CHAPTER - 5

FOREST AS AESTHETIC RESOURCE

5.1. INTRODUCTION

Forests are of multifarious uses and as such are considered to be of immense help to human being. They moderate the climate, maintain soil fertility and regulate water supplies. By their photosynthetic activity, the plant take carbon-di -oxide from atmosphere and release oxygen thus purifying air and also convert solar energy into various forms of energy such as fuel, food, oil and oil products, which can be directly used by human being. Forests have great potential to control rainfall and contribute largely towards moderation of flow of water in the catchment areas (Chandra Sarkar 1971).

The ecological usefulness of forests of the study area is most readily observed in their beneficial effect on river catchment areas, where they have a regulatory influence on stream flows and where they protect soils form erosion and prevent silting of dams, canals and rivers (Bhutia, 1999, Sarkar 1987,1989, 2000).

The economy of the Darjeeling and Jalpaiguri district around the forest used to be dominated by animal husbandry, but with steady depletion of forest, this is hardly the case now. The extensive shortage of fodder has severely limited the number of cattle that can be kept in a village or by a family. For agriculture, this has meant an acute shortage in the availability of organic manure which previously used to be available in plenty.

Forest are indeed creator of fertile land and prime source of human welfare needs. In facts, forests provide us almost everything we may require, besides responsible for developing a generally healthy and invigorating environment and micro-climate at all levels. In their turn forests require nothing from us other than being left alone, and are by and large the creation of abiotic components interacting with their biotic counter parts, and where faunistic components play a vital role. This relationship and the forests of the study area are amply clear form figure 5.1.

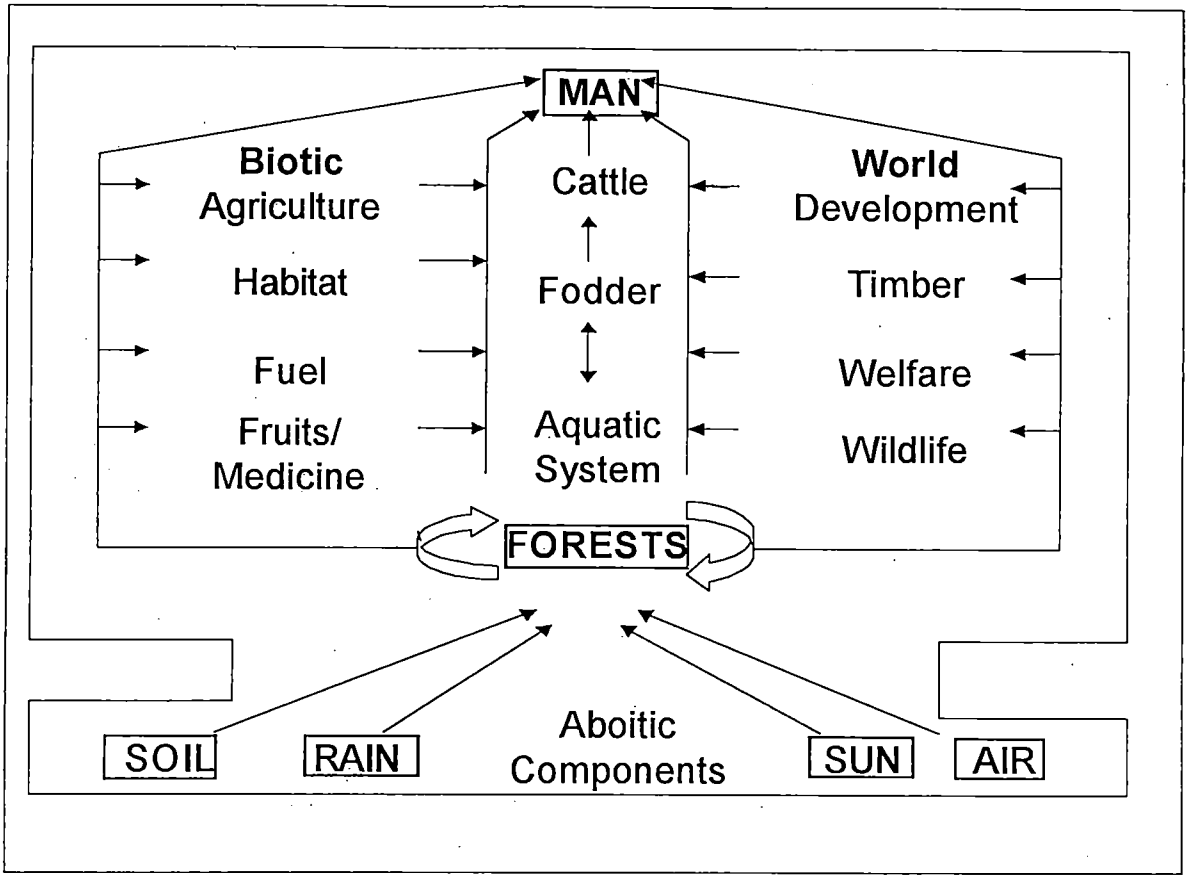

Fig. 5.1. Role of forest as aesthetic resource in the study area

This chapter focuses the protective functions of forest of the study area which includes landslide, soil erosion, flood, eco-tourism etc. The investigator has collected several data from fields through sample survey and secondary sources. Some case studies have also been conducted to highlight the indirect benefits of forest in the area.

5.2. WILD LIFE

The natural fauna of any area depends on the floral types found in it (Iyar 2000). As has been pointed out in the previous chapter, the study area has a large variety of flora. This combined with the widely different climates found in the study area has resulted in the existence of a wide variety of birds, animals and reptiles. As far as variety goes, no other part of the country is as rich as the study area. It would be presumptuous to attempt to describe or even to enumerate all the species of wild animals, and birds that are found in this area in the limited space of this chapter. A brief account of the important and well known species is given below.

The animal kingdom of the study area can be roughly divided into two main groups- the flesh eating or carnivores and the grass eating or herbivores. Among the carnivores we have the Indian Tiger (also known as Royal Bengal Tiger), the panther of leopard, the snow leopard, the fishing cat, the wild cat which all belonging to the cat family. Those belonging to the dog family are the Tibetan black wolf, Hyaena, the Wild dog, the Jackal and the Fox.

Among the herbivora, the largest is the wild elephant followed by the rhinoceros, the wild buffalo and the bison. There are two types of deer are found in the study area. These type are hog deer or para and the barking deer which are mostly found in the B.T.R. areas. Two types of bears are existed in the study areas. The brown bear which is found in the hilly region at higher altitude and the black bears which occurs at lower altitude . Among the cat-bear, the most important is the Red Panda which is found at the high altitude of hilly regions of Darjeeling district. Besides these, wild goat and gaur (*Bos Gaurus*) which is locally known as Mithun are also found in the area.

Two varieties of pig, the Indian wild pig and the pygmy hog, the former widely spread all over the plain forests of the study area and even in the hilly region up to the elevation of 9000 feet altitudes and the latter is found very rare. The largest snake found in the study area is the python which is nonpoisonous but nonetheless dangerous because it kills by coiling itself round its victim and crushing it to death before swallowing it entire. Among the poisonous snakes the most dangerous is the king cobra, which is highly poisonous and has been known to attack unprovoked, the common Cobra, the Krait, the Russells viper, the saw-scaled viper and the pit viper.

The largest bird is the Sarus Crane which stands almost 1.5 metres high and the smallest is the little Sun-bird hardly 7 cm long, which flits from flower to flower sucking nectar like the butterfly. Black necked crane is found in the Bhutanghat forest of B.T.R. Pied Hornbill is also found in dense habitat. The swift rivers of Rydak and Jainti are visited by Trans Himalayan Migratory Goosanders, the beautiful Ibis Bill, the resident Fork-tails, varieties of Red starts, the Narathali lake is visited by migratory common Teal, Gargani Teal, White Eyed Poachared etc.

The above names of animals, reptiles and birds found in the area is descriptive, but by no means exhaustive and only gives an idea of the wonderful variety of the fauna of the study area. A list is prepared for some important fauna which are found in the area is given in table 5.1 & photo 5.1 - 5.4.

Table 5.1

Some important fauna in the study area.

Animals Carnivores and herbivora	Snakes	Birds
Bengal Tiger, Leopard, Fish eating, hyaena, wild dogs, Jungle cat, Jack and fox, large Indian civet, Malayan Gaint Squirrels, Asian Elephant Gaur, Rhinoceros, Bison, Red panda,or rarely wild Buffalo, brown and black bear, Wild pig, Hog & Barking deer, Wild goat, the largest reptile is the Fish eating crocodile or the Gharial, Chinese pangolin etc.	Rock python, Reticulate python, King cobra, Rat snake, Dhaman fresh-water snake etc.	Saruscrane, Sunbird, Peacocks Pied hornbill Black-necked crane, Migratory black strok etc.

Source :- Wild Life Wing, Forest Department, Government of West Bengal.

5.2.1. Wild life management

Wildlife protection in West Bengal received stimulus through promulgation of Wild Birds and Animal Protection Act, 1912. In the rules framed under the provisions of this Act, many species of birds and animals were given protection for whole year or for a part of the year during the breeding season. Complete and special protection were afforded to various species like the elephant under Bengal Elephant Preservation Act, 1879. The wildlife board was first constituted in the state in the year 1955.

Photo 5.1 Elephant at Gorumara N.P.

Photo 5.2 Rhinoceros at Jaldapara WL.S.

About one third forest area of the districts is under protected net work, with a primary objective of wild life management with propagation of other bio-diversity and eco-system. As stated earlier three important large animals like Tiger, Elephant and Rhinoceros are present in the study area along with various other wild animals, the management of the same is quite a challenging task from the wild life management point of view. The state has created 1 Tiger Reserve, 3 National Parks and 5 Wild Life Sanctuaries in the districts of Darjeeling and Jalpaiguri (Table 5.2)

Table 5.2
Protected areas for wild life management

Sl. No.	Protected areas	Area in sq. km
1.	Buxa Tiger Reserve	813.3
2.	Singalila N.P. (Darjeeling Division)	78.00
3.	Neora valley N.P (Darjeeling Division)	88.00
4.	Mahananda WL.S (WL. Division-I)	127.00
5.	Senchal WL.S (WL. Division-I)	38.00
6.	Jorepokhri WLS (WL. Division-I)	0.04
7.	Jaldapara WL.S (WL. Division-II)	216.00
8.	Gorumara N.P. (Jalpaiguri Division)	79.45
9.	Chapramari WL.S (WL. Division-II)	09.60
	Total	1449.39

Source - State Forestry Action Plan 1996 - 2015

The ecological networks of some protected areas are highlighted below :

BUXA NETWORK

All most all the wildlife values of this biogeographic zone (excepting the high altitude Himalayan eco-system) are represented in this eco-system with both Elephant and Tiger.

Photo 5.3 Red Panda at Neora valley N.P

Photo 5.4 Deer at B.T.R.

Form the conservation point of view Buxa being more compact has a higher potential. This network is second important to Sundarbans from the stand points of fuel, fodder and grazing pressures which are acute combined with illicit removal of trees. The eco-development in the fringe areas with joint management approach are urgently needed along with increasing the strength of protection forces .Three important issues emerge in the ecological and wildlife protection in this areas. Firstly Buxa has a total 36 forest villages which is creating biotic pressure and interferences, secondly degradation by dolomite mining and thirdly corridor access between protected areas within network need to be resolved .The following are the some important steps for the conservation of wild life in B.T.R.

Periodic Census Works : To know the exact population, periodic census works was carried out in the year 1989,1992,1995 and 1997.

Patrolling Works : Patrolling is done on foot, by elephant and by vehicle. As some of the terrain of the reserve is (Bhutri, Gangutia, Newlands, Bhutia Basti Beats) not suitable for patrolling on foot during rainy season, more elephant are required for effective patrolling during rainy season.

River camps : At present 6 river camps are operating in BTR. These are established to check the river rafting of illicit timbers during rainy season. (Sankosh, Raydak and Dima).

Manned barriers : To check the entry of human beings and vehicles into the core area, 2 manned barriers (one at Rajabhatkhawa and another at Mainabari) exist. Two manned barriers (one on NH-31 at Chakchaka and another at Damanpur) operate against illicit timber traffic.

Soil and water conservation : Erosion is a major problem in B.T.R. as number of hill rivers (Raidak, Sankosh, Jayanti, Dima) and streams (Kalikhola, Hatinala, Turturi) flow through the reserve. They frequently change their courses. These damages wildlife habitat. Bank protection measures are taken at few places

Rescue centre : There is a rescue centre at Rajabhatkhawa. It is been maintained by research range. It is maintained well. Veterinary officer takes care of the centre.

MAHANANDA-NEORA VALLEY NETWORK

This includes to Neora Valley N.P (88 sq.km), Gorumara (79.45 sq.km), Chapramari (9.6 sq.km) and Mahanada (127.2 sq.km). WL.S interspersed with high human population, and tea gardens. The elephant depredation problems of this region are also so severe that long term survival prospects of the West Duars population of elephants is seriously in question. Yet this wild life values, particularly the unique ecosystem of Neora Valley are so important that a way out of the impasse need to be sought. Successful resolution will depend heavily on fringe area eco-development and addressing the problems faced by villagers and settlers.

SINGALILA NATIONAL PARK :

This is high altitude protected area (78 sq.km) which is not only important for the faunal diversity, but the unique floral diversity particularly indigenous orchids, rhododendrons need the protection and preservation of the area as genepool.

Apart from major protected areas mentioned above, there are other smaller protected areas and number of wet lands scattered in different parts of the study area where preservation of smaller animals like migrating birds and other is extremely necessary. With this objective further management plans are prepared and under preparation for the areas mentioned such as (1) Senchal WL.S. and (2) Jorepokhri WL.S.

In addition to the above national parks and wild life sanctuaries, there are two important wetland in the Jalpaiguri district which are the ideal house for the preservation of smaller animals such as fish eating crocodile or the gharial and the migrating birds like Black necked crane, Black stork etc. Wetland reserve of Jalpaiguri district is given in table 5.3

Table 5.3
Wetland reserve in Jalpaiguri district

District	Name of the wetland	Name of the village/town	Area (in ha)	Ecological category
Jalpaiguri	Jalua para	Madarihat	196.00	Fresh water
Jalpaiguri	Kathambari Beel	Odlabari	136.00	Fresh water

Source :- Forest Department,Government of West Bengal, 1990.

5.2.2. Number and growth of wild animals :

A list is prepared showing total number of some important large animals in the study area is given in table 5.4

Table 5.4

Number of some large animals

Sl. No.	Name of Animals	Number
1.	Tiger (Tiger Census 1997-1998)	57 (B.T.R -32 Jaldapara - 13 Mahananda WL.S - 12)
2.	Elephant (Elephant Census -2000)	292
3.	Rhinoceros	66 (Jaldapara - 48 Gorumara - 18)
4.	Leopard	150
5.	Indian Bison(Gaur)	540 (Mahananda - 120 Gorumara - 65 Jaldapara - 95 Chapramari - 15 Buxa - 245)
6.	Bear	10
7.	Deer	700 (Hog 500, Barking 200)
8.	Red panda	46

Source - State Forestry Action Plan 1996-2015 and Wild Life Division I& II, Forest Department, Darjeeling and Jalpaiguri districts

The number of some important animals of the area have been increased over the last few years. This is the result of proper planning and good management of wild life by the forest department of the study area. The state government has taken several measures to increase

the number of wild life in the districts of Darjeeling and Jalpaiguri. A comparative growth analysis of some important animals is presented in table 5.5

Table 5.5

Comparative growth analysis of some large animals in the districts

Name of the Animals	Year	No.	Year	No.	Increase in number	Period
Bengal tiger	1993	40	1998	57	17	6 years
Rhinoceros	1996	58	1998	66	8	3 years
Indian Bison (Gaur)	1996	450	1998	540	90	3 years
Elephant	1996	250	2000	292	42	5 years

Source :- Paschim Banga, Government Bulletin July 1998, Govt.of W.B. and Wild Life Division I & II, Forest Department, Darjeeling and Jalpaiguri.

5.3 ECO - TOURISM

The sub - Himalayan North Bengal is associated with three T's - **Tea, Timber and Tourism.** Tourism occupies a pivotal place in the economic life of the area. Tourism, apart from tea, is the only important industry in the district. Eco-tourism is a part of general tourism. Eco- tourism concept is recently developed by the forest department of the study area. Eco- tourism in the area can be developed without disturbing the natural forest. Forest department can earn more revenue through the establishment of eco-tourism spots which can also provide a large number of employment to the local people.

The study area is a place where various types of natural beauties are existed. Tourism industry can be flourished with the proper exploitation of these natural beauties of the study area. The forest department has taken active role for the development of eco - tourism in the area with the underlying objective of the following :-

- To develop awareness for conservation of bio-diversity and including a spirit of adventure amongst the young generation in particular.
- To develop a good relation and interdependence between the man and nature.
- To flourish the tourism industry in the study area through the exploitation of local natural resources.
- To help develop awareness for conservation of forest through eco-tourism
- To make the study area economically advanced through the establishment of eco-tourism.
- To generate rural employment through forestry and related activities.

The basic components of the eco-tourism industry in the districts are shown on the following figure 5.2

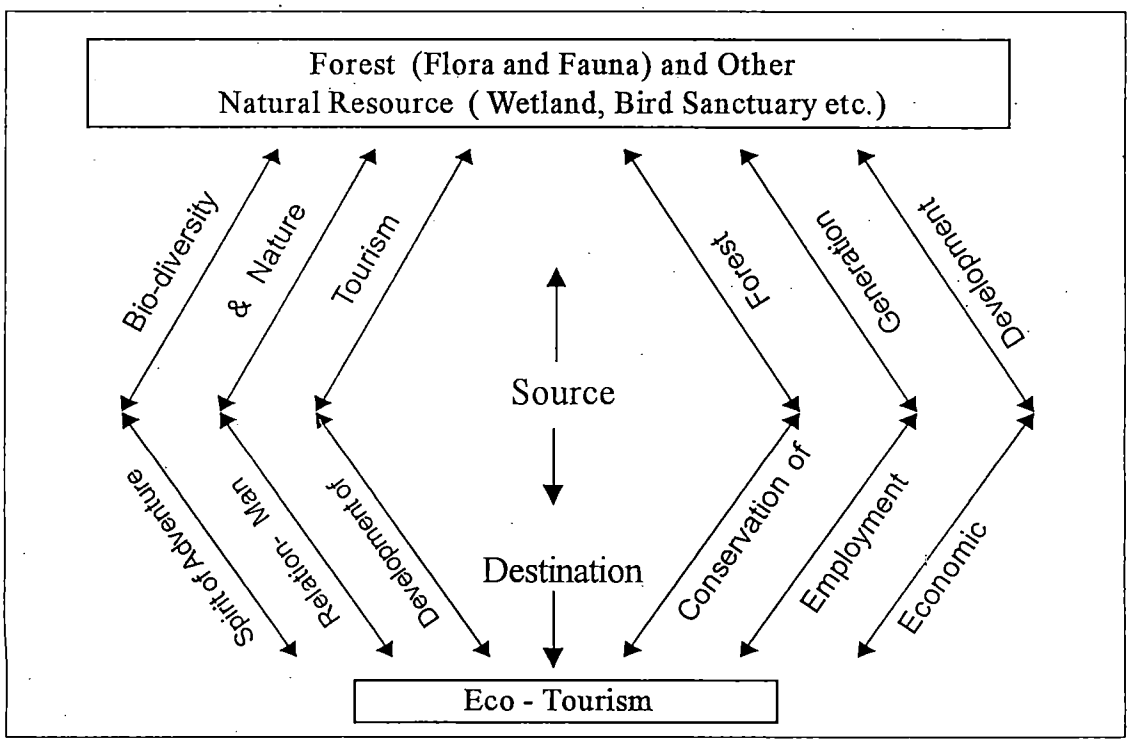

Fig. 5.2 - Basic components of eco-tourism in the area.

5.3.1. Some important eco - tourism spots

There are several eco - tourism spots in the districts. Most of the spots are managed by the forest department. These spots are classified into four categories.

- Tiger Reserve
- National Park and Wild Llife Sanctuary
- Nature Interpretation Centre and
- Other which includes forest museum, zoo, picnic spots etc.

5.3.1.1 BUXA TIGER RESERVE

Buxa Tiger Reserve was set up in the year 1982-83 at the north eastern corner of West Bengal bordering Bhutan and Assam. The area of the reserve encompasses 759.26 sq.km. having a core area of 331.60 sq.km. which hosts a sanctuary over 314 sq.km. Out of which 117.10 sq.km. of pristine forests has been declared as National park in January 1992. Wilderness of Buxa Tiger Reserve reveals to be the largest dense chunk of remaining forest in West Bengal. The veritable flora and fauna of these wet forests attract more than 20,000 tourist and nature lovers every year. The special attraction of the area is Buxaduar Historical Fort which was used for the detenues during freedom movement of India as a most regorous prison next to Andaman Celluler Jail. The dolomite caves locally called "Mahakal" attracts numerous tourists and pilgrims with it's beauteous "Stalactites" and "Stalagmites". There are three watch towers with guided tourism facilities.

Other places of tourist attraction in the B.T.R. area which include - (1) Jainti, (2) Bhutanghat, (3) Buxaduar, (4) Raimatang, (5) Rydak, (6) Barobisha near Sankosh, (7) Rajabhatkhawa, (8) Nimati and (9) Bhutan ghat.

5.3.1.2 NATIONAL PARKS AND WILD LIFE SANCTUARIES

There are four national parks (including B.T.R) and five wildlife sanctuaries in the study area. These NPs and WL.S play an important role in promoting the eco -tourism industry in the area (Photo 5.5&5.6). The sub-Himalayan North Bengal is a source of natural beauty. It attracts the nature lovers from the different parts of the country and abroad. The

Photo . 5.5 Tourists at Jaldapara WL .S.

Photo 5.6 Eco-tourism spot at Gorumara N.P.

infrastructures of tourism industry in the study are existed. With the proper management and planning, these natural resource can easily be utilised for the economic development of the area. Construction of tourist lodge, forest rest house, and observation point or watch tower are the various steps which are taken by the forest department for the promotion of eco-tourism in the Darjeeling and Jalpaiguri district (Photo 5.7). The forest department has prepared the wild life management programme to achieve the following objectives :-

- To preserve and protect the existing stock of wild animals, particularly the one horned Rhinoceros, Bengal Tiger etc.
- To create congenial habitat condition so as to enable the rhinoceros and other animal to multiply.
- To provide recreational facilities to the public and promote tourism as far a possible.

A brief description of some important NPs and Wild Life Sanctuaries along with main species of wild life for tourist attraction is given in table- 5.6

Table - 5.6

Some important national parks and wild life sanctuaries in the study area for the promotion of eco-tourism.

Name of NP and W.L.S.	Location (District)	Area in Sq. Km.	Main faunas of tourist attraction	Best time for visit
Gorumara (N.P.)	Jalpaiguri	79.45	One horned Rhinoceros, Elephant, Tiger, Bison, Sambhar, Barking & Hog deer, Buffalo, Leopard, Gaur, Chital etc.	April, May, October & November
Jaldapara	Jalpaiguri	216.00	Indian Elephant, Rhinoceros, Deer, Indian wild boar etc.	December to May,
Chapramari (WL.S)	Jalpaiguri	9.60	Rhinoceros, Elephant, Tiger, Bison, Buffalo, Pig Barking & Hogdeer, Fowl etc.	February
Mahananda (WL.S)	Darjeeling	127.00	Tiger, Elephant, Bison, Deer, (Barking, Hog, Sambhar & Chital) Pig etc.	November to April
Senchal (WL.S)	Darjeeling	38.00	Serpw, Bear(Himalayan) Barking Deer, Goral etc.	April, May & October

Source :- Centenary Commemoration Volume (1964) and State Forestry Action Plan 1996-2015.

Photo 5.7 Watch tower at Kunjaban

Photo 5.8 N.I.C. at Lataguri

5.3.1.3. Nature Interpretation Centre (N.I.C)

Various nature interpretation centre are created near the NPs and WL.S in the study area to promote eco - tourism industry. NIC is an important step which is taken by the forest department with the underlying objectives of the following :-

- To create a interlink between man and nature.
- To create awarness about the ecological balance for the existence of human life.
- To create forest museum through which people can get the different information about the wild life of the study area.
- To create a spirit of adventure amongst the nature lovers.

At present, there are seven NICs in the study area which are created by the forest department of Darjeeling and Jalpaiguri district. A brief picture about these NICs are presented below:-

Madarihat

This centre is established on the way of Jaldapara Wildlife Sanctuary at Madarihat. Jaldapara Wildlife Sanctuary is famous for one horned Rhinoceros. Description of wildlife habitat and the different floras are exhibited in this centre.

Lataguri

It is also established on the way of Gorumara National Park. Various information about this national park are disclosed in this centre. Gorumara national park is a place where different types of floras and faunas are existed. These are presented in this centre in a systematic manner. It attracts huge number of nature lover every year (Photo 5.8).

Rajabhatkhawa

Rajabhatkhawa is a main spot of Buxa Tiger Reserve. It is 18 km far from the Alipurduar sub- division of Jalpaiguri district. The varitable flora and fauna of B.T.R. attracts many

nature lover every year. This part of the country is characterised by it's high degree of plant and animal bio-diversity where 60% species are endemic to the area. The generic diversity of mammals is second among all the tiger reserve in India, first being Namdhapa Tiger Reserve of Arunachal Pradesh. All these information are disclosed in this centre. There is a nature's trell in front of this centre. So visitors can get the feeling of natural forest.

Lava and Lulegaon

This centre is established at the high altitude of 7000 feet of Neora Valley National Park. Wonderful varieties of tree species of upper hill forest are the main attraction of this centre. Neora Valley National Park is the main house of Himalayan Red Panda which is also the attraction of nature lovers. The W.B.F.D.C. has developed adventure eco-tourism resorts at Lava and Lulegaon.

Sukna

It is located in the Mahananda Wildlife Sanctuary. The distinctive features of Mahananda WLS., are shown in this centre scientifically. There is a forest museum on NTFPs.

Darjeeling

The natural features of Senchal Wildlife Sanctuary are exhibited in this centre. Himalayan Black bear , Wild pig, Barking deer etc. are the important faunas of senchal WLS. A forest museum is also operating which attract many tourists every year.

Murti

This centre is establised very recently with the active role of West Bengal Forest Development Corporation. It is also a adventure eco- tourism resort which is named by **"Banani"**. Banani is a part of Gorumara National Park. There is a beautiful river Murti near the resort. Banani may be the new address to the nature lover tourists (Photo 5.9).

In addition to the above National Parks, Wildlife Sanctuaries and Nature Interpretation Centres, the forest department has reserved some forest lands as picnic spots through which a good amount of revenue is collected by the forest department every year. This is also a new coponent of eco - tourism in the study area. Forest Department provides large number of direct and indirect employment to the rural people in this sector. The important picnic spots include Mongpong, Kunjabehar, Sukna, Murti, Jaldhaka , Samsing and Bhutanghat (Photo 5.10).

A sample survey (Table 5.7) has also been conducted by the investigator from he nature lover tourists at the different eco-tourism spots of the study area through questionnaire.

Photo 5.9 N.I.C. at Murti

Photo 5.10 Picnic Party at the Mong Pong forest

This study has highlighted the different aspects of eco-tourism. Various responses have come out from the tourists. Most of the tourist have suggested that a proper infrastructural development is immediately needed for the expansion of this new chapter of tourism. Besides organisation and management from the side of forest department should be more active.

Table - 5.7

Sample survey report on eco-tourism in the study area (2000-2001) in percent

1.	Type of nature lover tourist	Within the state	Out side the state	Out side the country	Total
		62%	25%	13%	100%
2.	Purpose of visits	Refresh-ment	Curiosity & culture	Health & other	
		54%	36%	10%	100%
3.	Preference of eco-tourism area to visit	Hilly Region	Foot hills & plains		
		68%	32%		100%
4.	Best eco-tourism spot	Hill area	Plain area		
		68%	32%		100%
5.	Transportation, management & organisation	Highly satisfied	satisfied		
		48%	52%		100%
6.	Growth of awarness of man & nature relation after visit the area	Very high	High	moderate	
		53%	27%	20%	100%
7.	More infrastruc-tural development	Required	Not required		
		93%	7%		100%
8.	Plan for next visit & motivating others	Very high	High	Low	
		52%	36%	12%	100%

5.4. Forest As Ecological Resource

Forest affect the environment substantially. The beneficial effect of forests on human environment arise out of moderating the climate, maintaining the soil mantle, regulating the rains and water supplies, purifying the air and helping in noise abatement. In view of the fact that forests are a vital element of environment and there are intricate mutual interactions between forests and environment, their planning and management have of necessity to reflect the concern for maintaining and improving the quality of the environment.

There is a growing awarness of the role of forests of the area in vital ecological functions. Unfortunately, deforestation and poor land use practices in the study area are undermining these support services at a rapid rate. Ecological cost of deforestation depends on a number of factors, including topography, rainfall patterns, soil characteristics, geological conditions and land use. In general, forests help anchor soils; thus the loss of tree cover especially from steep sloping hillsides of Darjeeling Himalaya lead to accelerated soil erosion (Sarkar, 1987). Besides diminishing upland productivity, such erosion transfers sediment to river channels, which aggravates local flooding and contribute to the premature silting of reservoirs down stream. The ecological effects of forests of the area is shown on the figures 5.3 and discussed in the following sections.

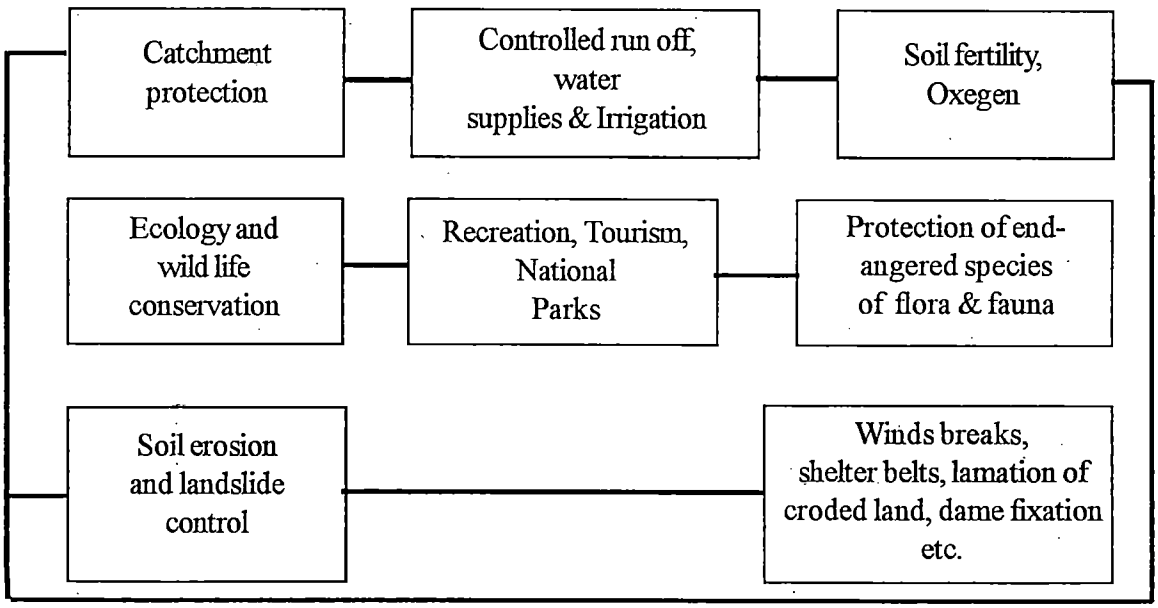

Figure - 5.3 - Impact of forests on local ecology.

5.4.1 Landslide

Landslide is the most pervasive of natural problems that undermine the economic and cultural development of hilly tract of Darjeeling district. Records since 1849, show a sharp acceleration in the rate of divasting slide occurrences along with innumerable lesser slips leading to the loss of life and heavy damage to land and property. The situation has deteriorated further in recent years, the last two decades having witnessed the worst landslides on hill slopes and heaviest floods in the plains. During the last 100 years, over 1000 slides were registered covering an area of over 1000 hectares. More than 1000 lives were lost in addition to the loss of property and environment and hindered the overall economic development of the hill areas.There are several reasons for landslides in the hilly tracts of the study area. Darjeeling Himalaya is prone to landslides because of their young, weak and unstable geological formation. Extensive heedless deforestation is one of the important reasons of landslide in the hilly tracts. The situation had not been so desperate a hundred and fifty years ago, when the hills were densely forested.

Various work on the landslide of hilly tracts of Darjeeling district were done and the landslide prone areas were also identified (Basu and Sarkar, 1987, Dutta 1966, Sarkar,2000). Basic information on landslide have been collected from different secondary records. The investigator has identified some degraded forest tracks which are landslide prone areas. Some landslide prone areas and the rate of degradation of forest in the respective areas are given in table 5.8

The occurrences of landslides are found much less in densely forested tracts in the study areas. The virgin forest which are practically landslide free zones. Eastern part of the river Mahananda, Rangtong Khola, Manjha Jhora, Marma Khola, Siva Khola Catchment and the riverine tracts of the lower Balason river are practically landslide free area. These tracts are still under mostly natural forest cover of different species. Mahahaldiram range, Latpanchar and Cinchona areas are now under dense vegetative mostly by Cryptomeria Japonica, Cinchona etc. Such large scale plantation although have detrimental effects on bio - diversity but also have much beneficial impact on landscape and sediment-water management. It reduces soil erosion, recharges ground water aquifers and thereby, has positive impact on regional environment.

Table - 5.8

Landslide prone areas and the rate of Degradation of forest.

Sl. No.	Landslide prone areas	Forest range	* Degradation rate.
1.	Paglajhora	Kurseong	55%
2.	Sukiapokhri	Ghoom Simana	40%
3.	Tindharia-Mahanadi	Kurseong	60%
4.	Pesok	Teesta valley	35%
5.	Chunabhati	Chel	60%
6.	Sonada	Sinchal	45%

*Estimation was made based on old map and satellite image of 2001

5.4.1.1. Afforestation and Landslide

The study area with a high potential for landslide hazard was recognised by examining geological set up, processes of slopes evolution, precipitation, soil, deforestation, and hydro-geomorphological history. Prevention of such hazard could prove nearly impossible, however, good land-use practice can do much to minimize the hazard. Afforestation is an important remedial measure for a long term control against check wall collapse and soil movement. Afforestation with soil binding grasses and fast growing species may be planted all along the affected area. Slope movements generally disturbs vegetation including grass cover. Afforestation of the disturbed slopes is an important part of any corrective treatment and it should be carried out during the latter stages of the work, invariably after at least some degree of stabilisation of the slip has been achieved. The plantation should be proceeded by drainage along with the filling up of cracks of the affected area. Contour walling is an effective method of stabilising slip area. It should be followed by planting of grasses like *Arundo donax* and *Saceharum species*, shurbs like *Viburnum* species *Vitex negundo*. *Thy-samolaena maxima* and tree species like *Erythrina suberosa*, *Alnus nepalensis*, *Macaranga* species and locally available bamboos.

During the year 1998, 225 ha. of landslide affected area has taken for plantation which was totally funded by the West Bengal Forest Development Corporation Limited. The details regarding the plantation working circle wise is given in table 5.9

Table - 5.9

Afforestation in landslide affected areas - 1998

Working Circle	Range	Beat	Block/Comptt.	Area	Total
Eco-Dev. & Eco-Tourism W.C.	Tista Valley	Gelf	Riang-2	2.0 ha.	
	- do -		Riang-2	3.0 ha.	
	- do -	Peshok	Mangwa-3	5.0 ha.	
	Badamtam	Badamtam	Badamtam-2	7.0 ha.	
	- do -	Sombang	Sombang-3	3.0 ha.	
				Total	20.0 ha
Bio-Diversity & Wildlife Conservation & Preservation W.C.	Dhodrey	Dilpa	S.Rimbick-5	5.0 ha.	
	- do -	Selimbong	Selimbong-1	7.0 ha.	
	- do -	- do -	Selimbong Extn.	3.0 ha.	
	Rimbick	Raman	Raman-4	5.0 ha.	
	Tonghu	Relling	Relling-1	5.2 ha.	
	- do -	Manebhanjang	MBJ	4.8 ha.	
				Total	30.0 ha
Conifer & Misc. Dev. W.C.	Takdah	Gelf	Riang-2	2.0 ha.	
	Darjeeling		Riang-2	3.0 ha.	
	- do -	Peshok	Mangwa-3	5.0 ha.	
	Ghoomsimana	Pokhriabong	Pokhriabong-3	10.0 ha.	
	- do -	- do -	Pokhriabong-4	10.0 ha.	
	- do -	- do -	Pokhriabong-5	13.5 ha.	
	- do -	- do -	Pokhriabong-6	8.5 ha.	
	- do -	Rongbong	Rongbong-5	2.0 ha.	
	- do -	- do -	Jorepokhari-4	1.0 ha.	
	- do -	Lepchajagat	Tomsong-3	22.0 ha.	
	- do -	Sukhia	Pulungdung	5.0 ha.	
				Total	92.0 ha
Broad Leaved Endemic species DEv. W.C.	Darjeeling	G. Bhanjang	Bhanjang-1	5.0 ha.	
	- do -	- do -	Bhanjang-2	17.5 ha.	
	- do -	- do -	Bhanjang-3	18.0 ha.	
	- do -	- do -	Bhanjang-5	1.5 ha.	
	- do -	Chataidhura	Poonam-4	23.0 ha.	
	Ghoomsimana	Lepchajagat	Guasedara-2	23.0 ha.	
				Total	83.0 ha
				Grand Total -	**225.0 ha.**

Source - Annual Report 1998-99, Darjeeling Forest Division

5.4.2. Flood

Generally, the river maintains it's courses in the nature, adapting itself with changes in terrain characteristics and runoff conditions. But human interference in many forms affect the natural balance and cause decline in the channel capacity. The channel capacity is deteriorated due to intense erosion in the catchment areas, whereas the erosion in most cases is related to faulty land use, primarily the destruction of forest. Deforestation in the upper catchment affects the runoff with silt load, whereas the silts deposited in the channel raise the river bed. Apart from causing severe shortage of several basic necessities of life, deforstation has also aggravated the damage from natural disasters, specially land slide and flood. The contribution of deforestation to flood and landslides is complementary. Deforestation affects landslides directly and landslides affects the flood indirectly. The study area receives very high rainfall (> 3000 mm.) compared to other parts of West Bengal. The heavy rainfall in the northern hilly tracts induces soil erosion and landslide, which in turn block the channels of the streams. With sudden release of the blockade the streams burst in flash floods over the foot hills, i.e. in *terai* and *duars* region (Sarkar, 2000). The severe flood of Tista in the year 1968 was caused due to heavy rainfall resulting in heavy landslides in the upper catchment.

The Mahananda originating from Mahaldiram range at an altitude of 2060 m. receives nearly 3000 mm. rainfall in it's upper catchment in Darjeeling Himalayas. The catchment area, specially the eastern part of the river Mahananda (Mahanadi local name) is still under dense forest cover and perhaps prevents the occurrences of major flood in the Terai foot hills.

On the contrary, occurrences of floods are found more frequent in degraded forest areas. Field observations along with secondary sources of information revealed that severe flood has taken place in many such areas during the last few years. A brief picture on flood affected areas with the rate of degradation and name of the rivers is given in table 5.10

Table - 5.10

Flood affected areas of Jalpaiguri district and the rate of degradation of forest.

Sl. no.	Affected areas	Forest range	*Degradation rate	Name of the river
1.	Salkumar	Jaldapara	40% of total area	Torsa
2.	Hasimara	Jaldapara	50% of total area	Kaljani
3.	Morakhata Nirafuli, South Raydak	Raydak	45% of total area.	Raidak
4.	Rangamati	Pana	35% of total area.	Pana
5.	Kumargram, Newlands, Rajabhatkhawa	Rajabhat--khawa	30% of total area.	Sankosh, Raidak-1 & Raidak-2
6.	Oodlabari, Chengmari Hashkhali	Apalchand	40%of total area.	Chel, Kumlai.

*Estimation was made based on old map and satellite image of 2001

5.4.3 Ground water

Forest have significant bearing upon the increment of ground water. The ground water of any region is very important specially its utilisation in irrigating crops and for drinking water and other uses. Ground water has a significant role in the successful operation of agriculture of this region (Sur-2000). Rainfall in the study area follows the typical monsoon pattern. It occurs mostly during four months from mid-May to mid-September with its all uncertainty in amount and distribution. As a result, flood and drought conditions prevails

with water shortage even in those areas receiving good amount of rainfall. On the whole, irrigation becomes necessary in the agricultural field particularly in the dry season.

The degradation of forest is the single most important reason for the shortage of ground water in the hilly region of the study area (Yadav & Ram, 1993). This is demonstrated by the drying up of innumerable 'Jhoras' in the Darjeeling hills by the close of the last century. The case is just reverse in the foot hills, where moderately dense forest cover reduces runoff and make some water available to form a good ground water reserve. The most of the river basins of the study area are still under partial forest cover with variety of species. Water resource of the major river basins of Darjeeling and Jalpaiguri district is shown in following table 5.11

Table 5.11

Availability of water in different river basins of Darjeeling & Jalpaiguri district

Sl No.	Name of the river basins	Area in '000 ha.	Surface water	Ground water in MCM / ha.	Total
1.	Sonkosh	11.5	118.7	3.6	122.3
2.	Raydak	70.0	95.2	3.5	98.7
3.	Torsa	223.2	53.4	5.8	59.2
4.	Jaldhaka	313.2	40.4	2.6	43.1
5.	Tista	152.5	210.6	2.0	213.5
6.	Mahananda	747.6	17.8	1.9	19.7

Source - Water management in West Bengal : S.C. Chakraborty, IIM (Wps - 159(91), may 1991.

The depletion of the broad-leafed trees such as Oak of the Darjeeling Himalayas, which conserve rain water and then release it gradually throughout the year in the form of springs

have considerably reduced these natural sources of water which have met the villagers' needs for hundreds of years. In most of the villages of the northern hilly tracts, during the dry season, the women can not sleep restfully due to their anxiety to reach the springs early enough to collect the few drops that trickle in. The overall situation of the hill areas is thus, becoming bleaker day by day as a result of extensive degradation of forest land.

5.4.4 Soil erosion

Soil erosion is one of the destructive process which reduce the production potential of land. Upper soils generally bears most of the nutrients and good structure for vegetation growth and materials eroded from the upper part of soil profile have detrimental effect on crop yield and vegetation growth. The northern hilly tract of Darjeeling district was a true nature's domain till the British occupation. This hilly tract was covered with dense natural forest and had no major soil erosion problem. The hapazard cutting of forest trees of the hilly region to create land for tea plantation, cultivation, settlement and road construction reduces tramspiration and water infiltration. This headless deforestation of the northern hilly tract invites drying up of Jhoras, and accelerated soil erosion.

Some works on soil erosion have so far been done in the study area (Sarkar, 1987, 1989,) Different information on soil erosion have been collected from various secondary sources. Accordingly, the investigator has identified a soil erosion affected area which is one of the important contribution of extensive deforestation. The upper Mahananda basin of Kurseong sub division of Darjeeling district has taken into consideration (Table 5.12). Since the land-use types and patterns, ultimately depend on the complex phusuco- biological processes and it reflect, the human level of interference in the natural eco-systems. The Survey of India and the Forest maps have been mainly used to evaluate the land-use factors, along with an intensive field checking. A biological erosivity (C.P) map has been prepared (Fig 5.4) from the available C.P values which also include C and P co-efficient of the USLE (Sarkar. 1987).

Table 5.12

Rating table for the parametric values of C.P. factor.

Sl. No.	Major land-use types	Percentage coverage	Rating value
1.	Virgin forest with a thick vegetal matter on the surface	100%	< 0.000.5
2.	Natural vegetative cover i.e. forest bush, permanent pasture land	100%	0.001-0.0005
3.	Natural vegetative cover i.e. forest bush, permanent pasture land	50-100%	0.05-0.001
4.	Tea garden	100%	0.05
5.	Degraded forests, rough grazing perennial cover.	> 30%	0.05-0.5
6.	Degraded or semi-degraded Tea garden	50%	0.1
7.	Raw Crops, intertilled crops	< 30%	0.5-0.8
8.	Terraced cultivated field	20-50%	0.5-0.8
9.	Root crops; such as ginger, potato, cardamom etc.	50%	0.9-1.0
10.	Bare soil, cultivated fallow cover	0	1.0

Source -Geographical Review of India 1987, PP 47 - 56

It has been found from the map, that the C.P co-efficient is directly dependent on the existing land -use pattern. The highest C.P has been found in the two distinct zones of the

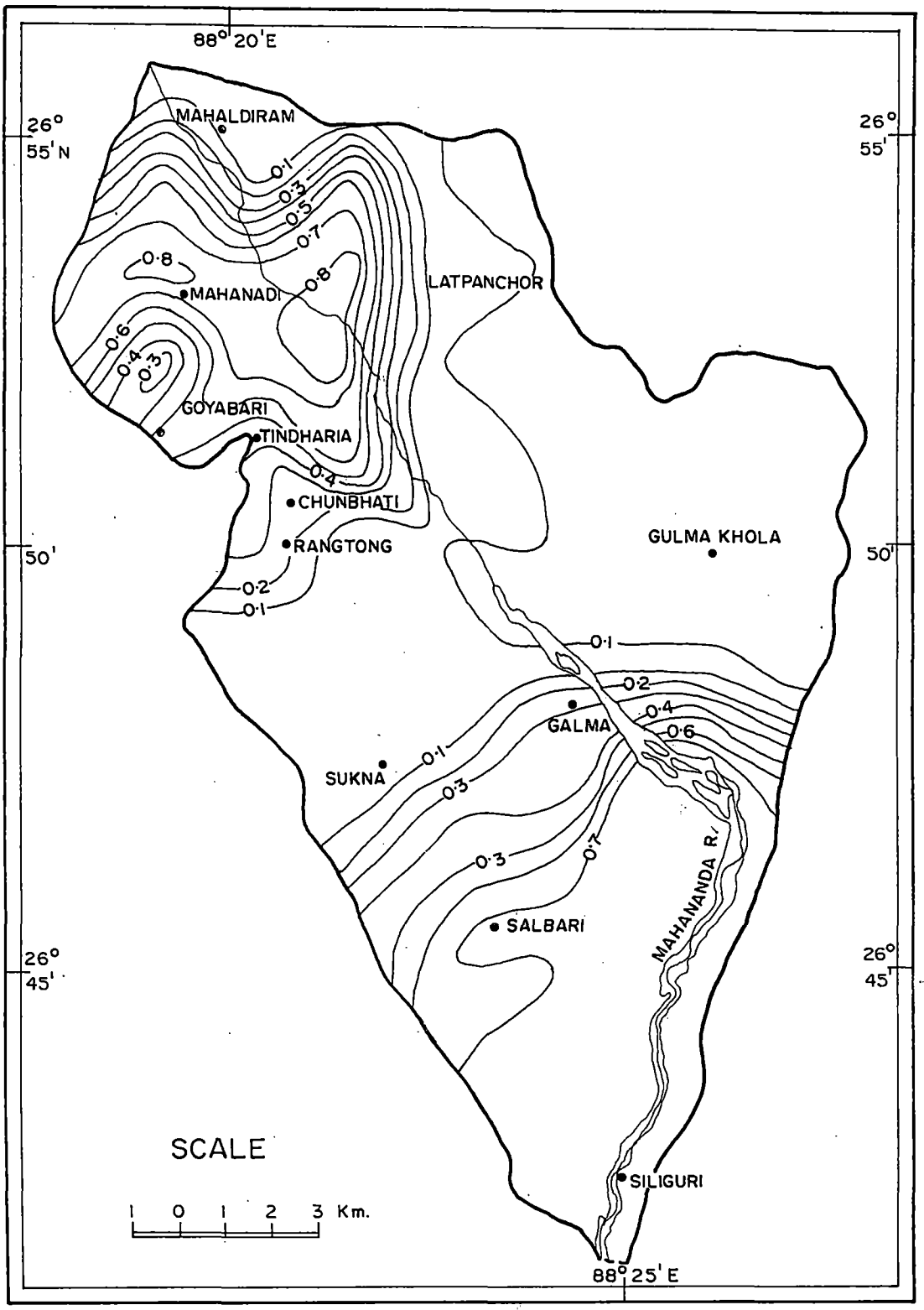

Fig. 5·4 Based on S. Sarkar, 1987

upper Mahananda basin; (i) in the hilly north -western and north-central parts, where the C.P varies from 0.5 to 0.82, due to extensive human interference i.e, heedless deforestation for the construction of tea garden, unscientific terrac cultivation especially, root crops like ginger, (ii) the southern part of the basin also possesses a high C.P (0.5 to 0.7) due to the complete destruction of the natural eco-systems for plantations and other agricultural activities. A low to insignificant C.P has been noticed over the north- eastern part (< 0.001), due to hundred percent natural protective cover. This tract till today is far from any significant human interference and is a true nature's domain, with a forest floor of vegetal matter, sometimes thickness of upto 50 cm. A low C.P (< 0.1) has been found in the north, central and west -central parts of the basin, due to a moderately dense vegetative cover.

5.5. CONCLUSION

The study area possess a large variety of fauna from the largest Elephant *(Elephas maximus)* to the smallest Hogbadger. The high altitude of the Darjeeling Himalayas is the house of Red Panda *(Alurus fulgins)*. Apart from this the Royal Bengal Tiger (*Panthera tigris)* and one horned Rhinoceros *(Rinoceros unicornis)* are the important fauna of the study area. The growth rate of these fauna is very low. Tourists should not be allowed in the reserve forests through out the year. The natural habitation of fauna may be affected by the movement of tourists. Dolomite mining activities in the Jayanti hill (B.T.R) is also found to be responsible for the destruction of under growth rich bio-diversity of this area. This also exerts detrimental effect on the wild life of these region. Shifting of river courses like Jayanti has also destroyed rich bio-diversity of this region. It also affects the animal migration. Moreover calcium richness in the fodder and drinking water may cause health hazard to the wild life. The state government as well as the forest department should take necessary steps to improve the wild life condition in the natural forests which maintain balanced ecological stability in the area.

The area is highly developed in tea industry. Apart from tea, timber and tourism occupies a pivotal place in the economic life of this region. Eco-tourism is a part of tourism which can be developed in the districts by the proper utilisation of natural resources including forests. There are various eco-tourism spots in the area which attract more than 40,000

nature lover tourists every year. This industry also offers a large number of employment in the study area. The area has the great scope for the development of eco-tourism industry which will not disturb the local eco-systems. It is revealed from the sample survey that infrastructural development is needed for the development of eco-tourism in the area.

Extensive deforestation invites landslides, soil erosion and flood which are the main natural disasters in the area and which also paralyse the economic development of the districts. Large scale afforestation programme at the government level and private level is needed to check such natural events. Afforestation programme should not concentrate on only the first growing and economically important species. Afforestation also be ecologically viable. Plantation of species like Dhupi and Eucalyptus which affects soil conditions and water resource, should be restricted. People of the area should be motivated about the ill effect of deforestation. Various programs are being started in the study area for large scale afforestation which may bring a good environmental balance in the region. We must keep in mind the slogan **"Plant a tree and save a life"**.

REFERENCES

Annual Reports,(1996 - 2000) : Forest Department, Darjeeling and Jalpaiguri district.

Basu, S.R. & Sarkar, S (1987) : Some consideration on recent landslides at Tindharia, and their control, Indian Journal of Power River Valley Development. 187-194 P.

Bhutia, Pop Tshering (1999) : Environmental Degradation : Problems and Prospects - A Study in Kurseong sub-division of Darjeeling Himalaya. Unpublished Ph.D. Thesis. University of North Bengal.

Chandra Sarkar, M.A. (1971) : Sudden floods in Himalayan rivers - causes and effect in process. Seminar on landslide and toe erosion problem with the particular reference to Himalayan region, Gangtok, PP 147 -164.

Chakrabarty,S.C (1991) : Water Management in West Bengal, working paper series 155(91), I.I.M Calcutta.

Dutta, K.K. (1966) : Landslides in Darjeeling and neighboring hill slopes in June, 1950. Bulletin GSI series B 15(1), PP. 7-30

Iyar, S. Mani (2001) : New perspective for wild life conservation. Yojona, Vol. 45, February -2001.

Sarkar, S.(2000) : Recent flood in sub- Himalayan North Bengal - causes and remedial measures- Bipanna Paribesh PP. 288-293

Sarkar, S (2000) : Landslide in Darjeeling Himalaya - Bipanna Paribesh PP. 266-278.

Sarkar, S (1987) : Soil loss in the upper Mahannda basin in Darjeeling Himalaya, Geographical Review of India 49(2) : 47-56.

Sarkar. S.(1989) : Some consideration on soil erosion hazard in Darjeeling district (West of river Tista), W.B. Geographical Thought 45-54.

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

State Forestry Action Plan(1996-2015) : Forest Department, Govt. of West Bengal.

Sur, S.K. (2000) : Ground water resource of West Bengal, Geographical Thought, North Bengal University.PP 41 - 54.

Yadav, Y.P. and Ram, N (1993) : Water crisis in Darjeeling Hills - A case study, Bhagirath 40(1), 1993.