control and distribution planning, however, difficult in the light of present realities it may be implemented in order to relieve pressure in vulnerable and fragile areas around big settlement centers.
2. Natural forces that are at work in Darjeeling hills though cannot be stopped but there are marginal possibility of reducing the run off volume and velocity of the streams through afforestation, bio-engineering measures and man-made structures like check

dams, retention basins and designed drainage way. Thus arresting of land degradation by soil loss and landslide would be possible.

3. Alternative employment through value addition services, emphasis on high value produce including crops, horticulture, floriculture and orchid culture may reduce the growing demand for more land controlled occupations.
4. Development of fuel forestry, non-conventional energy, eco-friendly tourism industry and small scale or cottage based industries should be promoted.
5. Appropriate land use planning, creation of aesthetic biomes and national parks, trekking area, biodiversity core as a repository of natural resources, restrict demographic and technological threats in the fragile catchments area at the cost of deforestation. Exploration of conservation oriented development techniques and spread of environmental awareness are absolutely needed.
6. Implementation of pilot projects with integrated approach may be experimented at micro-level and their results should be monitored for exploration of future projects in such other areas.
7. It may also be recommended that research and development on to the functioning and dynamics of the hill ecosystem should be initiated for an everlasting and sound environment management in the hill areas of Darjeeling district.