FOREST RESOURCE : IT'S PROBLEMS AND PROSPECTS A STUDY OF DARJEELING AND JALPAIGURI DISTRICT, WEST BENGAL

A Ph. D. Thesis

Submitted by

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PREFACE

Every country is blessed with many natural resource that human labour and intellect can exploit for it's own benefits. Of all natural resource "Forest" is said to be one that is almost renewable. Being most important renewable resource, the forests, as green gold, are performing a number of functions including ecological, recreational and economic. Forests in the sub-Himalayan North Bengal (Jalpaiguri and Darjeeling district*) are the source of many kinds of timber with varied technical properties, which serve the requirements of the building, industry and communication as well as an expanding range of industries in which wood forms the principal raw material. Forests in the study area are also the source of fire wood. This apart, forests perform a vital function in protecting the soil on sloping lands from accelerated erosion by water. In the catchment areas of rivers of the districts, they serve to moderate floods and maintain stream flow. They influence the local climate and shelter wild life.

Forests play a pivotal role in the overall development of the study area. This is, therefore, why forests have been given due attention for the development of this region. Several forestry programme have been drawn by the state government in the area on systematic basis, consistent with the local requirements. The main objective of the forestry programme in the Darjeeling and Jalpaiguri district is to meet the economic demands of the forest products and maintain and improve the quality of the environment as well as provide substantial employment, particularly to the rural weaker section of the society. Thus the forests in the sub-Himalayan North Bengal are **productive, protective and aesthetic**.

In the present study attempt has been made to investigate the distribution of forest and their valuable species composition, industries based on forest products, marketing network of forest products, forest as aesthetic resource, several conservation measures and present and future potential of forest resource in the study area. This study has also attempted to identify various problems which are related with the forest resource. Some preventive and remedial measures have been offered by the investigator with the hope that they may be given some consideration by the appropriate authority to boost up the local economy through the proper utilisation and exploitation of forest resource of the study area.

* Spelling of Darjeeling has recently been changed as "Darjiling". The revised spelling is used only in maps in the thesis.

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ABBREVIATIONS

AIR	:	All India Radio
BTR	:	Buxa Tiger Reserve
^{0}C	:	Degree celsius
CF	:	Conservator of Forest
CFT	:	Cubic Feet
Cm.	:	Centimeter
CO.	:	Company
COBSF	:	Cooch Behar Social Forestry
CSIR	:	Centre of Science and Industrial Research
Cu.m	:	Cubic meter
DD	:	Door Darshan
DFO	:	Divisional Forest Officer
DGHC	:	Darjeeling Gorkha Hill Council
DL & LRO	:	District Land & Land Reform Office
E	:	East
EDC	:	Eco Development Committee
FAO	:	Food and Agriculture Organisation
FPC	:	Forest Protection Committee
FRI	:	Forest Research Institute
FSI	:	Forest Survey of India
GIS	:	Geographical Information System
GOI	:	Government of India
Govt.	:	Government
GOWB	:	Government of West Bengal
GP	:	Gram Panchayat
GSI	:	Geological Survey of India
Ha	:	Hectares
JFM	:	Joint Forest Management
JRY	:	Jahar Rojgar Yojona
Kg.	:	Kilogram
Km.	:	Kilometer
LT	:	Lataguri
Lt.	:	Liter
Ltd.	:	Limited
m	:	Meter
MCM	:	Million Cubic Metre
MFP	:	Minor Forest Produce

Misc.	:	Miscellaneous
mm	:	Milimeter
MT	:	Metric Ton
NESPON	:	North Eastern Society for Preservation of Nature
NGO	:	Non-Government Organisation
NH	:	National Highway
NIC	:	Nature Interpretation Centre
NP	:	National Park
NREP	:	National Rural Employment Programme
NTFP	:	Non-Timber Forest Produce
PA	:	Protected Area
p.a.	:	Per annum
PS	:	Police Station
Pvt.	:	Private
PWD	:	Public Works Department
Qtl.	:	Quintal
RLEGP	:	Rural Landless Employment Guarantee Programme
Rs.	:	Rupees
SC	:	Schedule Caste
SF	:	Square Feet
SL No.	:	Serial Number
Sq. Km.	:	Square Kilometer
ST	:	Schedule Tribe
TRIFED	:	Tribal Co-operative Marketing Development Federation
UGC	:	University Grant Commission
UN	:	United Nations
W	:	West
w.e.f.	:	With effect from
WB	:	West Bengal
WBFDC	:	West Bengal Forest Development Corporation
WC	:	Working Circle
WL	:	Wild Life
WLS	:	Wild Life Sanctuary

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INTRODUCTION

PRELUDE

The sub-Himalayan districts of Darjeeling and Jalpaiguri are associated with three 'T' s namely Tea, Tourism and Timber. As development progressed, priority was given to Tea. Beside Tea, Tourism and Timber also developed with the exploitation of forest. The most remarkable feature of forest of this region is the wonderful variety of species that it contains. Few places in India command range of variation of forest types as found in such a small area of Darjeeling and Jalpaiguri district. It is perhaps, in fitness of thing that forest conservancy was initiated in these districts first among other districts of West Bengal, more than hundred years ago.

Forest conservancy was started in the study area in 1878. We have celebrated hundred years of forestry in this region. But it may be interesting to know the development of forests, the factors that impeded the programmes and prospects of future development of the vast resource of the region. An attempt has been made by the investigator to present the various problems which are related with the forest resource utilization and to explore the remedial and preventive measures that we may have at hand for such valuable natural resource.

THE PROBLEM

The Darjeeling and Jalpaiguri district is a region of wide variety of forest resource. Of late, this respository of natural wealth has been subjected to virtual plunder. During the last 150 years about 70% of the total forest area had been cleared by so called developmental processes. In consequence, the local ecosystem are fast loosing their resilience and regenerative capacity. Since the nineteenth century, the fact which become evident that forests can not necessarily re-generate naturally. The forest is not capable of regenerating itself if greater number of trees are cut for use. Moreover, selective cutting of economically important species may cause significant degradation of the forest lands of the study area.

Extensive heedless deforestation invites catastrophic soil erosion and innumerable land-

slides in the hilly parts and devastating floods in the foot hills and plains during the monsoon months. 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. 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. The picture is just opposite during the non-monsoon months when paucity of water hinders the local people from reaping out any benefits out of the soils. The depletion of the broad - leafed trees such as the Oak in the Darjeeling Himalaya, 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' need for hundred of years. In several villages of the hill, during the dry seasons the women can not sleep restfully due to their anxiety to reach the springs early enough to collect the few drops that trickly in. Man and trees are symbiotically related to each other. So the non - existence of one would certainly vanish the other.

The removal of forest has economic implication also. Existence of agricultural civilization of the sub-Himalayan North Bengal is intimately connected with the forests. Thus, the removal of forest also threatens the existence of agricultural activities. A recent study reveals that in between 1993 to 1999, 850 hectares of good forest land was destroyed either by bank failure or by shifting river courses. Over two million trees were destroyed the market price for which are approximately 15,000 million rupees. In addition to this, dolomite mining activities is also found to be responsible for the destruction of under-growth rich bio - diversity of this area. This also exerts detrimental effects on the wild life of the region.

The forest based industries which play a prominent role in the economic development of the study area are also showing a sign of stagnation. These industries consume enormous quantities of forest produce and also provide employment opportunity to the local people. They are also facing an acute crisis from the deficiencies of raw materials. Moreover, un-scientific and unplanned exploitation of forest resource have led to the establishment of a vicious cycle of degradation, endangering the ecological balance and consequently hinders the economic development of the study area.

Future of forestry activities would be uncertain unless forest management are suitably redefined and made an integral part of the rural development. Attempt need to be made to manage the forest as renewable resource to cater the basic human needs and to ensure employment and income in the rural areas. It will also protect the already endangered environment from further degradation.

THE STUDY AREA

The study area comprises districts of Darjeeling and Jalpaiguri, West Bengal, bounded by the latitudes of 26 ° 16 ′ to 27 ° 13 ′ North and the longitudes of 87 ° 59 ′ to 89° 53 ′ East. The area is located in between three countries namely Bangladesh, Bhutan and Nepal. The area border to the east with Assam. The region covers an area of 9376 sq. km. which is 10.56% of the total geographical area of the state and inhabited by 50,09,104 persons (Census, 2001). Geologically, the study area is composed of several types of rock formation of different characteristics. Topographically, the study area comprises of three distinctive segments - (i) the hilly tract, (ii) the piedmont and (iii) the plain. The area is drained by a number of rivers, important are being the Tista, Mahananda, Jaldhaka, Torsa, Raydak and the Sankosh which are also subjected to occasional flooding (Figure1)

METHODOLOGY

The present study has based on both primary data which have been collected from sample plots and through questionnaire as well as from multifarious secondary sources. The details of methodological frame work are given below :-

a. Reconnaissance Survey

The basic areal data has been obtained from Survey of India Topographical sheets (1 : 50,000 & 1 : 63,360). Maps published by the Geological Survey of India, Forest Survey of India, Forest Department and D.L. & L.R.O have also been utilised for collecting other information of the area. These have been used for preparing a programme of survey, layout of cross sections and test pits.

b. Collection of basic data

Basic data on (a) geology, (b) topography, (c) climate, (d) vegetation, (e) landuse pattern, and (f) demographic pattern have been collected from secondary sources like

(i) topographical sheets and records of the Geological Survey of India, records of the Forest Survey of India and Directorate of Forests, (ii) Meteorological data i.e. rainfall, temperature, humidity from the Regional Meteorological Office and from various Tea gardens (iii) Census reports, District Statistical reports, (iv) Working plans and annual reports of Forest Directorate (v) Reports and publications of past work.

c. Methodology for collection of forest based information

The methodology for collection of forest based information is given below:-

- Collection of secondary data from several sources in the study area like District Forest Department, Institutional Libraries, Revenue and other authorities.

- Data for the study have also been collected from Kolkata to assess the market potential of timber mainly from the area.

- Collection of data from the sources like forest based industries, forest contractors, local market and the West Bengal Forest Develompent Corporation.

- Five types of questionnaires have been canvassed among the respondent includes Wood based industry, Market Centre, Wood depot, Forest area under social forestry and JFM; and Agro-forestry farms.

- Meetings and discussion with the concerned forest official and other authorities in the districts.

- Meeting with inhabitants of the forest area, forest dwellers, local villagers in the vicinity of forests including those involved with JFM activities and those without JFM activities. This has done to incorporate their views and suggestions in formulation of the strategy for protection of forests within the broad principles of Joint Forest Management and the people's participation.

d. Sample Design

Random sample has taken to give sufficiently reliable picture of the resource under consideration during the present study. The details of the random sample survey conducted by the investigator during 1999-2001 is given below :

- 3 FPCs and their JFM areas in each of the concerned districts;
- 5 villages under each FPC;
- 5 beneficiaries in each villages under FPC;
- 3 market centre in each of the selected districts to cover at least 5 respondents in each centre;
- 15 wood based industry units, which use raw material of such referred species;
- 3 wood depots which are owned by the West Bengal Forest Development Corporation and 3 private wood depots;
- 2 agro-forestry farm (seleceted during the field investigation based on ground realities);
- 10 saw mills, which are owned by the private management in each of the sample district and 3 Government undertaking saw mills at Madarihat (Jalpaiguri District), Siliguri (Darjeeling District) and Bhuttabari (Darjeeling District);
- 25 furniture/ toys /other wood products units (in each district) selected .

The various aspects of social forestry in the study area have been followed with the selection of random samples for collecting of growth statistics, survival percentage of different species in different areas. Data have also been obtained from the record of Zilla Parisad,

Panchayat Samities, N.G,Os and other private organisation in respect of seedling distributed and planted by them.

The data and information thus collected are processed and analysed to understand the problems and prospects of forest resource in Darjeeling and Jalpaiguri district. A few case studies have also been conducted to provide sustainable strategies for the future utilisation of forest resource. Time series analysis is used in the computation of estimated annual potential of forest in respect to production of timber, non-timber and employment generation. The analytical results are also been represented through tables, charts and diagrams.

CHAPTER -1

GEOGRAPHICAL BACKGROUND

1.1. INTRODUCTION

The Darjeeling and Jalpaiguri district covers an area of 9376 sq.km., comprising of 7 sub divisions, 25 blocks and 24 towns (Table1.1). Diversities in geology, physiography, drainage, climate and vegetation are apparent between the northern and southern parts of the districts.

Table1.1

Geographical and Administrative Setup of Darjeeling and Jalpaiguri District.

Sl No.	Districts	Latitudes	Longitudes	Area in sq.km.	Sub-division	C.D Block	G.P.	Urban centre
1.	Darjeeling	26° 31′-27° 13′N	87° 59′-88° 53′E	3149.0	4	12	77	9
2.	Jalpaiguri	26° 16′-27° 0′N	88° 25′-89° 53′E	6227.0	3	13	125	15

1.2. GEOLOGY

The geology of the study area is highly interesting. The Himalayas, forming the northern boundary, had it's origin in an ancient sea and had been subjected to large scale tectonic movement in the comparatively recent geological periods. The study area is divided into four tracts from the geological point of view. These division are from north to south the hard rock area, the piedmont belt, the terai belt and the alluvial plains. In the hard rock region, the southern portion is covered with sedimentary rocks while the northern part is composed of metamorphic rocks .The piedmont belt includes rock fragments, big boulders and fine grained clastics derived from the hard rock region .This area is also characterised by rather steep slopes, boulder surfaces and forest of tall trees. The terai belt is composed

of mostly course granular materials alternating with finer clastics. The whole of Jalpaiguri district excepting the northern hilly region, is covered by; alluvium deposits. The alluvium deposit consist of coarse gravel near the hills, sandy clay and sand along the course of the rivers and south of hills and fine sand and clay in the flatter parts of the river plains . There are over-ridden on a trust plain in an inverted sequence by older rocks namely the Gondwans, Buxas and Daling. Darjeeling gneiss occurs on the greater part of the upper hills. Recent alluvium covers the plain to the south of the foothills. A geological map has been compiled by the investigator (Figure1.1) to show the regional distribution of rocks. The chronological sequence of the geological series /system of the study area is given in table1.2.

1.2.1 Darjeeling Gneiss

The upper hilly part of the study area is composed of Darjeeling gneiss, consisting of garnetiferrous mica-schists, quartzites and sillimantie gneiss. The gneiss is well foliated, much folded and crumpled, highly micaceous and composed of colorless or grey quartz, white opaque, feldspar, muscovite and biotite. Kyanite and sillimanite are occasionally present.

1.2.2 Buxa series

The Buxa hill of the study area is composed of rocks belongs to the Buxa series, which consisted of variegated slates, quartzite and dolomite and are fringed on the south by low hills of upper tertiary stratas. Limestone occurs in considerable quantities in the Buxa series and masses of calcarious materials are found along their base. The Buxa series extended westwords along northern fringe of Jalpaiguri district up to the Rehti river, but east of the Buxa hill, it lies mostly in Bhutan (Lahiri, 1941).

1.2.3 Daling series

In the hilly region, the Daling series occur from the west of Balason river, above the Siwalik and bordering the Damudas in the south to the upper boundary commencing from the west, passing through Khairbari, Gayabari tea estate, Gayabari railway station and Sittong peak in the west which merges with the.Darjeeling Gneiss. In the Duars regions,

the north of Buxa series lies phyllites, schists and quartites, known as Daling series. All these formation have a general east- west strike, and dips are generally considered to be of pre-Gondwana age. In the Duars, the sandstone facies are well developed. Occasionally the sandstones are pebbly or conglomeratic in nature. West of the hills, the Tertiaries are not developed in the foothills regions for a length of about 64.4 km. They appear again in the foothills, west of the river Jaldhaka. The Daling series in the study area consists mainly of slates and phyllites, with silvery mica schists representing transition rocks.

1.2.4 Damuda series

The Damudas constitute a narrow belt between the Daling series in the north and the siwalik in the south. Steeply overthrusting the Siwaliks, they extent in a roughly east-west direction from Balason in the west to Kalijhora in the east. The sandstones are micaceous, feldspathic and brownish, often weathered in badly exposed areas, with coal bearing detrital rocks. Gondwana sandstones and slates with anthracite coal beds intervenes between Tertiary and the Buxa series. The best coal seams measure about 3 meter in thickness (Tindharia region) with sandstone on top and shale below. There is a thin and discontinuous band of limestone from west Kalijhora to Rangtong.

1.2.5 Siwalik series

The Siwalik appear north of Sukna extending from Mechi river in the west to the Sankosh in the east. It is irregularly interrupted by alluvium and fore-thrusts of older rocks. The deepest outcrop forming the southern margin of the Siwalik consist of bluish gray nodular marls and clays with micaceous fine grained sandstones. Occasional conglomerate layers with quartzitic pebbles are also found in many places.

1.2.6 Alluvium

The district of Jalpaiguri lies in the Sub-montane terai region . Excepting the northern hilly region, the whole of Jalpaiguri district is composed of alluvium, gravel beds, boulders and rock fragments. The rivers and stream have cut gorges giving rise to terraces across the undulating and low plateau like drift deposit forming typical piedmont landscape over looking and often merging in to the plains.

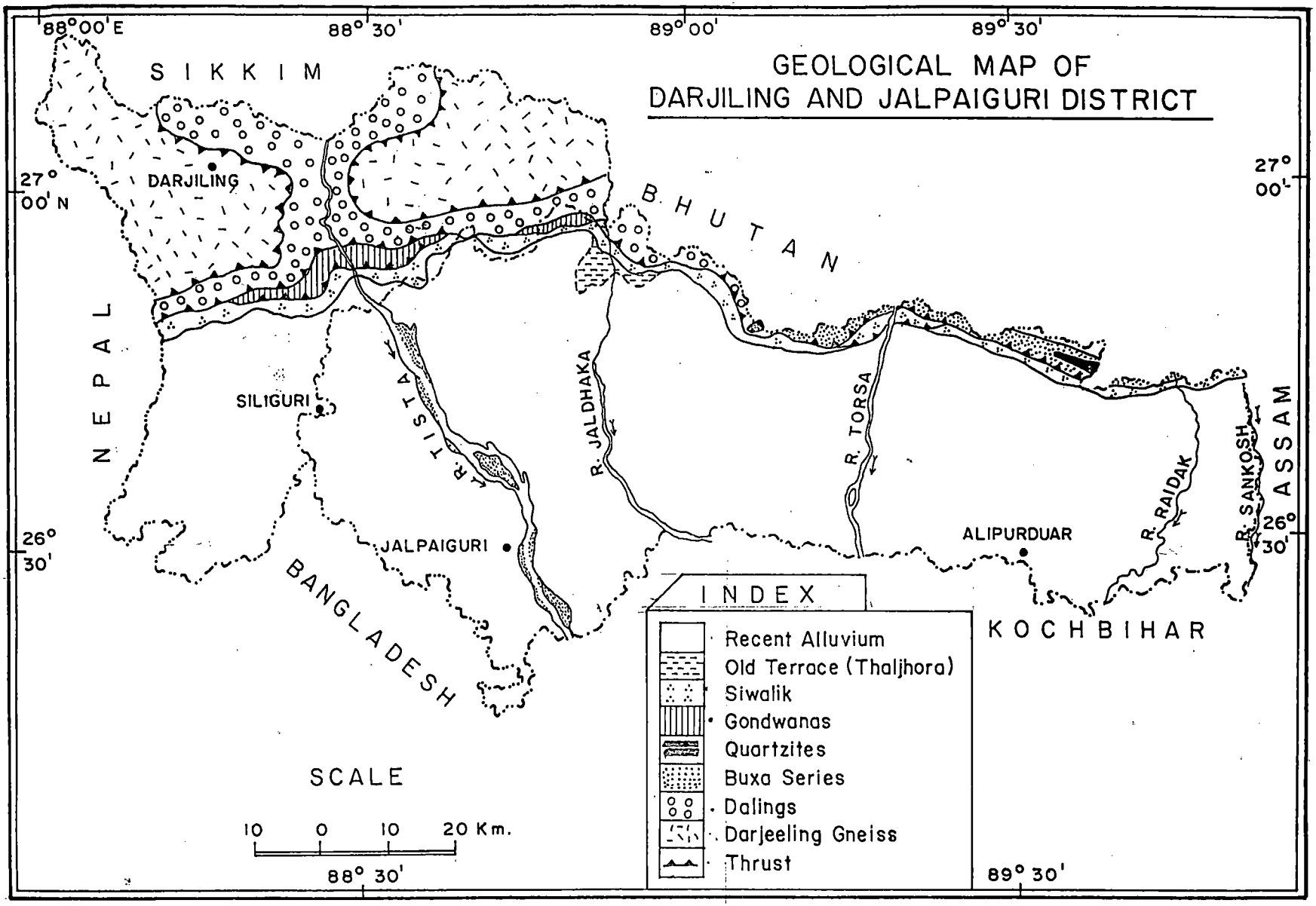

Fig. 1·1

Based on A. Gansser, 1964

Table 1.2
Geological succession of the study area

Name of series.	Geological age	Lithological character
Recent alluvium	Recent	Coarse gravel near the hills. Sandy loam to clay loam further south.
Old alluvium	Pleistocene	Boulder deposits along with gravel & sand beds.
	---- Thrust----	
Siwalik	Tertiary	Micaceous sandstone with siltstone, clay, lignitic lenticles etc.
	---- Thrust----	
Damuda series	Carboniferous-Permian	Sandstones, grey shales & coal (lower Gondwanas), carbonecous seams which have been metamorphosed at places to quartzite, slate & carbonaceous or even graphitic schists, particularly near the contact zones with the Dalings.
	---- Thrust----	
Buxa Series	Paleozoic	Chlorite-schists, slates, quartzite and dolomites. Best development in Buxa hills.
	---- Thrust----	
Daling series	Late Paleozoic	Slates, phyllite, banded haematitic quartzite and schists (mica, graphite, epidiorite, talc, chlorite schists).
	---- Thrust----	
Darjeeling gneiss	Pre-cambrian	Well foliated gneiss, composed of colourless or gray quartz, white opaque flespar, muscovite and biotite. Kyanite and Sillimanite occasionally present.

Based on A. Gansser, 1964.

1.3. PHYSIOGRAPHIC DIVISIONS

The study area exhibits a wide variety of landforms. Their genesis, mode of formation and morphological forms are also diverse in nature. Geomorphologic history was characterised by successive catastrophic events of accelerated erosion and deposition during the post-Pleistocene period. Physiographically, the study area may be divided into 3 major divisions (Fig. 1.2)

1.3.1 The Hills

The hilly region is restricted within Darjeeling and in the extreme north-eastern part of Jalpaiguri district. The region extends northwards into Sikkim and Bhutan, west-wards to the Napal, east-wards the divide line runs along the international border between India and Bhutan and southwards bounded by the 300 metre contour line. The lesser Himalayas run east to west direction within this region. The axis of the lesser Himalaya is marked by the water divide running east-west roughly through the middle of the region. Most of the rivers are flowing through straight courses according to the slope aligment . There are only four small fragments of the mountainous region in the east, which is situated along the northern border of Jalpaiguri district. The Jainti-Sinchula range (700 -1600 metre) is situated in this region. The hills rise abruptly from the piedmont plain (120 -300 metre) and the elevation increase northwards upto 2200 metre at the Mahaldiram ridge, with a further increase upto 3665 metre at Sandakphu Massif. Within these, there is a mosaic of micro-topographic units comprising of convex ridges and deep- cut valleys (Lama , 1994). The hilly region may further be sub-divided into 2 sub-units, namely high hills and low hills.

1.3.2. The Piedmonts

The piedmonts locally known as *terai* west of river Tista and *duars* east of river Tista , covers an area of 7254.0 sq. km. It includes the tilted plains at the base of the Himalaya bounded by the 300 meter contour line to the north and 66 metre contour to the south. It includes the entire Siliguri sub-division and northern part of Jalpaiguri district. This is formed due to the coalescing of several alluvial fans within the catchment area of the river Mahananda, Tista, Jaldhaka, Torsa, Raidak and Sankosh. The northern part of the *duars*

is made up of fluvio-slope wash deposits of the Quaternary period. Rivers and streams which have cut gorges have also given rise to terraces, across the undulating and low plateau like drift deposits thereby, forming a typical landscape, overlooking and often merging with the plains to the south.

1.3.3 The Plains

This region is located mainly in the district of Jalpaiguri . Perceptible gentle gradient of land is a significant feature of this region. Rivers flow through meandering courses and floods are common during the rainy months. Bed load is deposited close to the channel and suspended load with finer silt and clay accumulates in back swamp area of the flood plain from the river channels. However, in areas where flooding is infrequent, lateral accretion and channel deposition are more significant in the formation of flood plain.

1.4 DRAINAGE

The study area is endowed with an intricate network of river systems. Most of the rivers are considered to be highly notorious for their unpredictable nature, letting loose fury of flood and problem of extensive and regular bank erosion, shifting course that render thousands homeless during rainy season. The majority of the rivers of *terai* and *duars* originate in the Himalaya to the north and northwest and flow along south to southeasterly direction (Fig. 1.3). As many of the rivers originate from the same hill, flood often occurs simultaneously and the rivers coalesce to from a single vast sheet of water.

The upper catchment area of these rivers has mostly been deforested and the clearings of the steep slopes have been used for the extension of settlement, agriculture, plantation and communication, disrupting the overall hill slope hydrological balance (Sarkar, 1989). As a result, during heavy and concentrated rainfall, innumerable landslides are caused transporting huge amount of sediment to the rivers. Most of such landslides have never been treated scientifically with proper protective measures and as such those are in the habit of expanding their territories during monsoon (Bhutia, 1999). This often adds more and more silt to the rivers, which are incapable of transporting the loads efficiently under the existing hydrological conditions, especially areas beyond the foothill zone.

1.4.1 Drainage basin and sub-basins

The major drainage basins and sub-basins of Darjeeling and Jalpaiguri district are tabulated in the table 1.3.

Table 1.3

Drainage basins and sub-basins of the study area

Drainage Basin	Sub-basins	Major rivers
Brahmaputra Basin	Sankosh	Sankosh, Gadadhar
	Torsa	Torsa, Pana-Alaikuri Dima-Kaljani, Jainti, Raidak
	Jaldhaka	Dharla (west) Jaldhaka, Diana Mujnai, Dharla (east)
	Tista	Rammam, Great Rangit Tista, Nor-Neora-Dharla
Ganga Basin	Mahananda	Mechi, Balason,Mahananda

1.4.1.2. The Brahmaputra Basin

The rivers belong to the Brahmaputra system are the Sankosh, Raidak I, Raidak II, Torsa, Jaldhaka and the Tista, drain about two third of the total geographical area of the districts. The followings are the major sub-basins of the Brahmaputra system.

The Sankosh sub-basin : The river Sankosh originates from the Bhutan Himalaya, marks the eastern boundary of North Bengal. The sub-basin occupies only 295.0 sq. km. area or 3.15% of the geographical area of the region.

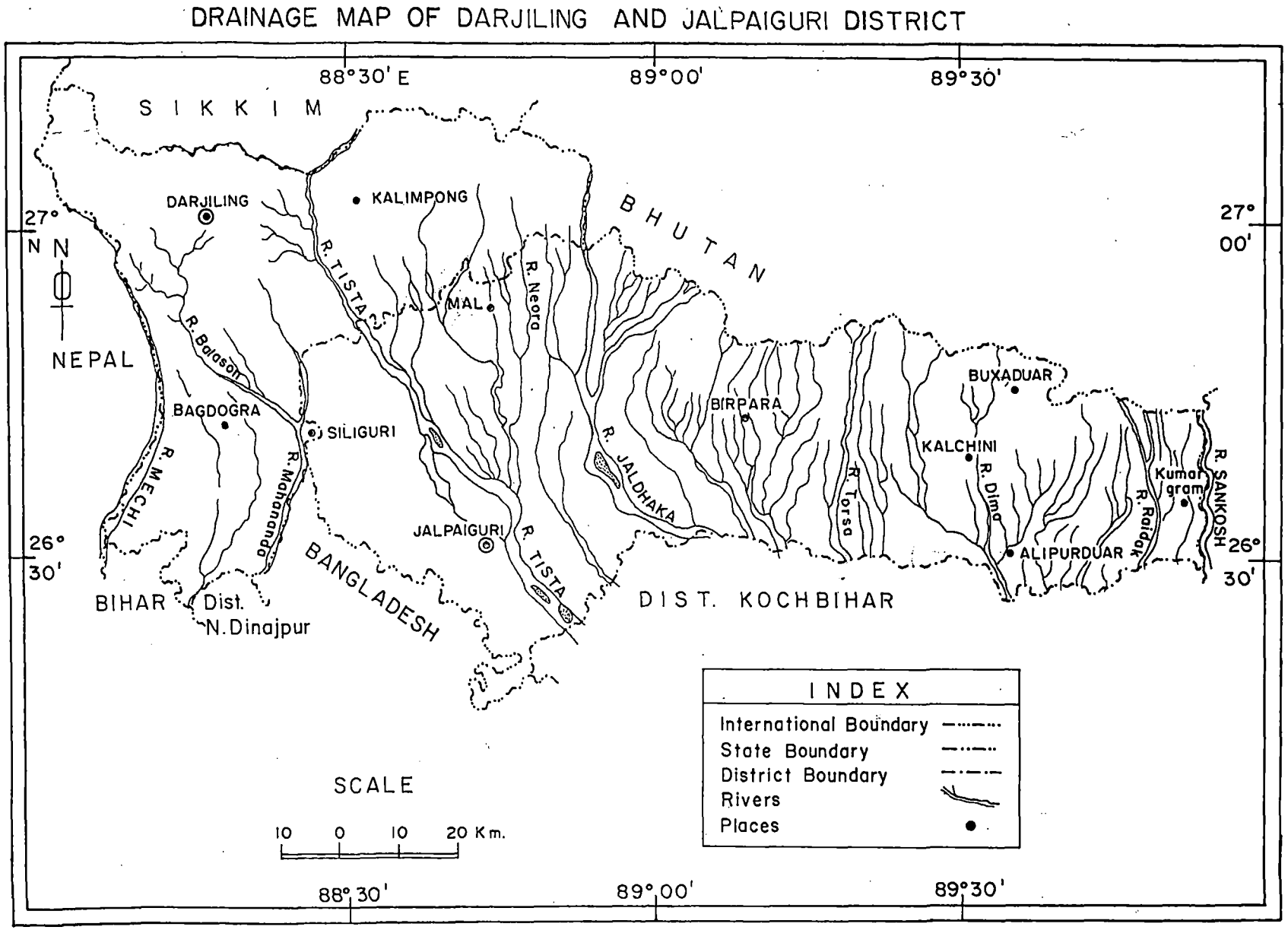
DRAINAGE MAP OF DARJILING AND JALPAIGURI DISTRICT
88°30' E
89°00'
89°30'
SIKKIM
DARJILING
KALIMPONG
BHUTAN
27° 00'
N
NEPAL
R. TISTA
R. Neora
MAL
R. Balasan
BAGDOGRA
SILIGURI
R. MECHI
R. Mahanada
BIRPARA
R. JALDHAKA
BUXADUAR
KALCHINI
R. Torsa
R. Dima
Kumargram
R. Raidak
R. SANKOSH
ALIPURDUAR
26° 30'
JALPAIGURI
R. TISTA
BANGLADESH
BIHAR
Dist. N. Dinajpur
DIST. KOCHBIHAR
INDEX
International Boundary
State Boundary
District Boundary
Rivers
Places
SCALE
10 0 10 20 Km.

Fig. 1·3

The Torsa sub-basin: This sub-basin drains by the rivers Raidak I, Raidak II, Gadadhar, Kaljani, Jainti and Torsa. All these rivers originate in the Bhutan Himalaya. The Torsa is the trunk stream of this catchment, originates from the upper most part of the Bhutan Himalaya and fed by both rain and snow melt water.

The Jaldhaka sub-basin : The Jaldhaka river originates from the Bhutan-Tibet border in the High Himalayas. It receives Murti and Diana in the northern *duars* and further south it receives rivers like Kumlai, Gilandi, Dim Dima, Mujnai and Burhi Torsa and finally joins the Brahmaputra in Bangladesh.

The Tista sub-basin : The river Tista originates from the Tista-Source Glacier (Tista Kanyse) or, Pauhurni Glacier near Khangehung Lake (Lat. 27°59′N and Long. 38°48′E) at an elevation of 7128 meters at Sikkim. It meets Brahmaputra (Jamuna) at Kumarganj in Bangladesh at an elevation of 23 mitres. Streams originating from the Sikkim-Darjeeling Himalaya are converging into the main channel of the Tista in its upper catchment area, i.e., Rammam, Great Rangit, Rangpoo, Rilli, Jit, Nor etc. The Tista river system, flanked by the Mahananda and the Jaldhaka on either side present a spectacular convergent cum divergent drainage pattern. The convergent pattern terminates around 90 metre contour line, subsequent to which the character assumed to be one of divergent from where the rivers are spreading out. While, the 300 metre contour line is curving upward indicating convergence of drainage, the 66 metre line in the extreme south is systematically curved downward indicating large scale fanning out or, divergence of the channels.

1.4.1.3 The Ganga Basin

The Ganga basin occupies about one third of the total geographical area of districts and is drained by the river Mahananda.

The Mahananda sub-basin : This river originates from the lower Darjeeling Himalaya, receives first major tributary the Balason near Siliguri town. The Mechi is the important tributary has its catchment in the northern hilly region and also makes Indo-Nepal boundary.

1.5. CLIMATE

The climate of the area is specially noteworthy because of it's position, the wide differences in altitudes, the powerful effect of the south-western monsoon against the Himalayan barrier and the peculiar configuration of the ridges and valleys which deflect or allow rain bearing winds that affect local temperature and rainfall. Large latitudinal extent and physiographic variations of the area have brought diversity in climate with contrasts in meteorological conditions resulting in the development of greater degree of seasonality. Indian Meteorological Department, Tea Gardens, Forest Department and Agriculture Department record climatic data mainly rainfall and these have constituted the main source of information regarding the climate of the study area.

1.5.1 The seasons

The study area experiences five dominant seasons but their duration and extent are not similar. The year may be divided into five seasons namely summer, rainy, autumn, winter and spring.

1.5.2 Rainfall

Rainfall in the area follows the typical monsoon pattern. It occurs mostly during the four months from mid-May to mid-September and is followed by a prolonged dry seasons. Sometime, the monsoon beings later and ends earlier and is also less certain and less uniform. Prolonged drought and severe heat in the plains affect the growth of vegetation and their regeneration. Many parts of the study area enjoy a warm rainy season which is advantageous for the growth of vegetation. Records of rainfall are available from stations, for the period ranging from 20 to 60 years. On account of the diverse physiographic nature of the study area, there are sharp variation in rainfall between the different stations. It is generally heavier in the southern face of northern hilly track (4455mm. at Kurseong, 4147mm. at Sonada and along the extreme north-eastern part of Jalpaiguri district-Raimatang 4639 mm., Chuapara 4597 mm. and Kumargram 4244 mm.) while the amount is maginally less in the foothills and plains (3336 mm. at Alipurduar, 3327 mm. at Malbazar and 3119 mm. at Siliguri). The spatial distribution of mean annual precipitation has been depicted in the Fig 1.4. The south-west monsoon contributes about 85% of the annual

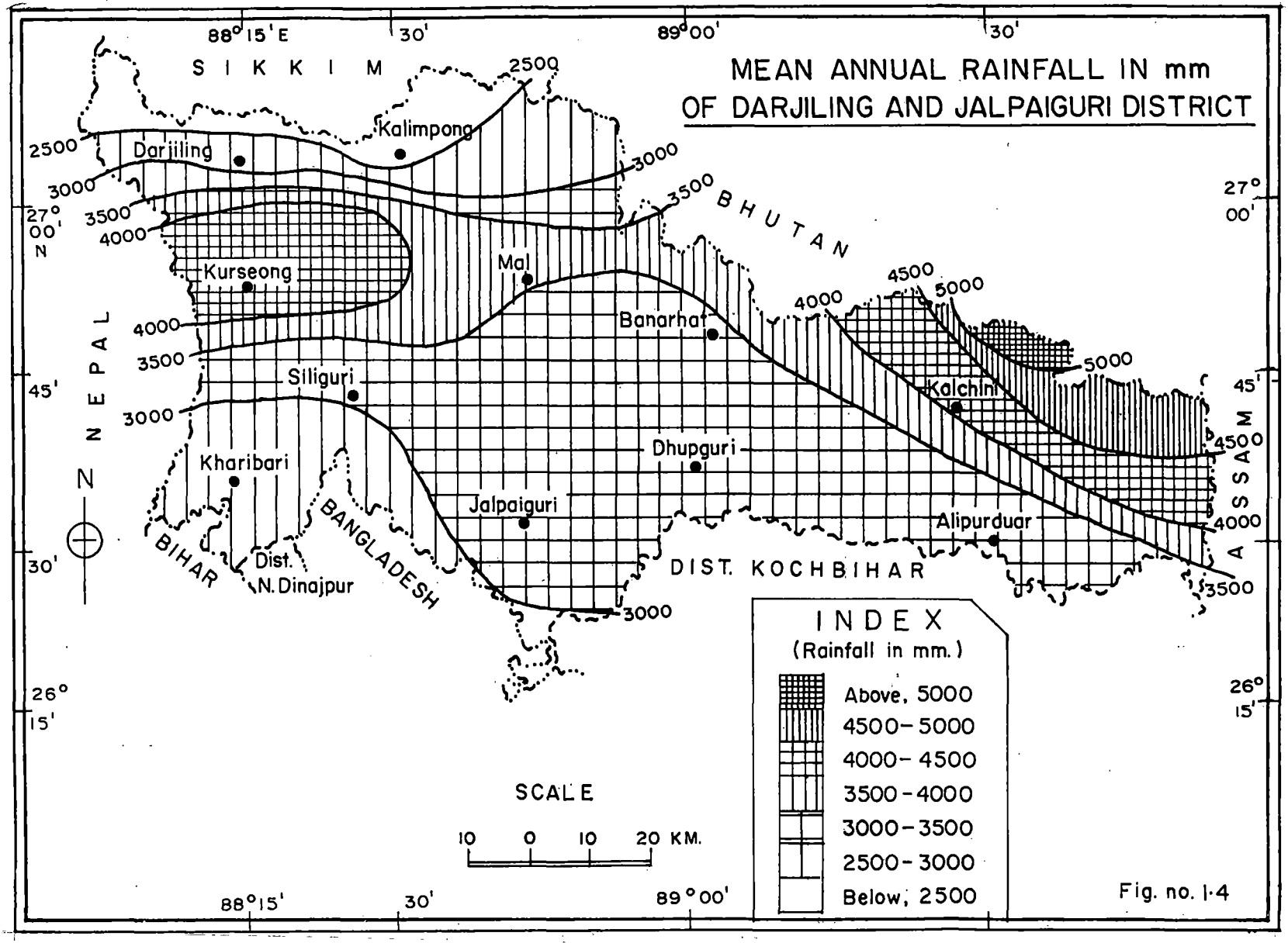
MEAN ANNUAL RAINFALL IN mm
OF DARJILING AND JALPAIGURI DISTRICT
88°15'E
30'
89°00'
30'
SIKKIM
Kalimpong
Darjiling
Kurseong
Mal
Banarhat
Siliguri
Kharibari
Dhupguri
Jalpaiguri
Kalchini
Alipurduar
BHUTAN
NEPAL
BIHAR
Dist.
N. Dinajpur
BANGLADESH
DIST. KOCHBIHAR
ASSAM
27° 00' N
45'
30'
26° 15'
2500
3000
3500
4000
4500
5000
INDEX
(Rainfall in mm.)
Above, 5000
4500-5000
4000-4500
3500-4000
3000-3500
2500-3000
Below, 2500
SCALE
10 0 10 20 KM.

Fig. no. 1·4

precipitation. The variation in the total rainfall from year to year are not much. On an average, there are about 120 rainy days. Annual rainfall of the area varies from 2000 to 5000 mm. The heaviest rainfall in 24 hours recorded was 864 mm.at Hasimara during 1993.

1.5.3 Temperature

Due to physical diversity the study area experiences temperature ranging from below freezing point in the hills during winter to about 35° C in the plains during the summer. The climate varies from moist-tropical to dry tropical in the plains and from sub-tropical to temperate in the mountains of the north. Temperature records (maximum and minimum) for different areas shows that May and June are generally the hottest months throughout the entire study area with maximum temperature recorded 22° C at Darjeeling and 39° C at Jalpaiguri. December and January are the coldest months having minimum temperature record as 2° C at Darjeeling and 6° C at Jalpaiguri. Siliguri is the hottest place in the study area with mean annual temperature of 29° C, while the coldest place adjoins Ghoom, where mean annual temperature has been recorded to be 9.6° C. A map has been prepared for a better understanding about the spatial distribution of mean annual temperature. (Fig. 1.5)

1.6. SOILS

Two main kinds of soils namely zonal and azonal are found in the districts. The zonal soils are found in the northern hilly region, alluvium in the plain represents the azonal group. Variations in the micro-environments in respect of relief, drainage, climate etc. have led to the formation of different types of soils.

1.6.1 Soils of the Hills

Due to differences in altitude within a short range, differences in soil properties are observed in the hilly parts of Darjeeling and Jalpaiguri districts. Highly acidic soils (p^H 4.5 to 5.0) are found in considerable parts of Mirik, Kurseong, Darjeeling , Pulbazar, Sukiapokri, Jorebungalow and Kalimpong sub-divisions due to the presence of coniferous trees at higher altitude. Organic carbon in these soil ranges from 0.5 to about 1.20.

Texture of the soil has been identified as sandy loam to clay loam. In Kalimpong sub-division, however, soils are less acidic and in Gorubathan the soils are sandy loam to clay loam in texture.

1.6.2 Soils of the plains region

Soils of the plains region are classified into the following groups.

The Piedmonts: The alluvial fans of the piedmont plains at the base of the mountains are principally accumulation of the coarser materials of heavy mountain wash, e.g, boulder, gravel, pebble, sand , etc. This soil (known as *bhabar* in north west India) is deep and coarse at the base of the mountains. It is azonal soil with low percentage of organic carbon, K_2O , P_2O_5 and acidic in reaction.

The Plains: Soil texture changes towards the south, along the floodplains of the large rivers comprising the southern part of Jalpaiguri district. Soil texture is relatively coarser towards the north but finer towards the south. The soil is mostly acidic (p^H 5.0 to 6.5) due to leaching. The K_2O , P_2O_5 contents are also low at most places, however, higher amounts have been found at isolated pockets of Jalpaiguri district.

1.6.3 Soil taxonomic units :

The systematic study of soils in West Bengal was taken up as early as 1898, when four main soils groups occurring extensively, were differentiated. At the beginning of 20th century, "Soil fertility" became the central theme of agricultural research and soil study in West Bengal. According to Soil Taxonomy, Murthy and Pandy (1983) prepared a soil map through NBSS and LUP, based on soil variation related to relief or physiography in different climatic zones. National Bureau of Soil Survey and Land Use Planing in co-operation with the Department of Agriculture, Government of West Bengal has published soil map of West Bengal in four sheets in 1991. This is perhaps the most comprehensive and descriptive map of West Bengal's soil. The soils of the study area (Darjeeling and Jalpaiguri district) have been classified on the basis of the above mentioned study. The following table (1.4) represents the major taxonomic order, sub-order, great group's which have been identified so far in the study area. 2 taxonomic soil

orders, 6 sub-orders and 8 great group have so far been identified in sub-Himalayan North Bengal. These are discussed below :

Entisols : These soils have little or no evidence of pedologic profile development either due to short duration or receiving of new deposits of alluvial at frequent interval from the higher tracks (Sarkar 2000). The only evidence of pedogenic alteration in these soils is a small accumulation of organic matter in the upper 30 cm. of soil profile. Entisols may have an ochric or anthropic epipedon. The entisols of the study area have a variety of soil moisture and temperature regime. Three sub-orders - Orthents, Fluvents and Aquents have so far been identified in the study area (Fig 1.6)

Inceptisols : These soils have altered horizons that have lost bases or iron and aluminium but retain some weatherable minerals, they do not have an illuvial horizon enriched either with silicate clay that contains aluminium or with an amorphous mixture of aluminium and organic carbon. The common diagnostic horizons that they may have are an umbic or ochric epipedon, a cambic horizon, a fragipan and a duripan. Inceptisols develop mainly in the fine textured parent materials. These are mostly found in the northern hilly part of the study area. Two sub-orders have so far been identified (Fig 1.6). -Aquepts, Umbrepts and Ochrepts.

Table -1.4

Major taxonomic orders, sub-order and great groups of soils in the study area.

Orders	Sub-orders	Great groups.
ENTISOILS	Orthents Fluvents Aquents	Udorthents, Udifluvents Fluvaquents, Haplaquents
INCEPTISOLS	Aquepts Umbrepts Ochrepts	Haplaquepts Haplumbrepts Dystrochrepts, Eutrochrepts

1.7 NATURAL VEGETATION

The sub-Himalayan North Bengal still possess some of the excellent natural vegetation of the country. The most remarkable feature of forest of the study area is the wonderful variety

of species that it contains. Few places in the world in which so many different type of forest exist within so small an area . It is perhaps, in fitness of things that forest conservancy and scientific forest management was initiated in this part of the country, a hundred years ago. Altitude, aspect, geology and climatic factors have influenced the forest types . The study area although, suffered extensive and heedless deforestation since the British occupation, yet it seems to be one of the most densely forested tract in the state with natural, semi natural and man-made forest . Details about the natural vegetation of the study area will be discussed in chapter 2.

1.8 DEMOGRAPHY

The study area supports a population of 50,09,104 (as per Census, 2001) which constitute 6.24 percent of total population of the state. The decadal population growth (1991-2001) shows an increase of 21.52 and 23.54 percent in total population of Jalpaiguri and Darjeeling district. The average literacy rate of the study area is 68.22 percent. The average density of population, as per census 2001 is 528.5 persons per sq. km. The area contains a polyglot language. In the hills Nepali, Hindi and in the plains Bengali are spoken by a great majority of the inhabitants but there are a great number of other languages. Main tribes of the study area are Rava, Mech, Garo, Munda, Uraon and Kharia. They reside mostly in Tea gardens and forest village of the *terai* and *duars* region. Details about the demographic picture is shown in the table 1.5, 1.6 and figure1.7.

Table - 1.5

Decadal population growth (in percent) since 1951 in the districts.

Sl. No.	District	Percentage of decadal variation				
		1951-61	1961-71	1971-81	1981-91	1991-2001
1.	Darjeeling	35.90	25.16	31.08	26.91	23.54
2.	Jalpaiguri	48.27	28.76	26.55	26.44	21.53

Source - Census 2001, Government of India.

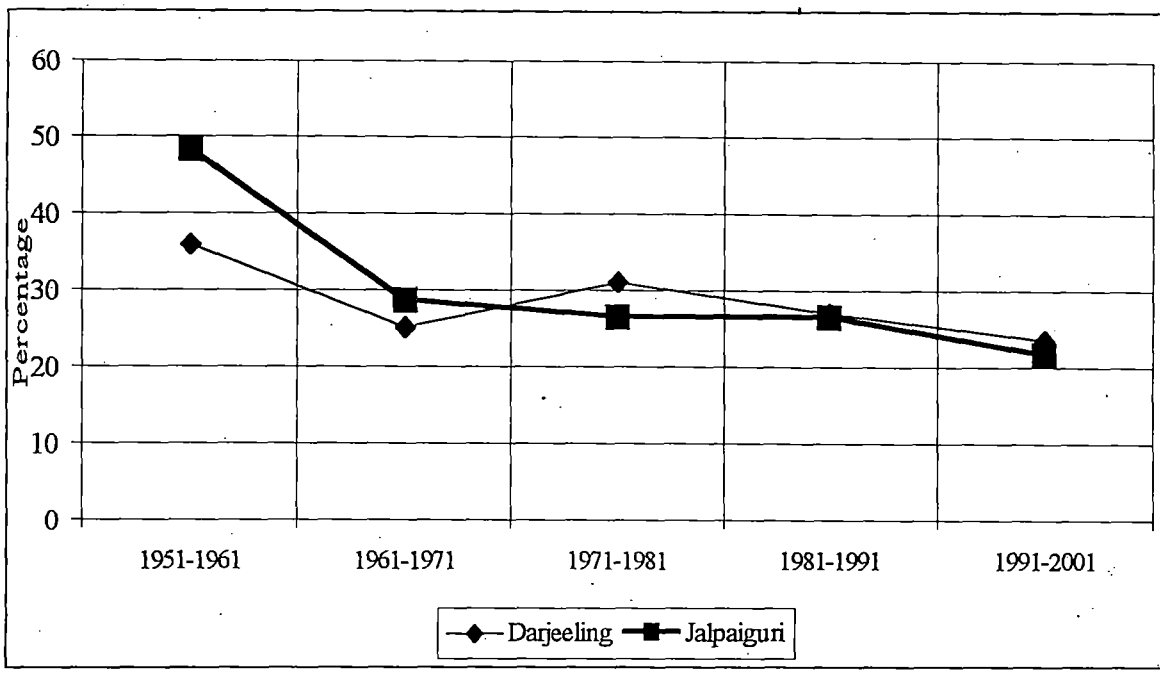

Fig 1.7 Decadal population growth.

Table No 1.6

Demographic pattern in the districts

District	Population	Male	Female	Sex ratio (number of female per male 1000	Population rank in 2001 (W. B)	Population density per sq.km.	Literacy rate (%)
Darjeeling	16,05,900	8,26,334	7,79,566	943	17	510	72.87
Jalpaiguri	34,03,204	17,53,278	16,49,926	941	10	547	63.62
Total	50,09,104	25,79,612	24,29,492	–	–	---	---

Source - Census 2001, Government of India.

1.8.1 Socio- economic condition :

Nearly 80 percent of the population resides in rural areas. The great majority of the population is dependent on agriculture, either as cultivator tilling their own field or as

agricultural labourers. A share of population is also employed in tea garden. Major portion of total agricultural land in the study area is under share cropping or "barga" cultivation. The daily wages in the form of cash or kind are considerably raised. Although the over all land for cultivation is limited in the study area, it's redistribution in favour of small farmers had an impact in increasing agricultural production (Bagchi, 1990). Further the involvement of the rural poor has been ensured in an organized manner in the process of planning. The local panchayats being essentially elected representatives of the rural people and are responsible for planning and implementation of rural development programmes at different levels. In forestry sector, panchayats also play an important role in motivating and implementing the Social Forestry and Joint Forest Management Programme. There are an overall increase in production of rice, milk, egg, poultry meat, fish etc., mainly due to involvement of people through panchayats and providing other inputs like credit, seeds, fertilizer, irrigation etc. The most important industry is the manufacturing of tea, which is also the major contributor to the economy of the area.

1.8.2 Demographic profile in forest village of the study area

Forest Conservancy in Bengal was started in 1864. The idea of conversion of high forests by means of planting was conceived as early as 1867 when baffled by the problems of natural regeneration. Shortage of labour was the main constraint in taking up the plantation activities. The artificial regeneration by taungya or agrisilviculture was prescribed in the working plans for hill areas of Darjeeling district drawn up in 1892 and that for plains areas of Jalpaiguri district in 1920 by Mr. Monsoon and Mr. Shebbeare respectively. This opened up the door for establishment of Forest Villages deep inside or in the fringe of reserve forests for easy availability of work force at nominal cost. Settlers are drawn from landless villagers from nearby places. They comprised mostly of tribals e.g. Rava, Mech, Garo, Munda, Uraon, Kharia etc. Some reserve forest land was cleared so that they could cultivate such lands for raising cereals and vegetables. At some places they are provided with hutments for habitation. On an average, one Forest Village was set up in each felling series and they used to be relicated from one felling series to other, depending upon the annual felling area. The Forest Villagers braved extremely inhospitable living and working conditions for the lure of these small concessions. They are primarily instrumental in raising more than 800 sq. km of plantations containing economically valuable timber species worth over Rs. 10,000 million at current prices.

An agreement are generally drawn annually setting out terms and conditions for their stay and various forestry works. In each "agreement" forest villager are provided with 0.6 ha. of cultivable land in the hills and 1.0 ha. of land in the plains. Each such villager are also permitted to raise agriculture crops over 0.44 ha. in current year`s and one year old plantations . They are also entitled for free firewood for personal consumption and facilities of grazing their cattle in high forests and in plantations over 5 years age. They are also permitted to collect specified number of poles and a cart load of thatch for repairing their houses where permanent houses are not built. In lieu of these services, the forest villagers are required to raise 0.4 ha. plantation every year free of cost. Presently forest villages are paid wages for plantation works, nursery and timber operations as decided by Minimum Wages Act.

There are in all, 168 forest villages in West Bengal distributed in the three districts of North Bengal, namely, Darjeeling, Jalpaiguri and Coochbehar. Demographic pattern of forest villages in the districts of Darjeeling and Jalpaiguri is given in table 1.7.

Table 1.7

Population of forest villages in the study area.

Division	No. of Registered Family	Total Population	Area under possession of forest villages (in sq.)	Population density (per sq km)
Jalpaiguri	419	5034	9.15	550.16
Wild life- II	32	355	1.00	355.00
Baikunthapur	151	1546	2.91	531.27
Cooch Behar	474	6653	8.36	795.81
COBSF	60	419	1.01	414.85
B.T.R	959	14583	15.88	918.32
Kurseong	483	5270	2.89	1823.52
Kalimpong	786	6862	8.22	834.79
Darjeeling	510	6257	3.51	1782.62
Grand Total	3874	46979	53.02	886.06

Source - Annual Report 1998 - 99, Forest Department, Northern Circle, West Bengal.

1.9 LAND USE

Land use pattern of the study area is controlled by the relief, drainage and soil condition. The land use characterstricts are related with the broad physiographic divisions. Out of 9376 sq.km. (Geographical area), the forest lands total 3037 sq. km., which is equivalent to 32.39 percentage of the geographical area. Agriculture is the mainstay of rural people. The major land use types of Darjeeling and Jalpaiguri district is shown in the table 1.8 and figure1.8

Table 1.8

Land use pattern in the districts

Sl No.	Districts	Area sq.km.	Forest (1)		Current Fallow (2)		Net area sown (3)		Others * (4)	
			sq.km	in %	sq.km.	in %	sq.km.	in %	sq.km.	in %
1.	Darjeeling	3149	1455	46.21	86	2.73	1434	45.54	174	5.52
2.	Jalpaiguri	6227	1582	25.41	40	0.64	3241	52.04	1364	21.91

* Others include fallow land other than current fallow, culturalble waste land, permanent pastures and grazing, barren and unculturable land and non-agricultural land.

Source :- District Statistical Hand Book, 1996-2000 and Forest Report, 1999.

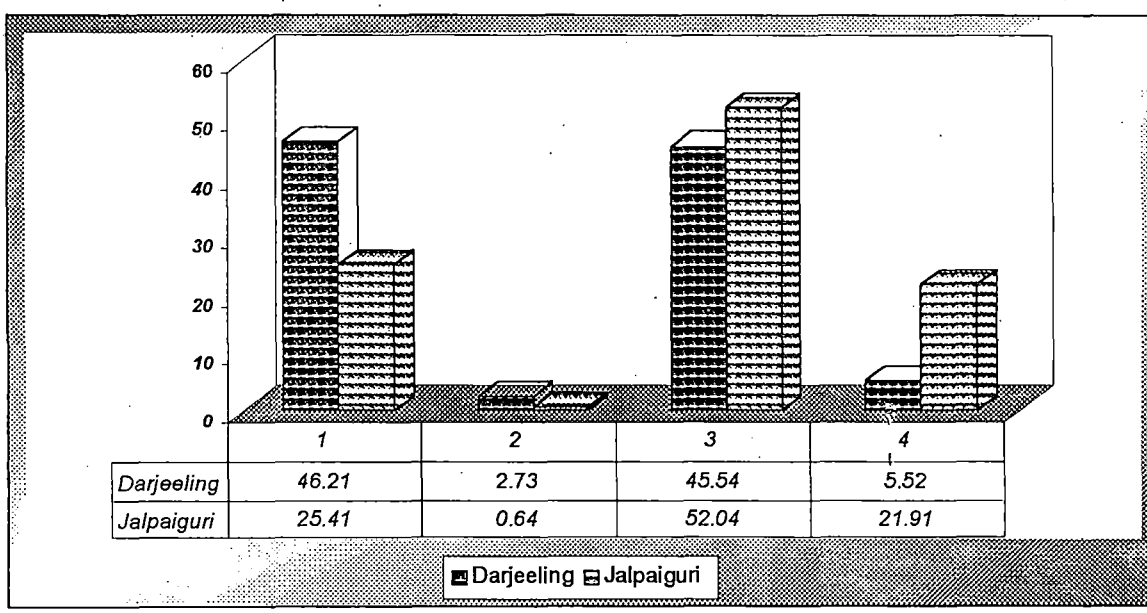

Fig 1.8 Major land use pattern of the study area.

1.10 CONCLUSION

The study area is composed of different types of rocks which are highly weathered, fractured, jointed and have a tendency to produce slope instability during intense rainstorm. Topographically, the area is divided into three broad zones, the hilly tract, piedmont and the plains. Geological structure and drainage pattern are primarily responsible for such topographical segments. The study area possesses a fair amount of natural vegetation but their distribution is not uniform. 32.39 percent of the geographical area is covered by forest. The most remarkable feature of forest of Darjeeling and Jalpaiguri district is the wonderful variety of species that it contains. Few place in the world in which so many different type of forest exist within so small an area. The area is unique for the study of forest resource where different types of forests are existed for comparative analysis. The diversified land use pattern is another advantage for investigating land use input and output under different usage. It also help to understand the importance of the forest of the study area. The area on an average receive 3000 mm. precipitation annually.

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CHAPTER - 2

ASSESSMENT OF FOREST RESOURCE

2.1. INTRODUCTION

Forest can be viewed as one of the important economic asset for the country's prosperity and a major segment of it is owned by the government. (Westoby, 1978). Forestry of our country provides us with a great variety of valuable products. In fact, the impact of forests and their importance on the economy can hardly be exaggerated. The influence of forest is so penetrating in nature that it hardly requires any special mention. Nevertheless representation of some of the aspects, over which forest exercises its influence in systematic manner, would necessarily help us a lot to understand it's relative degree of importance on our life and activities (Singh & Upadhayay, 2000). It is however essential to note that some of effects of forest are direct, while there are many others which are indirect in nature. Actually, it's relative range of influence stretches from the mere existence of the mankind on the earth down to the employment of a few million people, who are engaged in various kind of activities based on forests.

Forests of Darjeeling and Jalpaiguri district play an important role in the economy of the area (Figure 2.1a and 2.1b) Forests perform both productive and protective functions. The function which can be achieved through the exploitation of forest are called productive or direct functions. The local economy associated with it is called extractive economy. Protective function or indirect functions imply the protection of environment. These functions are now highly significant and according to United Nation's guideline 1/3rd of the total geographical area should be under forest (FAO, 1997). The functions which are performed by the forest of Darjeeling and Jalpaiguri district are summarised below :-

a) Productive functions

- Source of timber
- Source of fuel wood
- Source of food and fodder
- Source of raw materials for forest based industries and
- Source of medicinal plants.

b) **Protective functions**

- Moderation of local climate.
- Control of landslide and soil erosion
- Control of flood
- Reduction of the effects of air pollution.
- Wild life conservation.
- Maintaining catchment area water balance and
- Maintaining sustainable soil fertility.

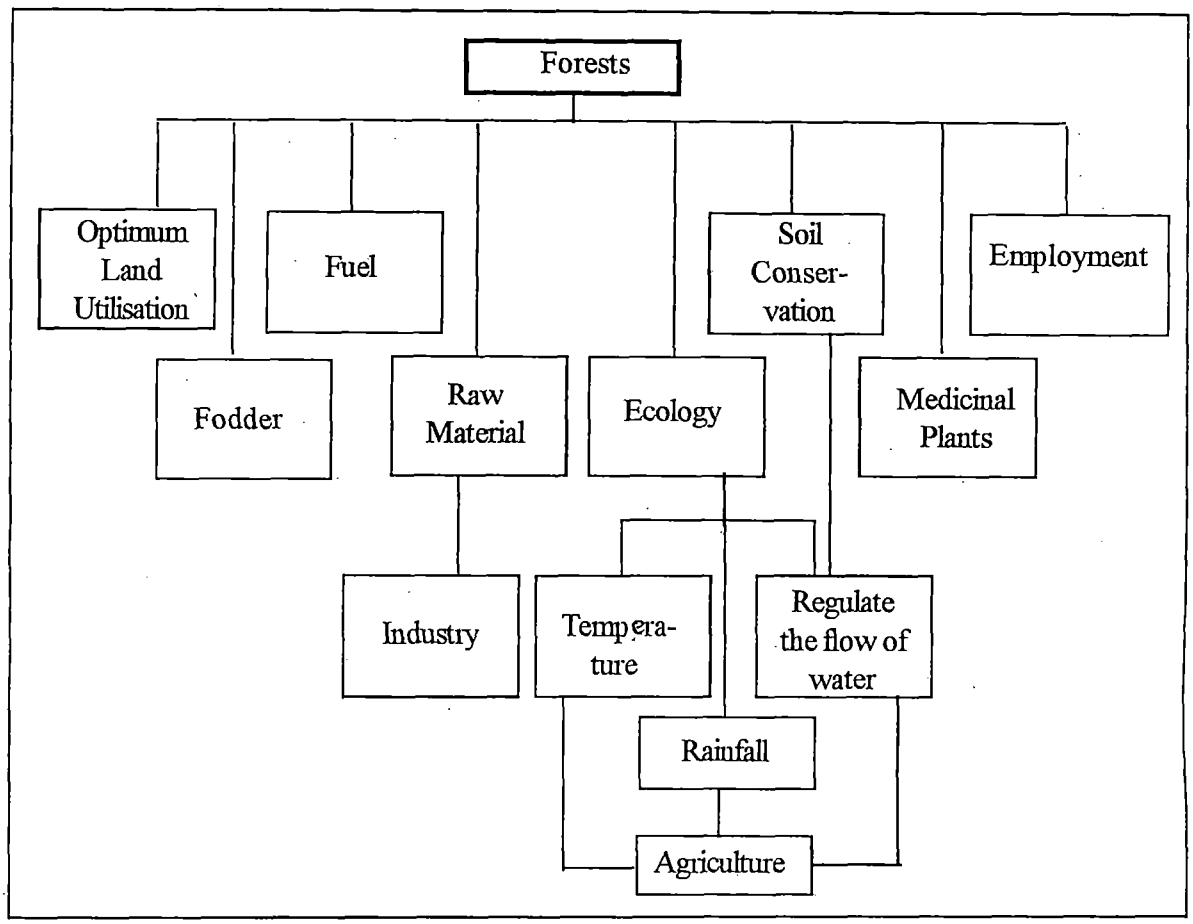

Figure 2.1a - Role of forests in the development of the study area.

The aim of this chapter is to assess the forest resource of the Darjeeling and Jalpaiguri district. It includes distribution of forest, classification of forest, types of species, extent of degradation and growth of stock of forest resource. The investigator, therefore, concentrates his investigation on :

- The study of distribution of forest from the view point of geographical area, legal status and their classification.

- The study of the classification of plant species which includes timber and non-timber plants

- The extent of degradation and its quantitative estimation through sample survey and secondary sources

- Estimation of growing stock of forest resource

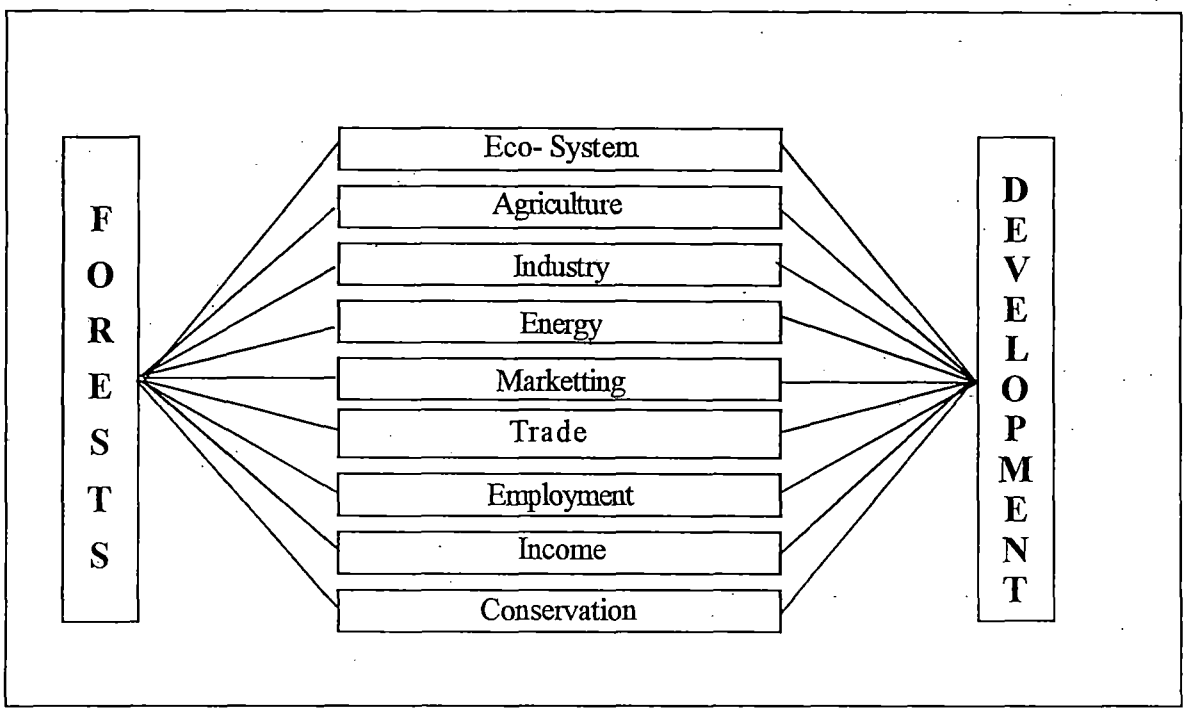

Fig. 2.1b - Linkage of forest with local economy

2.2 DISTRIBUTION OF FORESTS OF THE STUDY AREA

The sub-Himalayan North Bengal (Darjeeling and Jalpaiguri district) maintains a fair amount of forest but their distribution and density are not uniform. 32.39% of the geographical area is covered by forest (Table 2.1a). There is a marginal increase in the forest area of

the districts as per the details is given in table2.1b Darjeeling district can boast up the higher per capita forest land (0.10 ha.) in West Bengal, followed by Jalpaiguri (0.08 ha.), which are even higher than the national average of 0.07 ha. and the state average of 0.02 ha. per capita (Rohatgi, 2000). Many parts of the study area enjoy a warm rainy season which is advantageous for the growth of natural vegetation.

Table 2.1a

Distribution of forests in Darjeeling and Jalpaiguri district

(area in sq. km.)

Name of the District	Geographical area	Forest Area	% of forest area to total area	Dense forest	Open forest
Darjeeling	3149	1455	46.21	1096	359
Jalpaiguri	6227	1582	25.41	1445	137
Total	9376	3037	32.39	2541	496

Source - State Forest Report - 1999. Ministry of Environment and Forest, Govt. of India.

Table 2.1b

Comparative study of forest area.

Name of the District	1991-92 (area in sq.km.)	1999-2000 (area in sq.km.)	% of forest area increased over 1991 - 1992
Darjeeling	204	1455	1.20
Jalpaiguri (excluding COB forest division)	1415	1582	1.12
Total -	2619	3037	1.16

Source - State Forest Report, 1991-92 and 1999-2000, Ministry of Environment and Forest, Govt. of India

The investigator has also prepared a table (No.2.2) on distribution of forest of the study area as per geographical location.

Table 2.2

Distribution of forest according to geographical region

Geographical Region	Division	% of Plantation forest	% of Natural forest
Terai (Middle region of Mechi & Tista river)	Kurseong (Part) Wild life - I (Part) Baikunthapur (Part)	24	76
West Dooars (Middle region of Tista & Torsha river)	Kalimpong (Part) Wild life - II (Part) Baikunthapur (Part) Jalpaiguri (Part) Cooch Behar (Part)	35	65
East Dooars (Middle region of Torsa & Sankosh river)	Cooch Behar (Part) Buxa Tiger Reserve	31	69
Hilly region	Kurseong (Part) Wild life - I (Part) Kalimpong (Part) Darjeeling (Part)	55	45

Source -Forest Department, Darjeeling and Jalpaiguri district

2.2.1. Distribution of forest by legal status

For the convenience of administration, forest have been grouped into three broad categories:

- State forest which is under the direct control of the government and revenue earned goes to the state government.
- The community forest which is under the control of autonomous bodies and the Panchayat etc.
- Private forest - it is under private ownership and usually includes plants which provide fruits and timber for construction as well as fuel wood.

Further, on the basis of the legal status, the forest department has categorised into three broad divisions;

(i) Reserved
(ii) Protected
(iii) Unclassed and others.

Reserve forest is permanently dedicated either to production of timber or other forest produce and in which the right of grazing is seldom allowed. It is owned and operated by the government. In protected forest these rights are allowed subject to a few mild restrictions. Though owned by the government, it may be used by private individuals to meet their needs of wood and grazing. The unclassed forests are those which are under the general control of forest department and are allowed to be used by general public. The area distribution of forest by legal status in the area is given in table2.3 and figure 2.2

Table 2.3

Legal status of forest in the study area.

Legal status	Area (in sq.km)	Area (in %)
Reserve forest	2598	85
Protected forest	259	9
Unclassed & others forest	194	6
Total (including COB Division)	3051	100

Source - West Bengal State Forestry Action Plan (1996 - 2015)

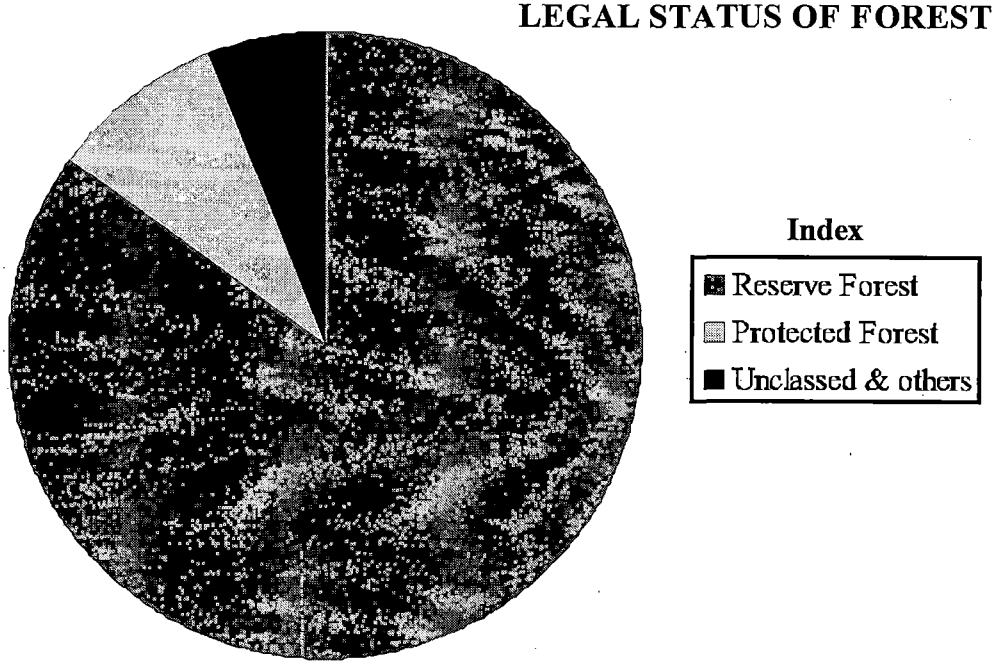

Fig. 2.2

2.2.2. Spatial distribution of forest land

It is important to note that, the forest, which is considered as one of the man's most valuable resources, have depleted through ages, particularly since the time when agriculture was introduced. But the rate and degree of depletion of forest are not same every where (Basu, 1999) In comparison to the forest of the temperate latitudes and sub-tropical latitudes, the forest of the equatorial regions have less been affected until recent times. This is largely because of the fact that the forest of the mid-latitudes and also of the tropical areas have been cleared very rapidly for the sake of expansion of agriculture and also for building roads, cities, and towns, but the tropical forests still retain, to a great extent, their virgin characters. The study area is situated within the monsoon climatic zone, gets heavy seasonal rainfall and plenty of sun light. The soils are also congenial for forest growth.

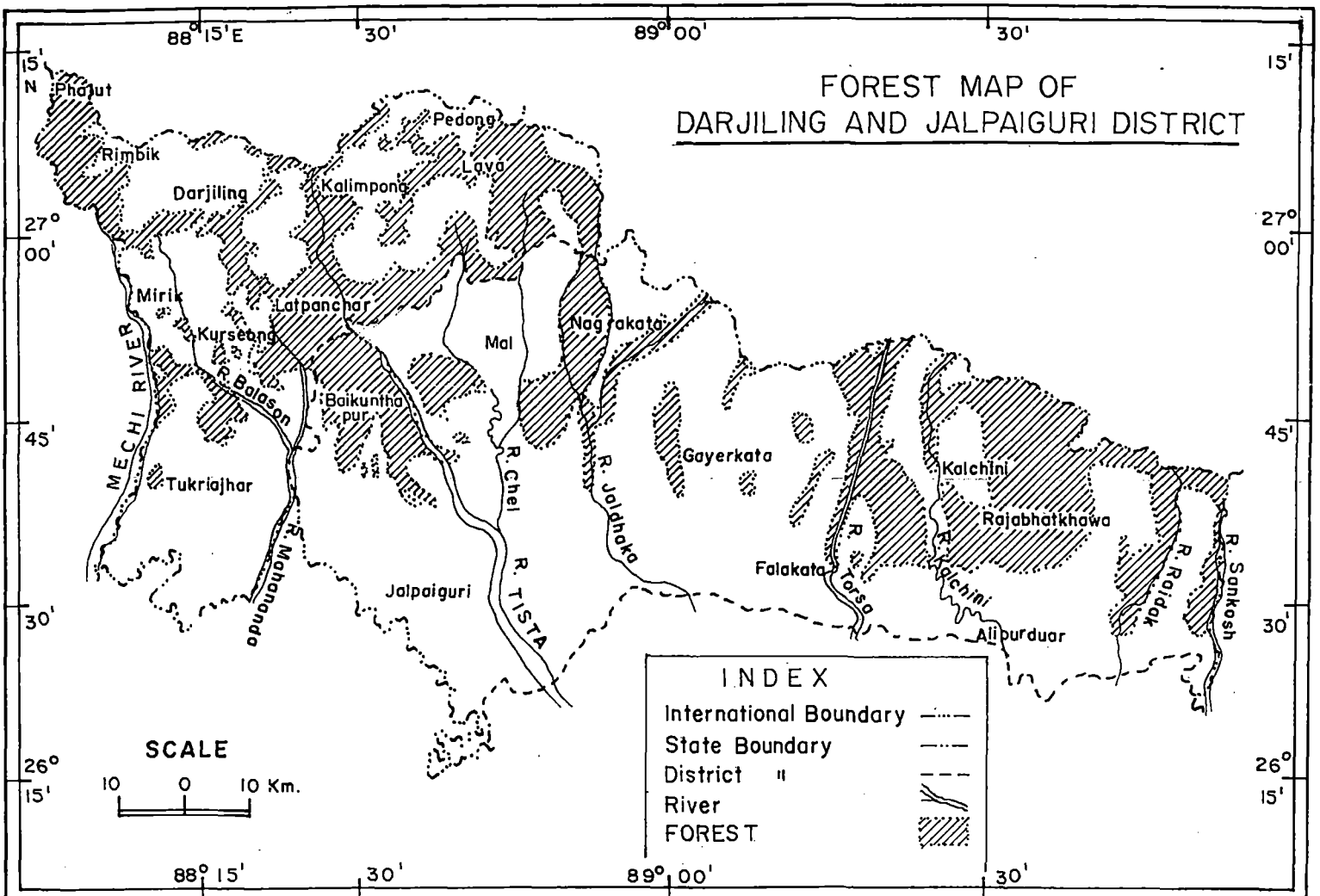
FOREST MAP OF
DARJILING AND JALPAIGURI DISTRICT
88° 15' E
30'
89° 00'
30'
15' N
27° 00'
45'
30'
26° 15'
Phalut
Rimbik
Pedong
Lava
Darjiling
Kalimpong
Mirik
Latpanchar
Kurseong
Mal
Nagrakata
R. Balason
Baikuntha pur
MECHI RIVER
Tukriajhar
R. Chel
R. Jaldhaka
Gayerkata
Kalchini
Rajabhatkhawa
R. Kalchini
Falakata
R. Torsa
R. Raidak
R. Sankosh
R. Monanadi
Jalpaiguri
R. TISTA
Alipurduar
INDEX
International Boundary
State Boundary
District
River
FOREST
SCALE
10 0 10 Km.

Fig. 2.3

During the past few years of the last century the forests owned by the government suffered wide spread damaged by illegal cutting and disintegration. So, these forest area lost their compactness. As such the original form and structure of forest have been modified except in the remote and inaccessible areas of Darjeeling and Jalpaiguri district.

Change in land use pattern, growth and migration of population in different periods of history and deforestation have influenced the spatial distribution of forest in Darjeeling and Jalpaiguri district (Figure 2.3). Even the forests which have managed to survive after prolonged exploitation show signs of degeneration. Moreover, gradual progress of agriculture on the forest lands have enhanced the problem and change the residual vegetation to scrubs. Yet these forests of the area provide the major requirement of fuel, fodder, and construction material for thousands of people living in these district.

2.3 CLASSIFICATION OF FOREST IN THE STUDY AREA

There is a positive co-relation existing in the Darjeeling and Jalpaiguri district between the diverse nature of physiography, climate and forest. Numerous factors are responsible for the changing of forest from place to place. Among the various factors responsible for spatial differences of forest, pedological and climatic factors are by far the most important (Chatterjee, 1964). Biotic, edaphic and climatic climax group dominates in forest growth. Several attempts were made to classify the forest of the study area. According to variation of rainfall and temperature the forest area are divided by Champion and Seth into following types (Table 2.4 , Figure2.4 and Photo 2.1 - 2.4)

1. Sal forests of he plains
2. Riverine forest
3. Wet mixed Sal and moist deciduous forest
4. Middle hill forest
5. Lower hill forest
6. Wet temperature montane forest
7. Alpine forest

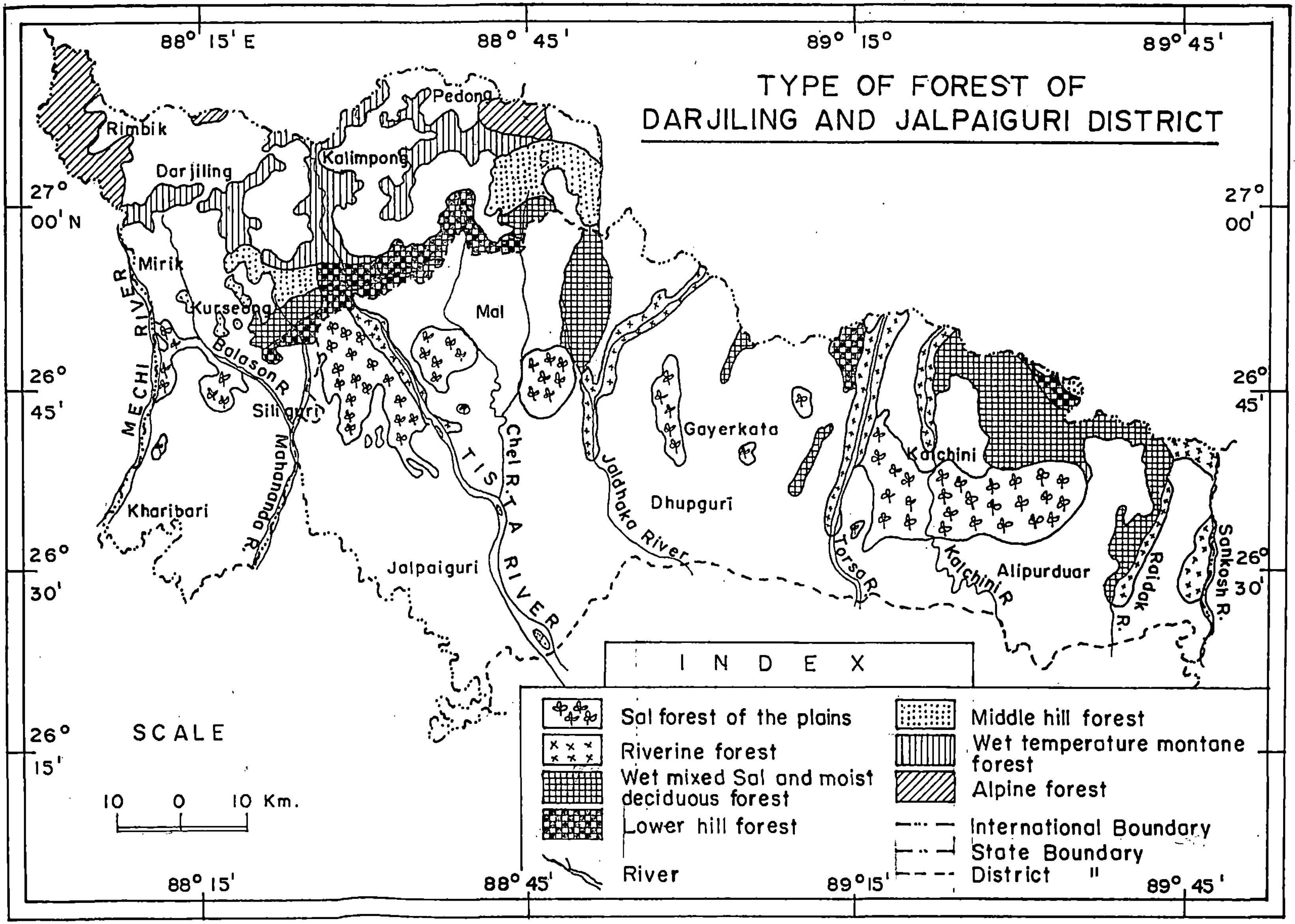
TYPE OF FOREST OF
DARJILING AND JALPAIGURI DISTRICT
88° 15' E
88° 45'
89° 15°
89° 45'
27° 00' N
26° 45'
26° 30'
26° 15'
Rimbik
Darjiling
Pedong
Kalimpong
Mirik
Kurseong
MECHI RIVER
Balason R
Siliguri
Mahananda R.
Kharibari
Mal
Chel R.
TISTA RIVER
Jalpaiguri
Jaldhaka River
Gayerkata
Dhupguri
Torsa R.
Kalchini
Kalchini R
Alipurduar
Raidak R.
Sankosh R.
SCALE
10 0 10 Km.
INDEX
Sal forest of the plains
Riverine forest
Wet mixed Sal and moist deciduous forest
Lower hill forest
River
Middle hill forest
Wet temperature montane forest
Alpine forest
International Boundary
State Boundary
District "

Fig. no. 2.4

Photo 2.1 Sal forest at Moraghat Range.

Photo 2.2 Riverine forest at Murti.

Table 2.4

Major forest types of the study area.

Forest types	Division wise occurrence	Place of occurrence
1. Sal forests of the plains	Kurseong, Wild life - I, Baikunthapur, Jalpaiguri Wild life - II, Coochbehar and B.T.R.	**Terai region** - Laltung, Salugarh, Bagdogra, Sukna, **West Duars** - Moraghat, Tandu, Apalchand **East Duars** - Chilapata, Rajabhatkhawa, Damanpur.
2. Riverine forest	Wild life - I, Jalpaiguri Coochbehar and B.T.R	**Terai region** - Sevoke **West Duars**- Diana, Murti, Jaldapara., **East Duars** - Pana, Raydak, Jayanti.
3. Wet mixed Sal and moist deciduous forest	Wild life - I, Kurseong, Jalpaiguri, Wild life - II Coochbehar and B.T.R.	**Terai region** - Sukna, Sevoke, Bagdogra, **West Duars** - Alpalchand, Moraghat, Gorumara, Chapramari **East Duars** - Jayanti, Buxa, Nimati. Chilapata, Rajabhatkhawa
4. Middle hill forest	Kurseong, Wild life-I & II Kalimpong, B.T.R	**Terai region** - Kalijhora, Latpanchar, **West Duars** - Chel, Noyam, Neora valley, **East Duars** -Raymatang, Buxa,
5. Lower hill forest	Kurseong, Wild life-I & II Kalimpong, B.T.R	**Terai region** - Panighata, **West Duars** - Jaldhaka, Samsing, **East Duars**- Buxa, Bhutanghat
6. Wet temperature montane forest	Kalimpong, Wild life-I & II Darjeeling	**Hill region** - Singalila National park (Sandakfu area), Neora valley National park (Alubari Renon area), Lava, Rimbik, Sinchal
7. Alpine forest	Darjeeling, Wild life-I & II	**Hill region** - Singalila National Park, Neora Valley (Jorpakri) Tonglu, Ghoom area

Photo 2.3 Middle hill forest at Bagora Range

Photo 2.4 Lower hill forest at Kurseong Range.

2.4. SPECIES OF THE STUDY AREA

Man's dependence on plants for his existence dates back to the beginning of the human race .In the early days he had only limited needs like food, shelter and clothing. But with the advancement of civilization his requirement also grew . The present day man depends heavily on a very large number of plants to meet his daily requirement . The forest product obtained are converted into useful articles, contributing to his comfortable life .He needs wood as a structural material, as a source of energy, for manufacturing of paper and many other fashioned and finished products . The drugs obtained from plants and plant can cure many of the human suffering starting from the simple headache to the serious heart ailments

The study area is fortunately endowed with a wide variety of climatic and edaphic conditions resulting in a rich and varied flora and fauna (Chowdhury, 1964,Mukherjee, 1965). Most of the plants are wild in nature and only a few are cultivated. Species of the forest of the area are classified into two categories :

- Species in General
- Miscellaneous Species .

Species in general indicates timber-bearing trees. On the other hand miscellaneous species means non-timber plants. General species are used as timber to sawn logs or round wood processed into veneer, plywood, furniture, poles and pulpwood. Non-timber species, in the broadest sense include bamboo, cane, grasses, fibres, and leaves of some trees , mushroom and seeds of some plants. Details are shown on figure 2.5.

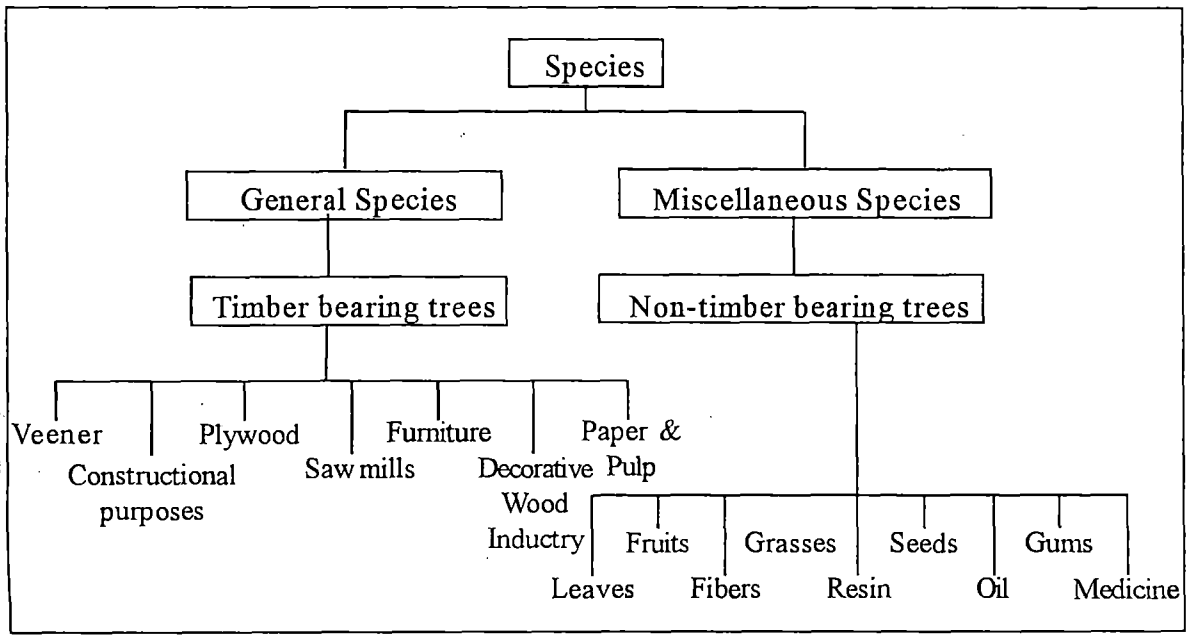

Fig. 2.5 - Different types of species and their uses in the area.

2.4.1. General species :

There are numerous species in the study area. Various factors are responsible for such variation of forest plants (Banerjee, 1964). Altitude , soil and climatic factors have influenced the growth of different species which are found in the area (Figure 2.6) . Some of the important species with their local name and scientific name are listed in Table 2.5.

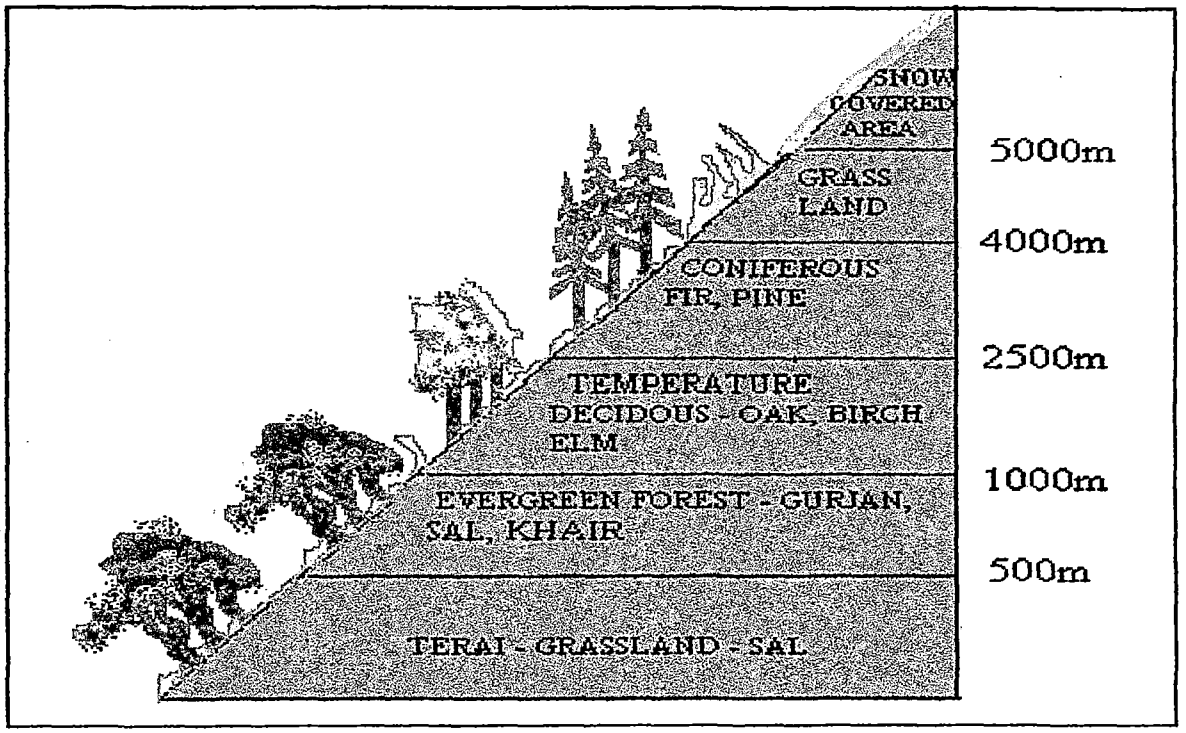

Fig. 2.6 - Variation of tree species with altitude in the study area.

2.4.2. Miscellaneous species :

Miscellaneous species include non- timber bearing trees. The products which are obtained from such trees are called non-timber forest produce (NTFP) or minor forest produce (MFP). Though sal, simul etc. are the timber bearing trees, yet these give a number of non-wood products. So these trees are considered as timber as well non-timber plants. There are various types of miscellaneous species in the area from which a variety of non-timber forest produce are available. A List is made for such species showing their products. (Table 2.6)

Table - 2.5

Some important species of the study area

Sl. No	Scientific name	Local Name
1.	*Acacia auriculiformis*	Akashmani *
2.	*Terminalia arjuna*	Arjun
3.	*Terminalia belarica*	Bahera
4.	*Betula alnoides*	Birch
5.	*Quercus lamcllosa*	Buk
6.	*Michelia champaca*	Champ *
7.	*Alstonia scholaris*	Chhatian *
8.	*Chukrassia tabularies*	Chikrasi
9.	*Schima wallichi*	Chiloni
10.	*Cryptomeria japanica*	Dhupi
11.	*Eucalyptus*	Eucalyptus *
12.	*Gmelia arbores*	Gammar *
13.	*Melia azaderach*	Ghoraneem *
14.	*Ailanthus grandis*	Gokul
15.	*Lagerstroemia flos-reginae*	Jarul *
16.	*Authocephalus cadamba*	Kadam *
17.	*Castanopsis*	Katua
18.	*Machilus*	Kawlas
19.	*Symplocos*	Kharani
20.	*Acacia catechu*	Khair
21.	*Careya arborea*	Kumbhi
22.	*Duabanga India*	Lampati
23.	*Artocarpus fraxinifolius*	Latore
24.	*Machilus odoratissaima*	Lalikawla
25.	*Macaranga pustulata*	Malata
26.	*Arundinaria racemosa*	Maling
27.	*Engelhardtia spicata*	Mauwa
28.	*Tetrameles nudiflora*	Mainakach
29.	*Cassia seamea*	Minjiri *
30.	*Auercus lamellosa*	Oaks
31.	*Terminalia crenuluta*	Pakasaj
32.	*Terminalia myriocorpa*	Panisaj
33.	*Quercus lineata*	Phalat
34.	*Book landia populnea*	Pipli
35.	*R.arboreum, Grande & falconeri*	Rhododendron
36.	*Shorea robusta*	Sal *
37.	*Bombax ceiba*	Simul *
38.	*Albizzia spices*	Sirish *
39.	*Dalbergia sissoo*	Sissoo *
40.	*Betula utilis*	Saur
41.	*Tectona grandis*	Teak *
42.	*Cedrella toona*	Toon

* Species of economic importance.

Table 2.6

Miscellaneous species for non-timber forest produce

Sl No.	Species (Local name)	Products or NTFPs / MFPs
1.	Sal (Timber & non-timber bearing tree)	1. Sal leave for Sal Plate 2. Sal seeds for oil etc.
2.	Bamboos	1. Constructional purposes 2. Making of Paper 3. Principal food for animals etc.
3.	Grasses - Citronella	Citronella oil
4.	Dhupi	Rasins
5.	Chirata	As medicinal plant
6.	Cinchona	As medicinal plant
7.	Mushroom	Edible wild plant food value.
8.	Cane	As Furniture
9.	Turmeric, Black pepper Cardamom, Ginger etc.	As spice and medicine
10.	Simul (timber & non-timber bearing tree)	Simul flower for raw cotton
11.	Gammar (timber & non-timber bearing tree)	Bark of Gammar used in cough, indigestion, seminal weakness etc.
12.	Ulatkambal	As medicinal plant
13.	Ritha	As detergent & hair smoothness
14.	Behara	Fruit of bahera used in stomach & eye ailments.
15.	Khair	As Khata
16.	Brahmi	As medicine
17.	Thankuni	Used in stomach & brain tonic

2.5. EXTENT OF FOREST DEGRADATION IN DARJEELING & JALPAIGURI DISTRICT

Deforestation and degradation of forest land are the main problems of forests in the districts. Different information about deforestation of forest in the area have been circulating in state newspaper since last few years. The people of these region realise the impact of deforestation. As such, there is no records of deforestation in the forest department. Different N.G.Os of the study area are showing their attention on the deforestation. There are many reasons for degradation of forest lands in the area (Figure 2.7). No extensive works have so far been done on the degradation of forest land of these districts. An attempt has been made in the present study to asses the extent of forest degradation in the study area based on information gathered from the N.G.Os as well as from the sample survey done during field work. Degradation caused by soil erosion, landslide, forest fire, flood etc has also been considered. Extent of forest degradation as estimated by the investigator based on the above mentioned is shown in tabuler form (table no 2.7 & photo 2.5).

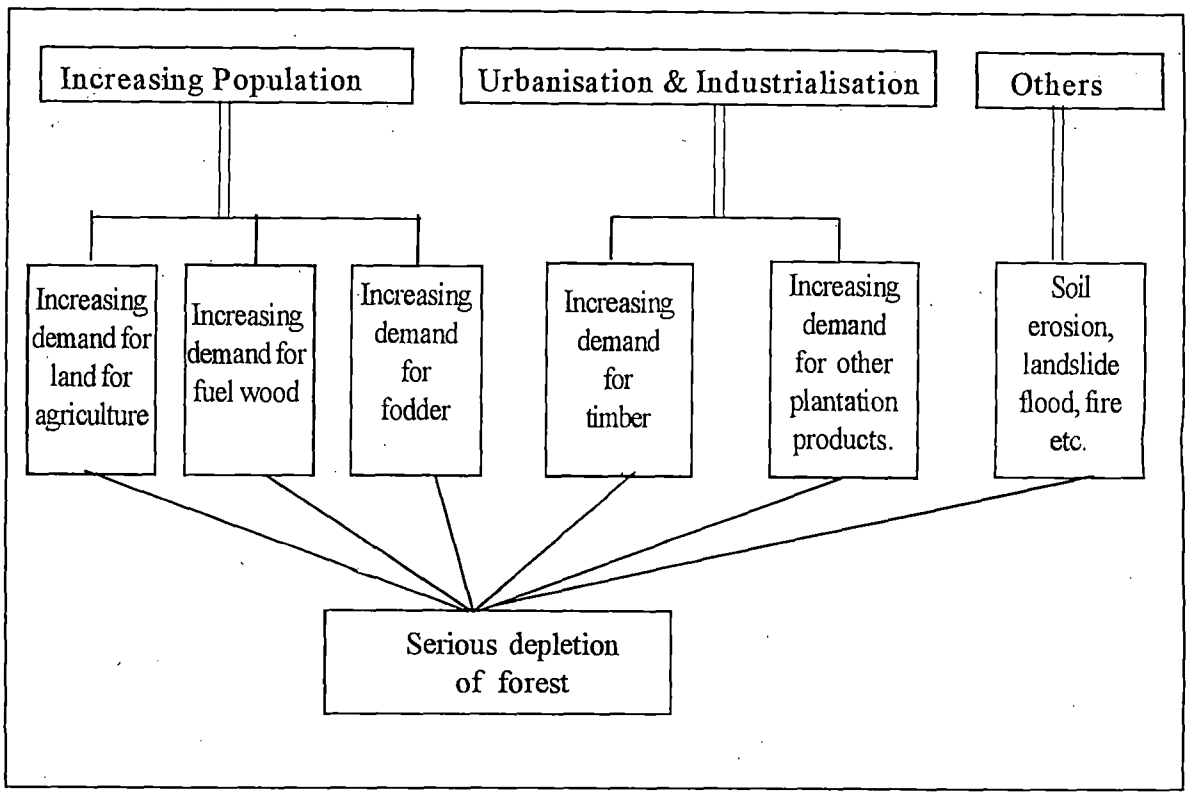

Fig. 2.7 - Causes of degradation of forest land in the study area.

Table 2.7

Extent of forest degradation of the study area

Division	Range	Severely degraded areas (more than 40% of total area)	Partly degreded areas (more than 20% of total area	% of degradation as per total range area.
Darjeeling	Tista Valley	Riyang, Geyel	Pesok	30
	Tokdah	Takdahvest, Pumong, Lopchu	Sim	30-40
Kurseong	Bagdogra	Kalka, Dolka, Kadam Central Malta, Tarabari Tirihana	Bagdogra	40-50
	Panighata	Balasan, Kalabari, Mechi	Bangkolong, Lohagarah	50-60
Kalimpong	Chel	Chunabhati, Noyam, Yanmakum	Lis, Mongpong	20
	Neora	Mal, Sakam	Ambiyok	20-30
Jalpaiguri	Moragat	North Moragat, Gosaihat	-	20-30
	Dalgaon	Dalgaon, Dhumchi Bandapani	Reti	60-70
Baikunthapur	Ambari	Total range area	-	50-40
	Belakoba	Total range area (excluding Batasivita)	Batasivita	60-70
Coochbehar (Part)	Madarihat	Khairbari	Titi	20-25
	Chilpati	Mondabari	Bariya	20-30
B.T.R.	Damanpur	Dima, Gadadhar	Damanpur	40
	Jayanti	Panbari, Cheko	Phaskhawa, Hatipota	20

Source - Sample Survey and N.G.O reports

The investigator also tries to quantify the amount of illegal felling of timber in some forest ranges the through sample survey. An estimate in this regard is given below (Table 2.8).

Table 2.8

Illegal timber collection from different forest ranges (in cu.m.)

Areas	Forest ranges from which timber is collected.	Main business centre	Average annual qty.	Main species collected
Terai	Salugara, Ambari, Dabgram (Baikunthapur), Bagdogra, Naksalbari, Sevoke, Panighata (Kurseong), Sukna (Wild life - 1), Chel (Kalimpong).	Siliguri	24000 To 25000	Sal, Segun Jalrul, Champ etc.
West Duars - 1	Lataguri, Chalsa, Ramsai, (Jalpaiguri), Apalchand, Targhera (Baikunthapur), Noyam, Chel, Neora (Kalimpong), Gorumara (Wild life - 2).	Malbazar & Kranti	13000 To 15000	Sal, Segun Jalrul, Gamari, Champ etc.
West Duars - 2	Moraghat, Nathua Diana (Jalpaiguri).	Gairkata & Banarhat	6000 To 8000	Sal, Segun Gamari, Champ etc.
West Duars - 3	Dalgaon	Birpara	3500 To 5000	Sal, Segun Gamar,Jarul Champ etc.
East Duars - 1	Jaldapara Wild Life Sanctuary (Coochbehar)Chilapata,Titi, Mandari hat, Nilpara, Kodal basti (Coochbehar), Salkumar, Jaldapara	Falakata Madarihat Hasimara Cooch - Behar	15000 To 20000	Sal, Segun Gamari, Champ etc.
East Duars - 2	Buxa Tiger Reserve	Kalchini Hasimara Hamiltonganj Damanpur Alipurduar	35000 To 45000	Sal, Segun Gamari, Champ Jalrul etc.
Total	Average annual illegal felling (excluding Hill area)		93500 to 1,18,000	

Source - Sample Survey and N.G.O reports

2.5.1 Forest fire

Forest fire causes extensive damage to ground flora every year. No major fire damage was occurred in the years 1997-98 and 1998-99 in the Jalpaiguri district. In the year 1996, plantation raised by Chamurchi beat of Banarhat range under model p_3 (Annexure-1) over an area of 10 ha. was completely damaged by fire (Jalpaiguri Forest Division, Annual Report 1997-98).

Fire has caused extensive damage to young as well as old plantations in the hilly regions of Darjeeling. The damage of the older plantations was caused in Rimbick, Tonglu and Ghoom Simana ranges of Darjeeling division. Fire has also caused damaged to the younger plantations especially in Teesta valley and Darjeeling range of this division (Table2.9)

Table 2.9

Forest areas affected by fire in Darjeeling division

Sl. No.	Year of occurrence	Area in Ha.
1.	1992 (April - May)	500.000
2.	1995 - 96	37.500
3.	1997 - 98	38.450
4.	1998 - 99	46.042

Source :- Darjeeling Forest Division - Annual Report - 1998-99

2.5.2. Snow damage

About 14.ha.plantation has damaged by snow/frost during 1998-99 at Tongly Range. (Annual Report 1998-99, Forest Department, Darjeeling Division).

2.5.3. Landslide

The denuded areas under Ghoom Simana range have suffered badly due to the erosion. Particularly affected blocks are Barbatia, Bhanjang, Ghoom and Majidhura. A large landslide has taken place in Kankibong forest block near Trishulay. The extent of landslide is estimated to be around 5.0 ha.(Annual Report-1998-99, Darjeeling Forest Division).

A picture on landslide affected areas during 1998-99 is given in table 2.10.

Table 2.10

Landslide affected forest area (1998-99)

Sl No	Forest Range	Name of the forest area affected by landslide	Location
1.	Dhodrey	Rithu forest area	Rithu
2.	Dhodrey	Plantation area 1994	Selimbarg-1
3.	Takdah	Hum block near 'O' centre	Hum-1 & 2
4.	Ghoom-Simana	Gurasedara - 4	Gurasedara - 4
5.	Darjeeling	Plantation area -1998	Risihat -1
6.	Tista valley	Peshok area -1	Peshok - 1
7.	Tista valley	Peshok area -1 & 2	Peshok - 1&2
8.	Tista valley	Approach road to Range Office	Approach road to Range Office
9.	Badamtam	Badamtam -1 & 2	Badamtam-1&2
10.	Badamtam	Sumbong	Sumbong

Source - Annual Report 1998-99, Forest Department, Darjeeling Division.

2.5.4. Flood / Bank erosion :

Flood also cause heavy damage to forest land every year (Photo 2.6). Most of the rivers of the area is subjected to occasional flooding. Some times the rivers of the districts change their courses. As a result many young and old plantation are damaged. The plantations(1996) were damaged seriously by flood in the Jalpaiguri division.(Table 2.11)

Photo 2.5 Degradation of forest land at Batabari

Photo 2.6 Flood affected forest area at B.T.R.

Table 2.11

Flood affected forest areas (in ha.) in Jalpaiguri division.

Forest range	Forest beat	Plantation model	Affected area in ha.
Madarihat	Gosaihat	P1	04.00
Dalgaon	Bandapani	P3	01.75
Nathua	South Diana	P3	01.00
Nathua	Ramsai	P3	05.00
Nathua	Ramsai	P3	15.00
Daina	Central Diana	P3	05.00
Dalgaon	Dalgaon	P5	02.50

Source - Annual Report 1996-97, Forest Department, Northern Circle, W.B.

In addition to the above causes, one of the most important direct loss caused by the unscientific and illegal mining activities in the sub-Himalayan West Bengal adjacent to Bhutan is the destruction of Jalpaiguri's rich forest, the best in West Bengal. Recent study reveals that in between 1993 to 2000, 850 hectares of good forest land was destroyed either by bank failure or by shifting river cources. Over two million trees were destroyed - the market price for which are approximately 15,000 million rupees. Huge dolomitic dust transported by air and river water accumulates on the forest floor, and rises the pH value of the soil (pH 7.5 to 8.1 recorded near Jainti). Alkalinity of the soil hinders the availability of phosphate to the plants. Non availability of phosphate along with Alkalinity is found to be responsible for dying of valuable timber especially Sal around Santalabari-Jainti area. Survey during 2000 reveals that over 5000 trees were dead around Santalabari-Jainti area. In addition to this, dolomite dust is also found to be responsible for the destruction of undergrowth rich bio diversity of this area. This also exerts detrimental effects on the wild life of the region. Shifting of river courses like Jainti and Dima 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.

2.6. ESTIMATED GROWING STOCK OF TIMBER AND NON-TIMBER

Growing stock for the different forest division is collected from the secondary sources.

There are some work on the growing stock which were conducted at the government levels by the Office of the Joint Director, Forest Survey of India (FSI), Eastern zone, Calcutta, in the year 1996 - 97. This survey reveals that the total growing stock of timber in the districts estimated at 3,27,87,690 (cu.m.). The present market price of this timber is more than 1,000 crores. A renowned N.G.O. (NESPON) of the study area has also conducted an extensive field survey for the growing stock pattern of forests of Darjeeling and Jalpaiguri district. Government records as well as N.G.O. records are considered to evaluate the exact growing stock of forest of the area. These survey report regarding growing stock of timber is given in table 2.12(a) and table 2.13(b)

Table 2.12(a)

Growing stock of timber as per forest type (in cu.m.)

Forest Type	Sample Range	Average timber per Ha.
Plains sal forest	Moraghat Apalchand	160.00 150.00
Wet mixed sal & moist deciduous forests	Chilapata Tondu	41.99 117.58
Riverine forest	Jaldapara Daina	37.08 22.62
Middle hill forest	Takhda	90.06
West temperate forest	Singalila Tonglu Lava	107.25 141.41 140.00

Source - Nagarik Mancha,2000.P355

Table - 2.12(b)
Total Growing Stock (in thousand cu.m.)

District	Growing Stock
Darjeeling	14887.69
Jalpaiguri	17900.00
Total of the study area	32787.69

Source - W.B. State Forestry Action Plan - 1996 - 2015

2.6.1. Growing stock of NTFPs

NTFPs are drawing greater attention in the area today which can supplement livelihood and income generation to the fringe people . The most important NTFPs of the study area are Citronella oil, Sal leaves, Sal seeds, Mushroom, Medicinal plants, Turmeric, Black pepper, Muster seeds, Cotton, Brooms, Khata etc. The following table (2.13) gives a picture about the present annual growing stock of some important NTFPs which is prepared by the investigator through sample survey with the guidelines of MFP Division.

Table 2.13
Growing stock of some NTFPs

Sl.No.	Name of NTFPs	Unit	Quantity/vol.
1.	Citronella oil	Ltr.	2049
2.	Blakpepper	Kg.	412
3.	Turmeric green	Qtl.	480
4.	Mushroom	Kg.	352
5.	Sal leaves	Kg.	2210
6.	Sal seeds	Kg.	2010
7.	Phul Jharu	No. of finished Pcs.	3015
8.	Bamboo	Number (matured)	6048
9.	Cotton	Kg.	1115

Source - Based on Sample Survey and MFP Division Report 2000 - 01

2.7. CONCLUSION

Forest is an important segment of economic development of the study area. They not only directly provide forest produce, employment to the rural poor, contribute immensely to rural energy, indirectly sustains the natural system which enriches human life in the districts. Most important matter of the forest of study area is that the proper inputs should be given to increase the production such as quality of multipliers like seed, clone, cuttings, grafts etc. to be selected from seed stand, seeds orchards only and all types of improved pre-planting techniques should be adopted like - seed collection, seed storage, treatment etc. Intensive silviculture should be adopted which is neglected in many cases like weed cleaning and finally thinning. Economically important species should be planted more to get a good amount of revenue which can improve the economic condition of the study area. Not only the wood matter but some NTFPs should be exploited on sustainable yield basis apart from natural means, propagation as inte-rcrop, value addition of the same by processing and marketing support for all forest produce should be ensured .

The forest sector is lacking proper data base and whatever data have generated are preserved in haphazard manner and become impossible to retrieve when needed. Great difficulties are found while collecting the different data for growing stock of timber in the study area. No ready made data are available for the estimation of NTFPs in the study area. So the activities F.S.I and Monitoring Cell of the forest department should be improved to preserve the data in systematic manner.

The vital problem of the forests of the area at present is the massive deforestation. There is no specific record with the forest department regarding deforestation of Darjeeling and Jalpaiguri districts. But this is an environment event in the study area. Forest department should not neglect such an important issue. During the course of sample survey, it is observed that there are some areas where the rate of degradation is more than 50% of the total forest area. The State Government should take immediate steps to stop such great extent of degradation of forest lands of the area. Otherwise this valuable natural resource of the area will be exhausted in near future.

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CHAPTER - 3

STATUS OF FOREST RESOURCE UTILISATION

3.1. INTRODUCTION

Forest is a multipurpose resource. It`s importance lies in its capacity to meet various kinds of human needs. In terms of weight, the timber supplied by forest is now second to coal among all raw material produced in the world. The benefits of forest are everlasting if it can be properly conserved. Forest of the study area may be divided in two classes - commercial and non -commercial. Commercial forest provides different kinds of timber and forest produce. Non-commercial forests are maintained to enhance the beauty of the landscape which also helps in tourism and to protect the area against landslide, soil erosion and flood .

Forest of Darjeeling and Jalpaiguri district provide employment to many and the business connected with forest plays an important part in the regional economy (Ghosh 1981). The most important product of forest of the study area is timber or wood and there is hardly any house where wood is not used in one form or another. The use of steel concrete and plastic materials has gone up tremendously no doubt. They have reduced the importance of wood to a considerable extent. Inspite of that the demand for wood is on the increase in the study area. But the development of forest industry of Darjeeling and Jalpaiguri district depends upon a number of factors. They are the relief of the land, nature of the forest, transport facilities, demand for wood, adequacy of capital and labour and the enterprising character of the local people who are interested in the development of this industry (Singh 1997). Another characteristic feature of this industry is its doubtful success if undertaken on a small scale. So, it is desirable that it should be undertaken on a large scale to cover a wide area. This industry is flow resource, but wanton timber cut makes the forests of the study area an exhaustible resource. So it is necessary that the annual cut should not exceed the annual growth. Afforestation and conservation of forest of Darjeeling and Jalpaiguri district should go side by side with exploitation of forest (Bist,1997). The major uses of forest resource of the area is shown in the following figure 3.1.

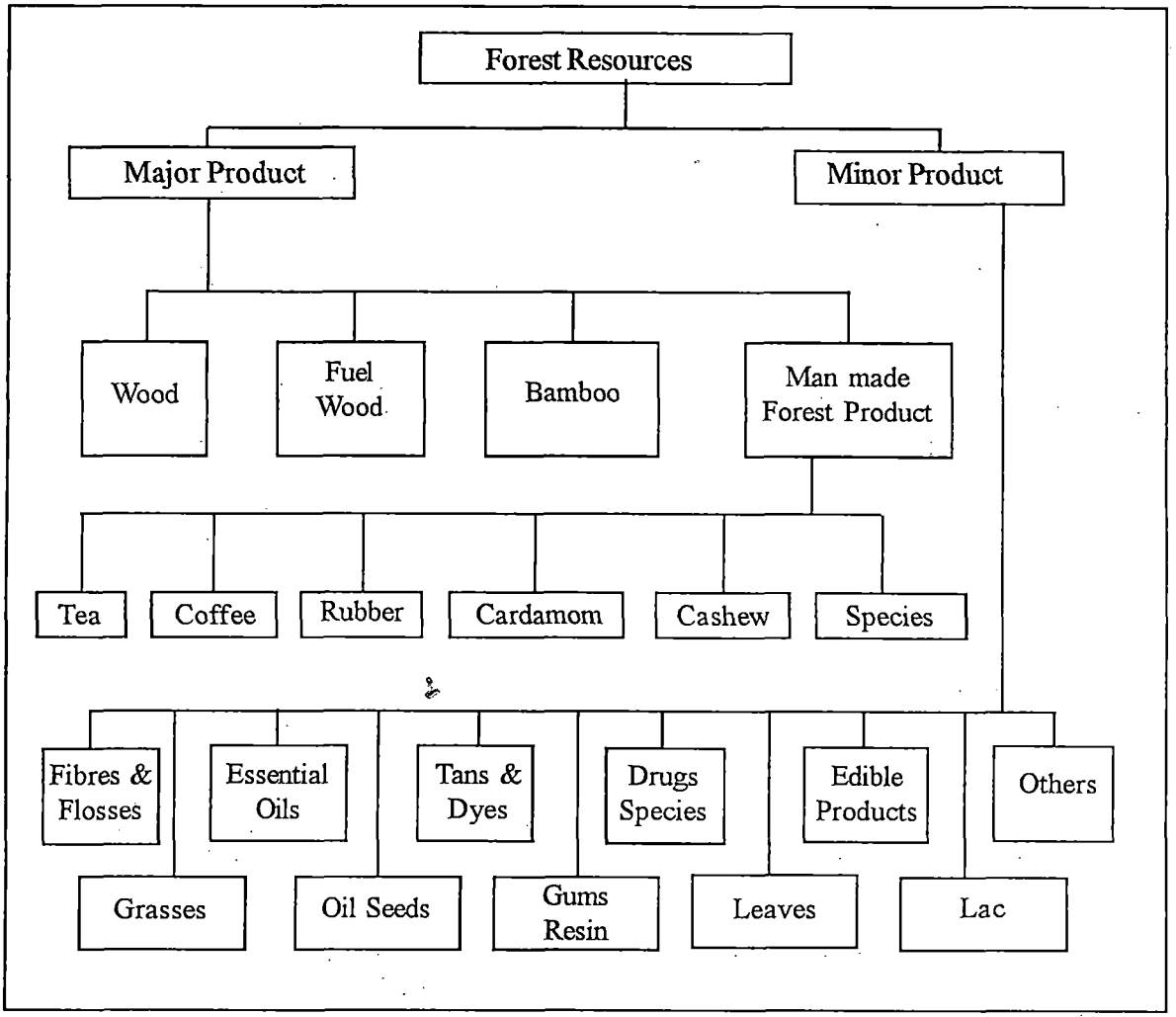

Figure 3.1 Major uses of forest resource

The **aim of this chapter** is to assess the present pattern of forest resource utilisation. It includes classification of forest based industries, demand of timber and fuel wood, employment generation by wood based industries and role of WBFDC in the industrial development of the study area. It also aims to identify various problems which are related to the forest resource utilisation and suggest corrective measures for prevention and to ensure all round development.

The **methodology** employed in the study is rationalistic one, comprising of the quantitative distribution of timber, composition of raw material pattern in forest based industries and analysis of demand of wood and non-wood products. Data have mostly been collected by the investigator through sample survey. Random sample has considered to give sufficiently reliable picture of the resource under consideration.

3.2. Forest based industry in the study area

The forests of Jalpaiguri and Darjeeling district are a store house of variety of major and minor products. The important forest products are wood and a number of minor forest produce (MFP). The industries which are based on forest produce of the study area is shown on the following figure 3.2

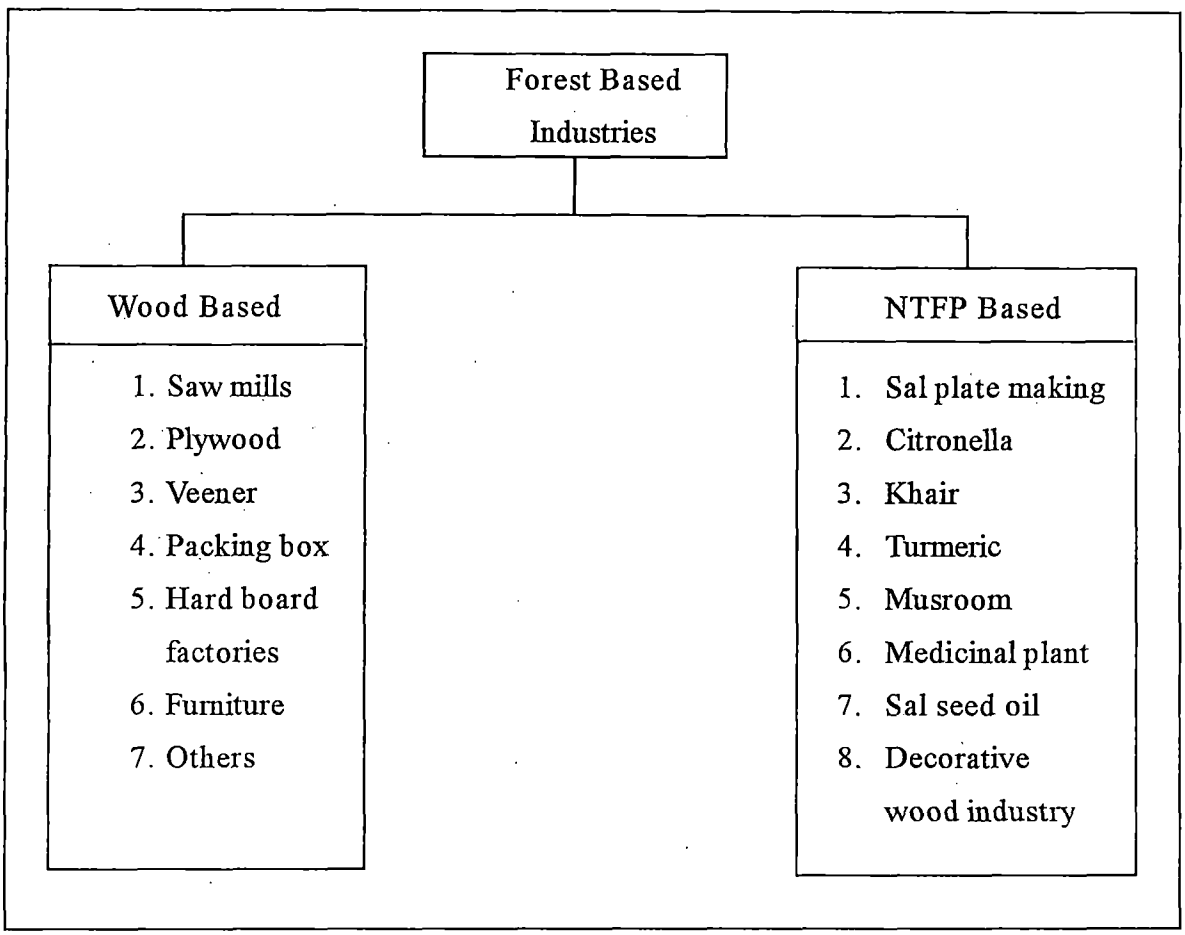

Figure 3.2 Types of forest based industry in the study area.

3. 2.1 Wood based Industries in the districts

The wood based industries occupy a prominent place in the economy of Darjeeling and Jalpaiguri district. These industries are traditionally dependent upon forests and consume huge quantity of wood and provide employment opportunities to the rural population. There

are large number of wood based industries in the study area namely saw mills, veneer mills, plywood, furniture , packing box etc (Photo 3.1 - 3.4). These industries require about 6 lakh cu.m. of timber annually on single shift basis (Singh, 1997). During next few years two big projects requiring small wood and soft wood as raw materials on anvil. M/s. Green Ply and M/s. Darjeeling paper and pulp are being set up to manufacture MDF board and paper. There are also large number of furniture industry mostly located in Dhupguri, Madarihat, Malbazar, Siliguri and Shibmandir. During the course of sample survey on wood based industries in the study area, it is observed that saw mills are the largest industries which accounts about 80% of wood based industries. The second largest is the furniture industry. Different aspects of these industries are studied through sample survey and are shown in the following sections.

3. 2.1.1. Status of saw mills :

Saw mill is the most important wood based industry in the area. There are large number of sawmills which are mostly managed by the private ownership. The West Bengal Forest Development Corporation (WBFDC), a government undertaking has four sawmills of it's own, located in Siliguri, Madarihat, Bhuttabari and Sarugarah. Swan timber products of this mills is sold to genuine consumer through a net work of 8 sale depots owned by the Corporation. The overall pattern of distribution in regard to establishment of sawmills existing in the study area is given in table 3.1.

Table 3.1

Year of establishment (in percentage)

Year of establishment	Number of saw mills (in %)
Before 1980	31.25
1981 - 1985	33.65
1986 - 1990	20.25
1991 - 1995	13.85
1996 - 2000	1.00
Total	100.00

Source- Sample Survey

Most of the saw mills were established during 1981-1985 (33.65%) followed before

Photo 3.1 Saw mill at Latagurl .

Photo 3.2 Box making factory at Berubari.

1980 (31.25%). After 1985 there has been decrease in the establishment of new saw mills and maximum decline was observed between 1990-95 and 1996-2000. These may be because of ban on felling and increasing awareness regarding conservation. After 1996 few saw mills were established at the different places of Jalpaiguri district. Most of these are closed by the High Court order and sealed by the respective Forest Ranges. The overall basis of installed capacity of sawmills in the area is given in table 3.2.

Table 3.2

Installed capacity of saw mills (in percentage)

Installed capacity (Cu.m.)	Number of saw mills (in %)
Upto 500	10.60
501 - 1000	35.26
1001 - 2000	47.57
2001 - 4000	2.66
above 4000	3.91
Total	100.00

Source- Sample Survey

It is seen from the above table 3.2 that 47.57% of the saw mills in the area have a capacity of 1001 - 2000 cu.m yearly followed by those capacity of 501-1000 cu.m (35.26%). There are only 3.91% sawmills having installed capacity of more than 4000 cu.m yearly. In Jalpaiguri district sawmills have installed capacity of 1001-2000 cu.m. yearly is more in number as compared to Darjeeling district. The picture is different in case of saw mills of Darjeeling district with capacity of 501-1000 cu.m. which accounts 55.85% where as in Jalpaiguri district it stands14.66%.

3.2.1.2. Sources of raw material of saw mills:

Saw mills of the study area collect rawmaterials for their own requirement from different sources. These sources include local forest division, social forestry, agro-forestry and other sources. During the course of sample survey an interesting picture has come out regarding the sources of material. At present, about 70% raw materials are collected from social

Photo 3.3 Furniture factory at Jalpaiguri.

Photo 3.4 Plywood factory at Dhupguri.

forestry followed by 21% from local forestry division through auction. Saw mills which are located in Jalpaiguri district collect major quantity of wood from social forestry. The picture is totally different in Darjeeling district where saw mills are mainly dependent on local forest division (55.60%). Social forestry plantations contribute only 30.40% of raw materials to the saw mills. Social forestry plantation of Darjeeling district have not achieved it's desired result on account of illicit collection of timber and fire wood. Moreover, auction of timber by local forest division is not arranged regularly due to restriction of clear felling .This is a vital problem faces by the saw mills of Darjeeling district. Wood from agro-forestry is mainly collected from tea gardens. The table 3.3 shows the sources of raw materials for saw mills in the districts.

Table 3.3

Sources of raw material of saw mills (in percentage)

Sources of materials	Quantity of raw materials (in %)
1. Local Forest Division	20.70
2. Social Forestry (farm forestry & strip plantation)	69.80
3. Agro-forestry	7.15
4. Others	2.35
Total	100.00

Source- Sample Survey

3.2.1.3. Employment generation by sawmills

The forests play an important role on the regional economy. The distribution of wood based industries, their transportation from producing area to consuming centre, exert great influence on regional economy. It opens large avenues of employment (Chetty,1985). Saw mills are the major industry in the study area which provide employment opportunity to the local people directly and indirectly. Two types of workers are engaged in the saw mills - (i) direct workers who are directly related with the production and (ii) indirect

workers who are involved in collecting raw material and marketing the end products. Number of direct workers employed by per saw mill is on a range of 15 to 20 persons. This figure vary from place to place. Direct employment opportunity provide by the saw mills is not very significant but it creates a long chain of labour force which indirectly influence the local economy. It is important to note that employment provide by the saw-mills is much higher than that of other small scale industries. The development of saw mills without adequate transportation system is not possible. So the exploitation and transportation of timber helps to develop transportation network which is provided large number of employment. The way in which saw mills are generating employment in the study area is shown below (Figure 3.3)

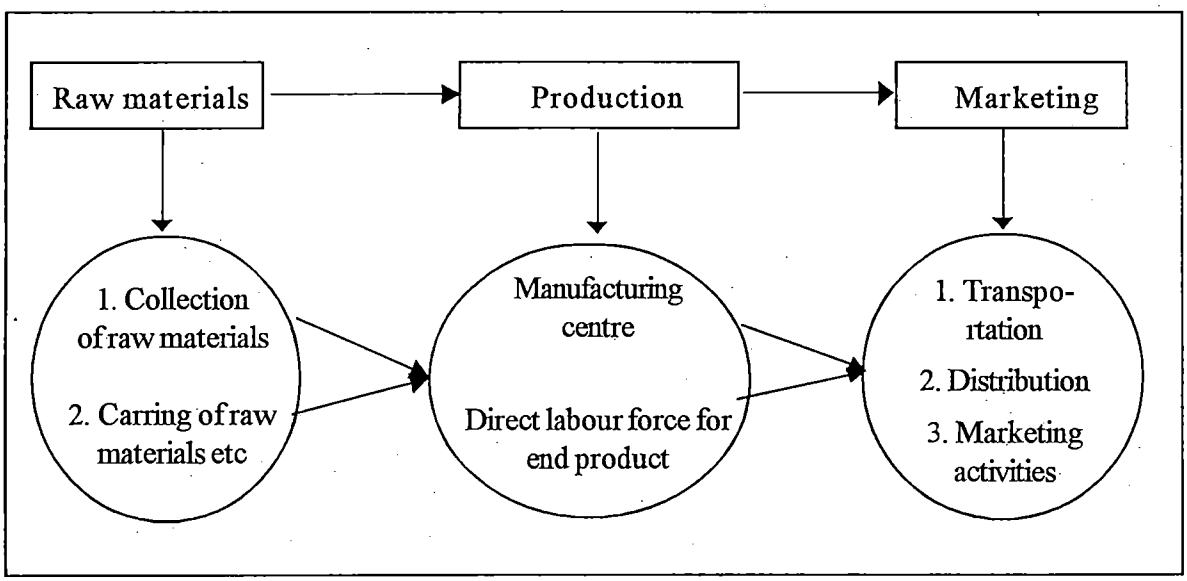

Figure 3.3 - Type of employment generation by saw mills in the study area.

3.2.1.4. Legal status of saw mills :

Most of the saw mills in Darjeeling and Jalpaiguri district are controlled and managed by private ownership. There are only 4 saw-mills which are undertaken by the Government of West Bengal through the establishment of WBFDC in the year 1974. The legal status of different saw mills under private management is classified into three categories - sole proprietorship, partnership and Pvt. Ltd.. Co., which are given in figure 3.4. It is observed through sample survey that 62.04% of saw mills are run by sole proprietorship followed by 35.77% under partnership business. Only 2.19% of saw mills are undertaken by Pvt. Ltd. Co., which reveals that the size of the saw mills of the area has not expanded to a significant level.

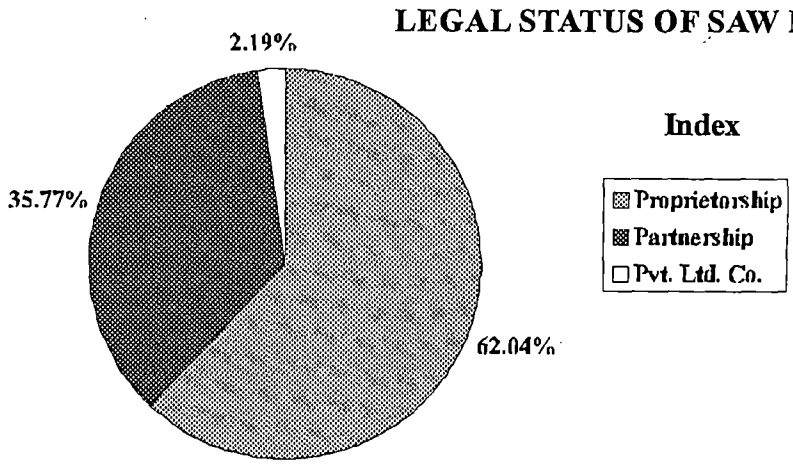

Figure 3.4

3.2.1.1.1 Status of furniture industry

Furniture industry is playing a vital role to boost up the economic condition of the study area. It has direct and indirect influence on the local economy. Furniture industry provides a large number of employment to the local people and use huge quantity of wood. During the course of field survey, it is observed that the employment opportunity provided by furniture industry is on average of 10-15 persons by per industry. Details are given in table 3.5.

Table 3.5

Distribution of Furniture Industry

Business Centre	No. of industry	Worker engaged (in person)
Siliguri, Bagdogra & Sivmandir	200	3108
Madarihat	45	540
Falakata, Dhupguri	55	668
Alipurduar	42	336
Malbazar, Lataguri	33	230
Jalpaiguri Town	30	288

Source- Field Survey

3.2.1.1.2 Raw material consumption for wood industries

About the pattern of consumption of raw materials by species, it is observed during the sample survey that Sal, Jackfruit, Neem, Gammar, Kadam, Dhupi, Arjun and Akashmani are the popular species in use. In Darjeeling district the maximum demand for Sal, Dhupi, Teak, Akashmani and Cottus where as in Jalpaiguri district the species in maximum demand for industries are Sal, Jackfruit, Neem, Arjun, Kadam and Gammar. All other varieties of wood are used in less quantity. Details are given in table 3.6.

Table 3.6

Usage of raw materials by species (in percentage)

Name of the species	Material used (in %)
Mango	1.50
Sal	21.00
Jackfruits	4.50
Neem	3.00
Arjun	2.00
Pine	2.00
Jarul	3.50
Gamar	7.00
Kadam	3.00
Teak	9.00
Dhupi	16.00
Cottus	7.50
Akashmani	11.50
others	9.00
Total	100.00

Source- Sample Survey

3.2.2 INDUSTRIES BASED ON NTFP (NON -TIMBER FOREST PRODUCE)

Non-timber forest produce includes all other tangible outputs including fuel and fodder, biomass, cane, bamboo, grasses, fibers, oils, gums, resin, medicinal harbs, sal leaves,

flowers mushrooms etc (Gupta, 1999, Krishnamurty, 1999). At present NTFPs of districts are drawing more attention as this can supplement livelihood and income generation to the fringe people. The most important NTFP of the area are sal leaves, sal seeds, honey, citronella oil, gums, resin, cardamom, chirata, black pepper, mushroom etc. Few small scale industries are being set up in the area based on NTFP.

Sal leave plate making is an important cottage industry in the area. Most of the sal leave making industry is located in Rajganj, Balacoba and Alipurduar block. This industry provide a good number of employment to the rural people. The State Government is giving financial assistance to this cottage industry through the District Industrial Centre. Sal leave plate has a great potential as it is biodegradable, hygienic, partly used as fodder after use. Systematic collection of leaves will also remove fire hazard in the forest during dry seasons (Tewari, 1999).

A mushroom manufacturing centre for production of spawn mushroom was established in Darjeeling forest division at Barakakjhora in march 1995. After initial training was imparted to the local workers, the centre started functioning full-fledgedly from the month of June 1995. During the year 1997-98 about 4030 packets of spawn were sold. A brief picture of production of various NTFPs in the Darjeeling and Jalpaiguri district is listed in table 3.6

3.3. ACTIVITIES OF W.B.F.D.C. LTD.

West Bengal Forest Development Corporation Limited was set up on the recommendation of National Commission of Agriculture. This corporation started functioning from 2nd November, 1974. Basic objectives of the corporation are as follows-

(i) To offer timber, non-timber forest produce and value added product, at reasonable price.
(ii) To help in promoting wood based industries.
(iii) To generate rural employment through forestry and related activities.

The corporation holds lease of about 440 sq.km. of forest area primarily in Kalimpong Forest Division. WBFDC produces tangible income-generating timber and non-timber forest products. Details are given in table 3.7

Table 3.6

NTFPs production in the districts.

SL No.	Name of NTFPs	Unit	Production (1999-2000)
1.	Citronella oil	Lt.	2049
2.	Black Pepper	Kg.	412
3.	Turmeric (Green)	Qtl.	480
4.	Golden mushroom	No.	33843
5.	Sal leaves	Kg.	2210
6.	Sal plate	No.	45000
7.	Sal seeds	Kg.	2010
8.	Phuljharu	No. of finished pc.	3015
9.	Bamboo	No (matured)	6048
10.	Cardamom	Kg.	270
11.	Cane	Bundles	100
12.	Semul flower	Kg.	380
13.	Chirata	Head load	50

Source - Data collected from Forest Department of Darjeeling, Jalpaiguri and Minor Forest Produce Division, Hill circle.

Table 3.7

Composition of Forest Products of W.B.F.D.C in the Study Area

Wood Products	Non-Timber Forest Products (N.T.F.P)
1. Timber (Round wood, Sawn wood etc.) 2. Poles 3. Fuel Wood	1. Semi mechanised Khata (manufacturing unit at Madarihat 2. Citronella Oil 3. Honey 4. Turmeric 5. Black Pepper 6. Black mustered 7. Cotton 8. Cardamom 9. Ginger 10. Resins 11. Gums 12. Khair etc.

Source : Based on discussion with forest officials, Forest Department

The industrial activities of WBFDC in the districts are classified into four groups which is shown in table 3.8.

Table 3.8

Industrial activities of WBFDC in Darjeeling & Jalpaiguri District

Name of the Industry	Total Number	Location
1. Saw mills	4	Siliguri, Sarugarh, Bhuttabari & Madarihat
2. Solar Seasoning Kilns	4	Two at Sarugarh & one each at Bhuttabari & Madarihat.
3. Joinery and Carpentry unit	3	Garubathan, Siliguri and Madarihat
4. Semi-mechanised Khata manufacturing unit	3	Madarihat

Source : Office of the General Manager (North) WBFDC, Siliguri.

WBFDC meets the growing demand of swan timber for construction and furniture making in the area. For distribution of swan timber among the general public at reasonable price, the corporation opened 8 sale depots owned by the Corporation. The same is also being distributed in different districts of West Bengal through 130 dealers drawn from middle class unemployed youth. In various activities of the corporation more than 2000 persons are finding daily employment in addition to regular employees. It is one of the important profit making government undertaking concern in the area.

3.4. DEMAND OF WOOD

The demand for wood is basically in the form of timber, poles, small and softwood, fuel wood etc. The users consist of general users and industrial users. The general users use the product as timber and fuel wood. They consist of furniture makers, building contractors and truck body builders etc. Industrial users use small wood of different soft species for plywood and manufacturing of wooden boxes. Table 3.9 shows the nature of wood demand in percent, based on sample survey within the districts under the study.

Table - 3.9

Nature of wood demand (in percent)

Types	Demand in percent
1. Timber (including poles, small wood etc.)	65.00
2. Fuel wood	33.50
3. Others	1.50
Total	100.00

Source-Sample Survey

The maximum demand of wood in the form of timber (65%) followed by the fuel wood consumption (33.50%). In Jalpaiguri district there is a maximum demand of timber (71%). This is due to the availability of best quality of sal forest of the district.

3.6. DEMAND OF NTFPs

NTFPs are getting more attention in the districts. Demand of different NTFPs has increased to great extent. Forest department has set up some retail shops of NTFPs at the various places of Darjeeling and Jalpaiguri district. Attitude of people regarding NTFPs has been improved. Citronella oil is an important NTFP which gives a good revenue to the forest department. Sal - plate making has become an important cottage industry in the area. It has also a good demand in the market. Mushroom culture is also improving. This NTFP has become very popular in the hilly region of the study area. The utility of other NTFPs to the local people has also been increased. The overall demand pattern of different NTFPs is given in table 3.10. Sal -plate (26.50%) and Citronell oil (22.50%) have occupied a good share in the market of Darjeeling and Jalpaiguri district. The quality of Turmeric, Black pepper and Cardamom which are sold by W.B.F.D.C. is very good. As a result the demand of these NTFPs are increasing. The overall demand of different NTFPs in the area will be very bright in future if these are properly collected and managed.

Table - 3.10

Distribution of demand of different NTFPs (in percent)

N.T.F.Ps	Demand in percent
1. Sal plate making	26.50
2. Citronell Oil	22.50
3. Mushroom	21.50
4. Turmeric, Black pepper, Cardamom	17.50
5. Others (Resin, Gums, Cotton, Khair etc.)	12.00
Total	100.00

Source-Sample Survey

3.6 CONCLUSION

The condition of forest based industries in the study area are not so bright due to the restriction on clear felling of natural forests by the government which was the old practice in the state and was the only silviculture system followed in high forests. So the major problems faced by the industries is the shortage of raw materials. Import of timber is also limited and costly. The New National Forest Policy 1988 (Annexure - 2) have also imposed a great restriction on the forest based industry. The National Forest Policy states that the forest based industries should manage their own requirement. Forest should be conserved to act as a genepool reserve and used for preserving the bio diversity instead of using for meeting demand of industries. It is therefore, imperative that the efforts be made for meeting the demand of these industries by growing trees out side the forest areas. Economically important trees should be planted. Awarness of tree plantation must be raised among the rural people. Three approaches are suggested in this regard which include the following :-

- Farm forestry or growing of trees by individual on their farm lands and other un-utilised lands.
- Stip plantation - growing of trees on strips along roads, embankment, railway lines, canals, rivers etc. by community.
- Agro - forestry.

It is also increasingly felt that the management of forest resource for NTFPs may be more sustainable from ecological and economic perspectives. NTFPs activities involved non-destructive harvesting of annual renewable plant part in contrast to timber harvesting regimes. Further, managing of forests for NTFPs also implies a great biodiversity of both plants and species in the area. Government role is very important for the development of NTFPs. Forest department should take the necessary steps for the proper exploitation and utilisation of NTFPs. Then only the possibility of augmenting employment in this sector will be bright.

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CHAPTER - 4

STATUS OF MARKETING OF FOREST RESOURCE

4.1. INTRODUCTION

Marketing of any product is determined from the end users' point of view. The product should have a market to start with. The marketing of wood specifically the timber, pole, firewood, depends on how it fullfil the consumers' needs for a certain specific activity. The different wood products fullfil different type of needs of the user. The timber of certain species are in great demand and in fact, the producers are unable to fullfil the market demand. Similarly, firewood has huge demand in rural / semi - urban areas. The need for creation of a marketing network arises in case of specific forest products for group of end users. One important parameter which influences marketing is the price (Lathara, 1976). The price at which producers negotiate with the buyer is an important determinant of the financial resource to continue the production / commercial activities. No organisation in wood trade can dictate the market but for certain products the quality claims its superiority over others. Other factor which influence market of wood are the substitute products. For analysis of marketing of timber, poles, small woods and firewood, some important market centres are selected to understand the marketing scenario of the area. For certain specific products, market does not respond well. The market centres are important because they provide a lot of information to understand the trends in marketing of wood products as a whole (Ghosh, 1997)

The bulk of forest produce in North Bengal comes from government forests. In Darjeeling there is mostly man-made conifer forest while Jalpaiguri to the east features the best sal forests in the country. Before the restriction on felling natural forests, a total of 1,000 ha. natural forest was harvested and new plantations established annually in the two areas put together. The total production from the 400 ha. of mature plantations annually available for harvesting is estimated at 40,000 cu.m. timber and 60,000 cu.m. fuel wood. (State forestry action plan, 1996 - 2015). Most of the fuel wood is sold to tea gardens and the army at pre determined allotment prices. The match wood is sold to Wimco in Kolkata and plywood species to local industries.

There are some 25 NTFP items, including both government undertaking and non-government undertaking in the study area, which are being handled by the W.B.F.D.C. The W.B.F.D.C. has retail shops at the different places of Darjeeling and Jalpaiguri district. Alipurduar of Jalpaiguri district is the main marketing centre. The NTFPs have a good demand in the study area and in other districts of West Bengal. The most important factor for the marketing of NTFPs in the area is the quality and utility of such products. General people are not very familiar about the use of NTFPs except citronella oil, honey etc. which have a stable market. Advertisement and publicity on NTFPs may help to raise the demand of such products. Similarly, the price of NTFPs is also an important parameter which influence the marketing (Gupta, 2001).

4.1.1. Objectives :

This chapter analyses the marketing network of timber, poles, small woods and fire woods. Few marketing centres have been selected by the researcher to understand the marketing scenario of the study area. It focuses the different type of buyer and seller who are involved in trading of forest products. Price of some selected species and their growth rate are also highlighted. This chapter also examines the various demand of woods as well as non-wood products. Few measures are also suggested by the investigator to improve the marketing network of forest products of the area.

4.1.2. Methodology :

The present study has based on both primary data which has been collected from sample plots and through questionnaire as well as from multifarious secondary sources including West Bengal Forest Development Corporation and Timber Merchant's Association, North Bengal. Five types of questionnaires have been issued among the respondents. Respondent group includes : (i) wood based industries, (ii) market centre and (iii) wood depots. Random sample has been taken to give sufficiently reliable picture of the forest product under consideration. 8 market centre, 15 wood based industries, 4 wood depots, 10 saw mills and few furniture and toy making units in the area have been surveyed.

4.2. MAJOR MARKET CENTRES

The major market centres in the districts under study are given in table 4.1. Other than these local markets, a big secondary market exists in Kolkata. This market not only controls the wood products of the area, but it also distributes the imported timber from Malaysia, Myanmar as well as inter-state products from Assam, Manipur, Arunachal Pradesh etc.

Table 4.1

Major market centre

District	Market Centres
Darjeeling	1. Kalimpong 2. Siliguri 3. Kurseong 4. Bagdogra 5. Shivmandir
Jalpaiguri	1. Birpara 2. Madarihat 3. Kalchini 4. Malbazar 5. Alipurduar 6. Dhupguri 7. Falakata 8. Lataguri 9. Oodlabari

4.2.1. Sources of raw material procurement (wood depots)

The sources of raw material procurement is done through sample survey. The results have been tabulated in table 4.2

Table 4.2

Sources of wood procurement (Respondent percentage)

Source	Volume (in percent)
1. Local forest department	40.80
2. Nearby village	31.20
3. Social forestry	14.60
4. Import	6.30
5. Other Sources	7.10
Total	100.00

Source-Sample Survey

4.2.2. Distribution of species in wood depots

The distribution of wood species in wood depots has been assessed through sample survey. On the whole Sal is the main species with 43 percent storage followed by Sissoo (14.5%), Teak (9%) Gamar (6.5%) and Jarul (5.5%) as per the details given in figure 4.1

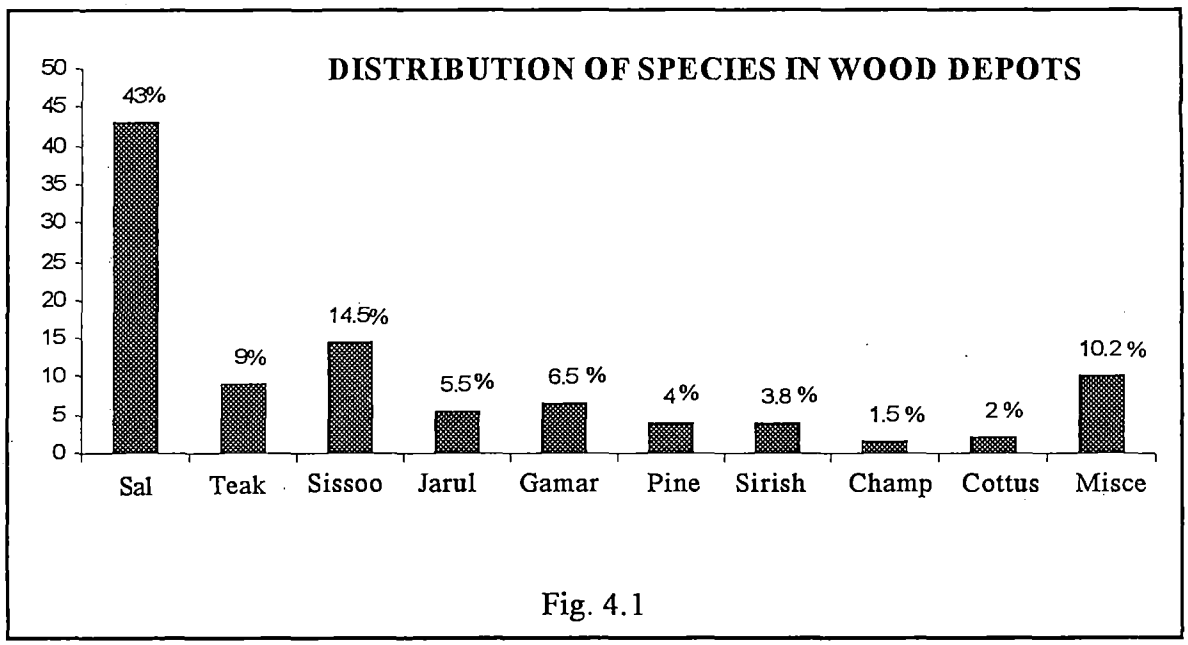

Fig. 4.1

4.3 - STATUS OF TRADERS

The wood trade provides handsome returns with secured and sustained market. It influences the new generation to take initiative in this trade. Normally the people are involved in retail business. This trade demands huge investment for whole sale business. As revealed by the sample survey, the status of traders involved is given in the table 4.3

Table 4.3

Distribution of wood traders by status (in percent)

Type of traders	Share (in percent)
1. Retailer	80.80
2. Wholesaler	5.20
3. Contractor	---
4. Fuel wood seller	4.50
5. Intermediary	3.10
6. Any other	6.40
Total	100.00

Source-Sample Survey

4.3.1 Role of Intermediaries :

The intermediaries are playing an important role in marketing of wood products. During the course of sample survey it is seen that the intermediaries have developed the wood market in the study area. Their activities are mainly to find markets, setting competitive price, regulating the market response properly etc. Table 4.4 depicts the distribution of intermediaries in the market by activities. It is also observed that without the function of intermediaries, the wood market cannot be developed in the area. Intermediaries have created a proper channel between the producers and the ultimate users.

Table 4.4

Role of intermediaries in wood marketing (in percent)

Activities of intermediaries	Share (in percent)
1. Finding market outside the state	19.50
2. Getting proper price of the product	19.30
3. To compete with other state sellers	21.40
4. Proper channelisation for industry	12.50
5. Regulating the market	27.30
Total	100.00

Source-Sample Survey

Table 4.4 reveal that the intermediaries play a vital role in regulating the wood market (27.3%) followed by competition with other state (21.4%). Intermediaries are not playing a vital role for the development of wood based industries in the study area. In Darjeeling district intermediaries are functioning properly to regulate the market. This may be because of the Siliguri town which is a very important market centre in the study area. Development of market out side the state is also an important function of the intermediaries. The position of Jalpaiguri district in this context is satisfactory . The Sal timber of Jalpaiguri forest has a great demand in the country (Forestry Consultant, 1994).

4.4. PRICE OF SELECTED WOOD SPECIES

As per the sample survey, species wise prices of woods are given in table 4.5. Some species of wood is sold at different prices due to size and measurement. Different species are sold on the basis of end product. Few species i.e Sal, Teak, Gamar, Sirish are available but some other scarce in quantity. In view of different prices, the species have been divided into three categories.

Table 4.5

Prices vis-a-vis species 2000 - 2001

Sl. No.	Category (Price - Rs./CFT)	Species
1.	Above Rs. 500	Teak
2.	Rs. 300 - 500	Sal, Sissoo, Gammar, Jackfruit Jarul, Eucalyptus
3.	upto Rs. 250	Neem, Champ, Arjun, Sirish Cottus etc.

Source-Sample Survey

Prices increased over the previous year for different species. Certain species have a good growth in price over the previous year. In view of different rates of prices, wood species have been divided into three categories as per the details given below in table 4.6

Table 4.6

Categories of wood species

Category	Growth rate (% /p.a.)	Species
I	Above - 5	Sal, Sirish, Teak
II	3 to 5	Gammar, Jackfruit
III	Less than 3	Neem, Champ, Arjun, Sissoo Cottus, Jarul, Eucalyptus

Source-Sample Survey

As per the species categorisation given in table 4.6, it is noted that Sal, Teak and Sirish are premium species in view of annual growth rates of prices. The quantity and end-use of other species vary to such an extent that it is not feasible to categorise then on overall basis.

4.5. TYPE OF BUYER

Type of buyer is important to understand the pattern of end use of the forest products. In the study area, there are two important categories of buyer are involved in trading of timber :-

1) Timber merchant, both local and outsiders.
2) General users. i.e. building contractors, furniture makers etc.

Relevant information regarding type of buyer are collected during the course of sample survey of selected districts which are given in table 4.7 It reveals from the table that local people are the largest buyer of end product of forest (28.05%) followed by 21.75% are the Timber Merchants. Furniture makers and Builders are also the important buyer. Timber merchants occupies about 40% in Jalpaiguri district, where as in Darjeeling district it is only 4%. This may be because of the location of excellent sal forests of Jalpaiguri. The quality of Sal forests of Jalpaiguri district is better than any other part of India.

Table 4.7

Type of buyer (in percent)

Sl No.	Buyers	Share (in %)
1.	Timber merchants	21.75
2.	Local people	28.05
3.	Furniture makers	14.25
4.	Construction/Builders	18.45
5.	Vehicle body makers	7.50
6.	Others	10.00
	Total	100.00

Source-Sample Survey

4.6. MARKET AND MARKETING CHANNEL OF NTFPs

It has been increasingly felt that the management of forest resource for NTFPs may be more sustainable from the ecological, economical and social perspectives. This is because many NTFPs activities involve non-destructive harvesting of annual renewable plant parts, in contrast to timber harvesting regimes. Tribal communities have extracted NTFPs for centuries with out destroying the renewing resource base. Further, managing forest for NTFPs also implies a great bio-diversity of both plant and animal species (Campabell,1995).

Today, some 25 NTFPs items are marketed by the WBFDC in the area. It is interesting to note that there is no important NTFPs markets in Darjeeling and Jalpaiguri district. In view of the importance of NTFPs for tribal welfare, the Government of India has involved various agencies in the marketing of NTFPs. At the national level, the Tribal Co-operative Marketing Development Federation (TRIFED) is established. All state levels co-operative and forest development corporation are its members. The major objectives of these organisation is to provide better prices to the tribal collectors. The role of forest development corporation and co-operative societies vary from state to state. The overall effect of these organisation has been in terms of presiding a floor price for NTFPs (Brahum,2000).

Two types of market channels are prevalent in the study area. These describe how NTFPs flow across the markets, depending on whether they are government undertaking or non-government undertaking. (Figure 4.2). The Government undertaking NTFPs are directly sold by the tribal collector to the agents of W.B.F.D.C. The product is then collected and stored in the WBFDC

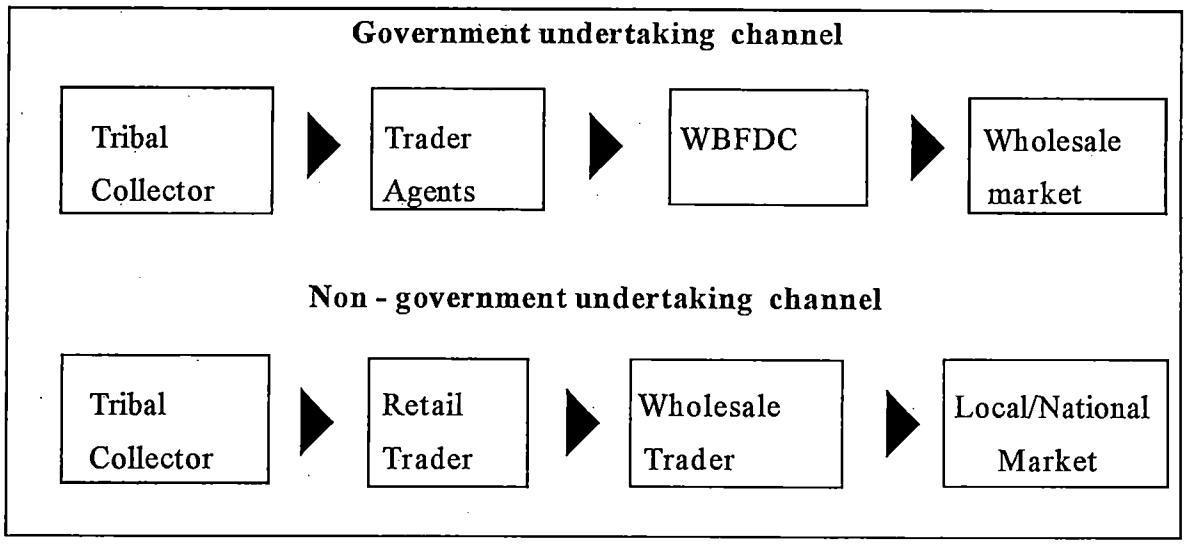

Figure 4.2 - Marketing channels for NTFPs in Darjeeling and Jalpaiguri district.

4.7. CONCLUSION

It is first suggested that the state needs to change the marketing strategy of it's forest products. This study has clearly brought out the present status of intermediaries in wood market. Total elimination of this important marketing channel is not advisable. But in some cases direct approach to the consumers and user is possible. There are also advantages in collective bargaining over individual approach. For example, FPC. can form their co-operatives and then approach larger / bulk consumer for their raw material supplies. Similarly farm and agro-forestry grower can form their co-operatives. As far as the forest department and West Bengal Forest development Corporation (WBFDC)are concerned they have to change their conventional methods of disposal of their produce. It is preferable that they restrict their activity to timber and other high value produce in government forest. But they will have to be flexible in case of FPC and farm forestry production. Action should be taken to simplify the transit pass rule by introduction of "Tree Card" so that the private grower are not demotivated to raise tree plantations by facing harassment for the disposal of produce.

There is no important market for NTFPs in the district. Awarness of different NTFPs among the people should be improved. Even today, a large number of people in the area do not know about the name and utility of many NTFPs. The forest department should arrange for publicity on NTFPs. Local people and members of FPCs in particular need training in simple skills of grading, sorting, selecting as well as primary processing and storing like seeds, fruits, gum, resins, flowers, certain leaves etc. This leads to value addition, better price potential, as well as giving the members gainful employment at their door step.

To make the marketing of forest produce more effective, the state government should get into marketing intelligence to enable it to monitor market prices, on weekly if not daily basis. A simple one page news bulletin may be issued indicating market location, market size, information on quality etc. Market requirements (specification regarding size and quality required for each size at each of the markets) and detailed advice on different products and marketing option and such news bulletin may be updated from time to time and broad-cast / telecast through AIR/DD under "farmers" programme.

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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.

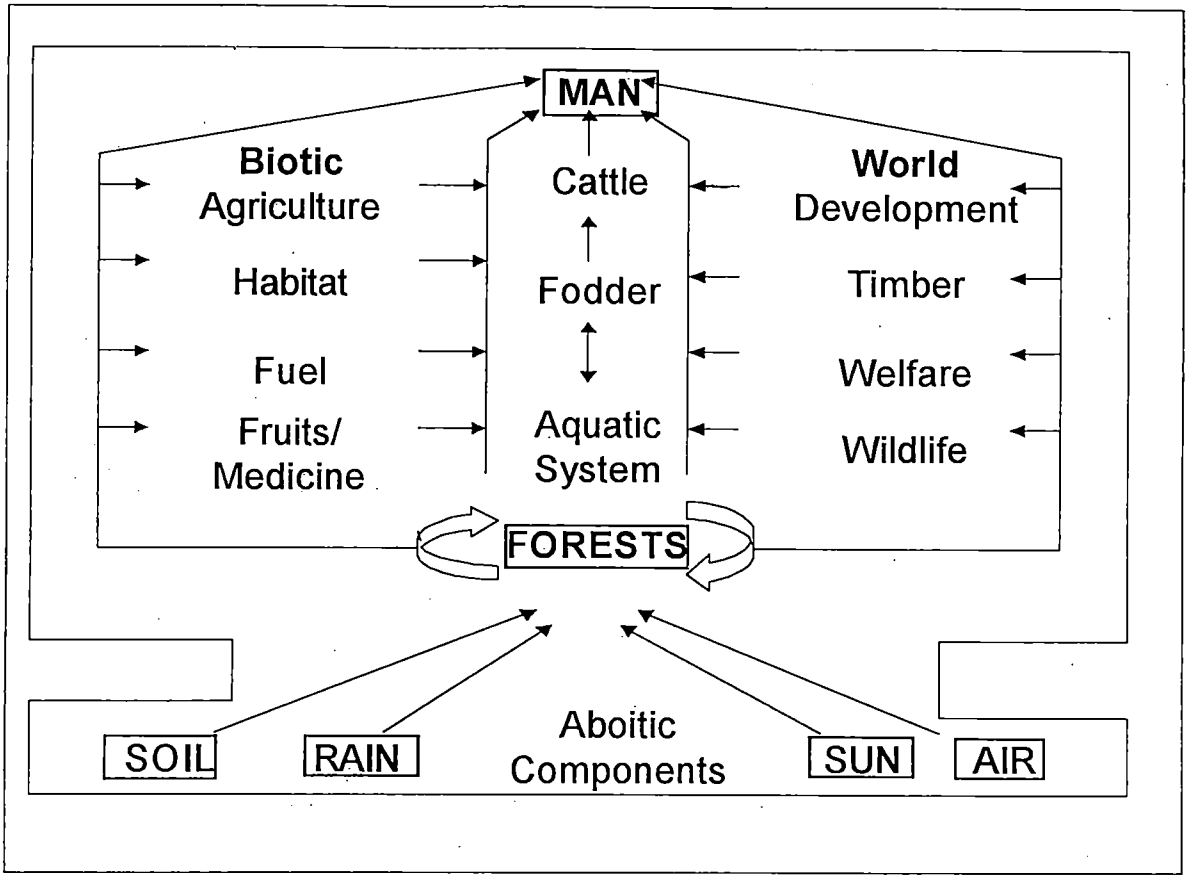

Fig. 5.1. Role of forest as aesthetic resource in the study area

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

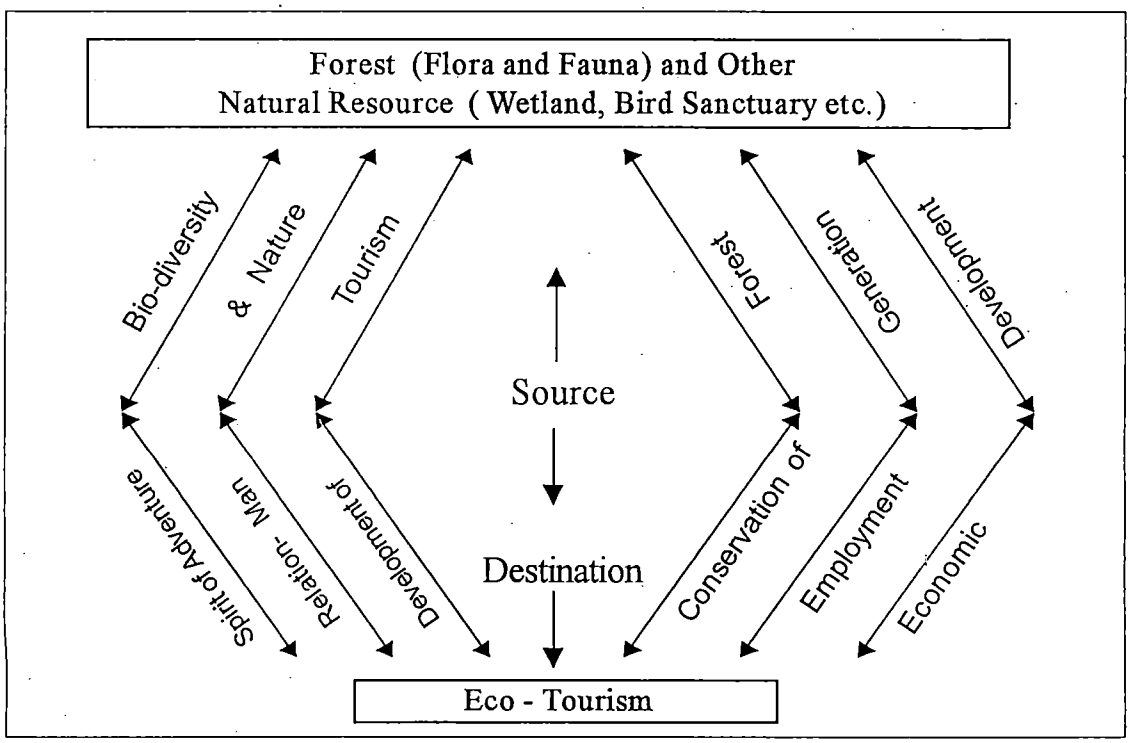

Fig. 5.2 - Basic components of eco-tourism in the area.

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.

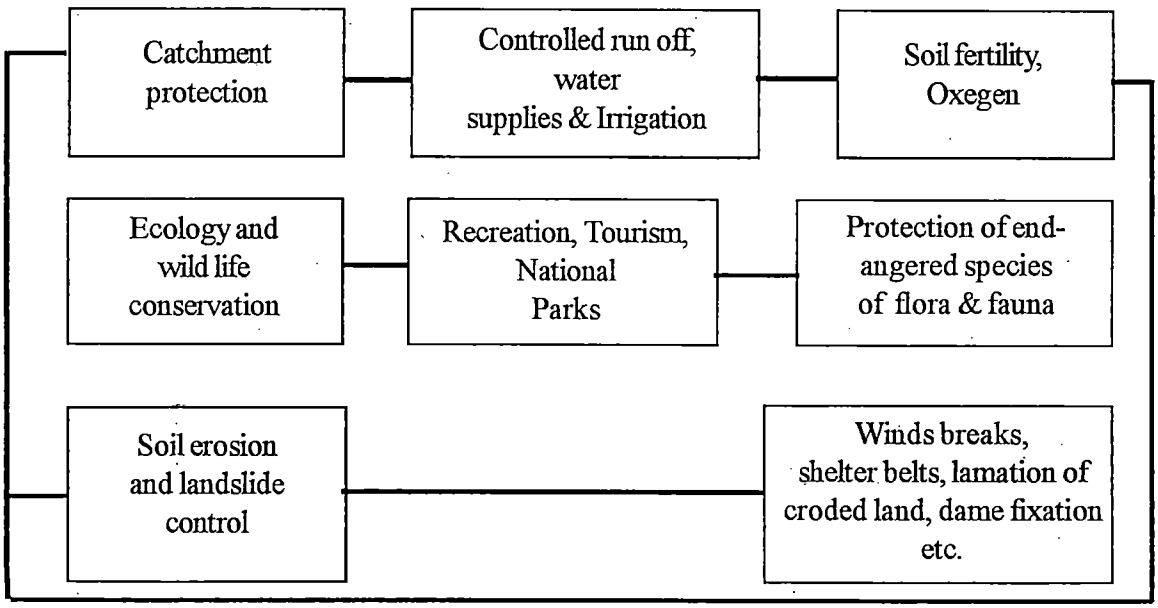

Figure - 5.3 - Impact of forests on local ecology.

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

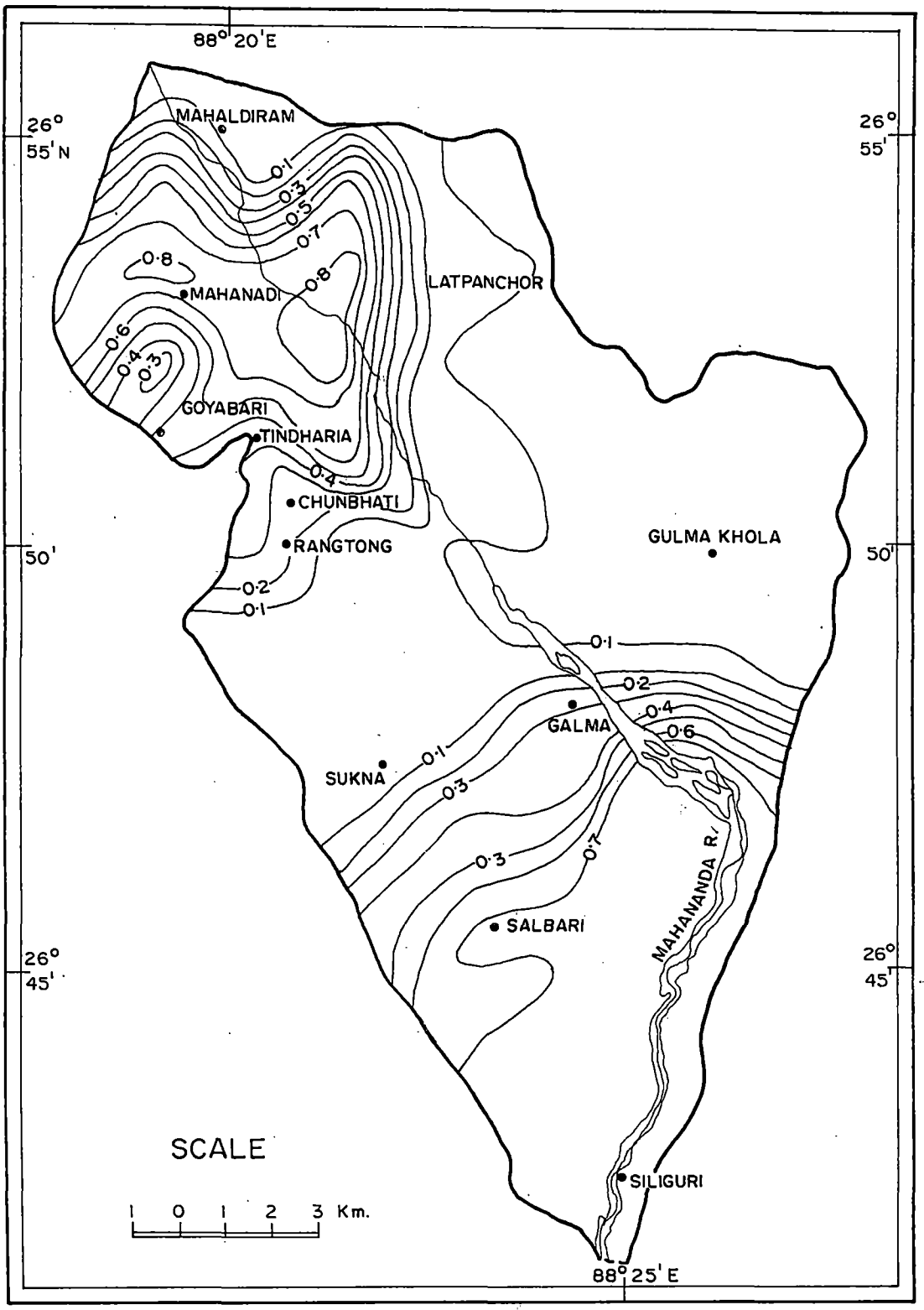

Fig. 5·4 Based on S. Sarkar, 1987

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"**.

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CHAPTER - 6

POTENTIAL OF FOREST RESOURCE

6.1 INTRODUCTION

Forest production and protection of the environment are not necessarily incompatible; they are complementary, and there is a great need for people to communicate with the forests (Nayak,2001). The best way to merge and link the social and productive functions of forests is to make forestry a profitable undertaking in the area. It therefore, becomes very important for us to examine the potential of forest resource of the selected districts. There are several factors on which the potential of forest is dependent which include soil characteristics, rainfall, altitude, temperature, wind, slope aspect, sun light etc. (Guleria & Gupta 1993). Temperature and rainfall are the most important factors which are directly linked with the potential of forest resource. Here an attempt has been made to investigate the potential of forest resource of the area which are directly and indirectly related with the local economy. (Figure6.1)

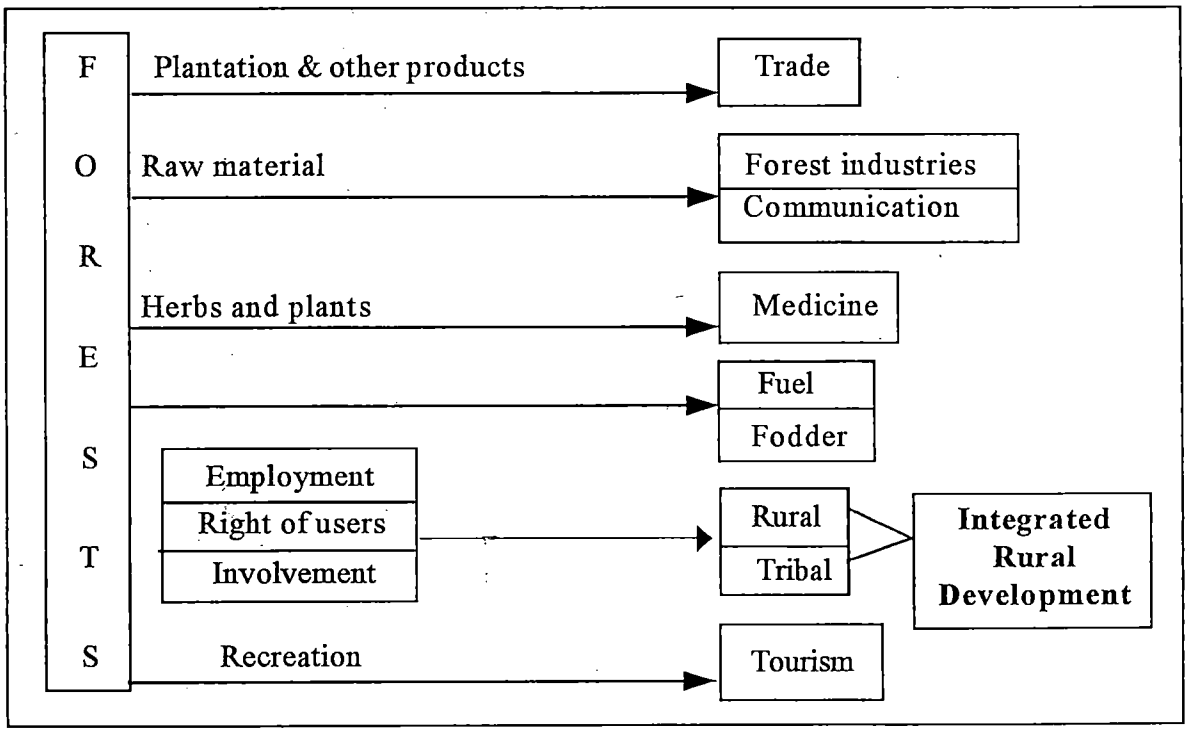

Figure 6.1 - Inter-relationship of forests with the rest of the local economy of the study area.

A picture of potential of various forest resource of the area has been made from the different angles. Estimation of potential of timber including fuel wood, poles and other non-timber forest products of the area is the main task of this chapter. In addition, there are some other elements which are indirectly related with the potentiality of forest products such as employment, wild life, tourism etc. have also been taken into consideration. The estimation of potential of forest resource and other linked elements has been divided into the following :-

- Potential estimation of timber, fuel wood and poles.
- Potential estimation of non - timber forest produces or minor forest produce
- Estimation of employment potential.
- Potential estimation of wild animals.
- Potential estimation of eco-tourism.
- Potential estimation of ecological role of forests.

6.1.1 Methodology

A systematic line of approach has been adopted to estimate the potential of forest resource of the area as par the details given below :-

- Collection of primary data from the field through sample survey.
- Collection of secondary data from the several sources of West Bengal State Forest Department.
- Meeting and consultation with the concerned forest official and other authorities.
- Meeting with the forest villagers, local villagers who are involved in JFM and social forestry activities.A case study on strip plantation has also been undertaken by the investigator.
- Potential estimation of forest resource and employment are calculated on the basis of average trend values of the last few years with the help of time series analysis

6.2 ESTIMATION OF POTENTIAL OF TIMBER, FUEL WOOD & POLES.

An attempt has been made to estimate the annual potential of timber, fuel wood and poles which are given in table 6.1. Estimation has been done for the hill forest and plain forest

separately. It is observed from the table that the potential estimation of timber in the hilly regions of the study area is more than that of plain areas. The Northern hilly tract still possesses a fair amount of natural dense forest with variety of species (Nagarik Mancha,2000). The average annual productivity of hill forest is 12.5 cu.m./ha. where as it is 5 cu.m/ha. in case of plain forests of the area. This is because of the good amount of rainfall, suitable soil, temperature, which help to grow natural vegetation of the hilly area. Average auction price of the timber of the plain forests is more than the hill forest. Timber of the plain forests mostly consist of Sal which is more economically valuable species and best quality in the country.

A huge amount of money is earned by the forest department every year from the sale of timber, fuelwood and poles through auction. Here average auction prices of the forest department have been taken into consideration to give the total value of estimated potential of timber, fuel wood and poles.

Table 6.1

Potential value of timber, fuel wood and poles in the study area.

Sl No.	Forest products	*Estimated quantity(Annual)	Average auction prices (Rs.)	Total value (Rs.)
1	2	3	4	3 x 4
1.	Timber	1,12,000 (hills)	500.00	5,60,00,000
	(in c.ft.)	59,850 (plains)	600.00	3,59,10,000
2.	Fuel wood	2,210 (hills)	130.00	2,87,300
	(in stack)	10,200 (plains)	130.00	13,26,000
3.	Poles	3,310 (hills)	80.00	2,64,800
	(in number)	1,610 (plains)	80.00	1,28,800
			Total Rs.	9,39,16,900

* The estimation above are based on 1994 - 2001 data.

Source - Annual Reports of Forest Department, Jalpaiguri and Darjeeling districs, Govt. of West Bengal.

6.3. POTENTIAL ESTIMATION OF SOCIAL FORESTRY

"Social forestry" identified by the Forest Department as growing of trees on lands not held by the forest department. The department feels that trees grown on these lands would meet the needs of rural population for fuel and fodder. In it's broadest meaning "Social forestry" must be defined as the establishment of fuel food-fodder production system on uncultivated land within and out side the jurisdiction of the forest department. Social forestry not only check the depletion of forests by providing an alternative source of livelihood to persons who presently depend on forest exploitation, but also improve the standard of living of the villagers by increasing productions on uncultivated and unforested lands.

Social forestry in the study area was launched in 1981-82 with the assistance from World Bank to make rural areas self-sufficient in their daily needs of forest products so as to act as catalyst for over all rural development and to utilize the waste and barren lands along the roads, canals, railway lines. Social forestry in the area covers strip plantation and farm forestry. At present social forestry supplies major quantity of the raw material to wood based industries in the study area. The importance of social forestry is increasing after the imposion of restriction on natural forests by the Honourable Supreme Court of India. It is one of the important source of timber of local wood based industries (Sinha, 1997).

6.3.1. A case study of harvesting of social forestry

Social Forestry has great potential to generate a large amount of revenue for the Panchayats. A case study of harvesting of social forestry has also been considered to measure the exact potential of social forestry. 17 ha. of strip plantation was raised on Falakata - Madarihat state P.W.D. road site during 1986 by Falakata S.F. range and on 21.06.1989, it was handed over to Moyradanga Gram Panchyat and Chotto Salkumar Gram Panchayat under Falakata Panchayat Samiti after 3rd years, for its further maintenance and protection. The said strip plantation was recommended for harvesting and replanting by Cooch-Behar Social Forestry Division during 1996-97. It was also decided that the harvested produce will be disposed off through auction by Cooch Behar Social Forestry Division. The following is the result of such harvesting and subsequent disposal :-

a) Year of plantation	:	1986		
b) Area	:	17 ha.		
c) Spacing	:	Row to Row		
d) i) Planting density	:	2000 number. per ha.		
ii) No. of trees planted	:	34000		
e) Species planted	:	Kadam, Gamar, Sirish, Akashmani, Sissoo, Chikrasi, Champ, Teak, Jarul, Neem, Jam, Radhachura, Mango and Kanthal.		
f) Year of feeling	:	1996		
g) Number of trees felled	:	1073		
h) Volume of harvested produce	:	i) Timber 177.414 (cu.m.) ii) Fire wood - 75 stacks.		
i) Amount of sale proceeds	:	i) Timber	Rs.	11,45,476.00
		ii) Fire wood	Rs.	9,750.00
		Total	**Rs.**	**11,55,226.00**
j) Creating cost including 3 years maintenance	:	Advance work	Rs.	6,716.40
		Creation (1986-87)	Rs.	91,016.92
		Maintenance (1987-88)	Rs.	16,621.28
		(1988-89)	Rs.	11,552.18
		Total	**Rs.**	**1,25,336.60**
k) Harvesting cost including felling, marketing, carriage logging, stacking etc.	:		Rs.	1,01,934.00
l) Cost of replanting	:		Rs.	3,06,000.00
m) Net surplus out of total sale proceeds handed over to Falakata Panchayat Samity [i - (j+k+l)]	:		**Rs.**	**6,21,926.00**

Source : Annual Report of Cooch Behar Social Forestry 1997. Forest Deptt., Govt. of West Bengal.

It is observed from the Falakate case study that the each hectre of land under social forestry generated Rs. 36,589.00 (17 hectres of land yielded Rs. 6,21,926.00) in 10 years rotation. It is also noted that out of 34,000 trees planted only 1073 survived i.e survival percentage was only 3.16. The enumeration of growth data in Jalpaiguri district indictate that with the proper selection of species, it is possible to attain Girth at Breast Height (GBH) of more than 90 cm. in almost 50% plants. It is also possible to reach a target of 50 % survival rate in this district under its favourable environmental setup.

It is further reveals from the above analysis that an optimum net surplus of Rs. 5,79,000.00 per hectre could have been realised, if 50% survival rate was achieved in the said plantation and maintained properly by selecting beneficiaries and adopting appropriate technical measures viz. proper selection of species using improved planting materials, maintains optimum spacing etc. However, the case study proves the point that strip plantation if properly protected can generate a huge amount of revenue for local Panchayats and provide rural development besides improving quality of environment and micro-climate of the region. These strip plantation would also help in meeting the raw materials demands of local wood based industries.

6.3.2 Projected Potential of Social Forestry

The Falakata case study conclusively proves the point that social forestry if properly protected can generate huge ammount of revenue for panchayat and provide rural development besides improving quality of environment and micro-climate of the region. Social forestry would also help in meeting the raw materail demands of local wood based industries. Further more, with the introduction of superior clonal planting materials, soil amendment etc; it is posible to attain 90 cm GBH grouth for all plants and average yield of upto c.ft or 0.8cu.m per tree in 10 years under suitable condition.

The study area has ample seope to plant trees along road side, river bed, school compound, waste land, embank ment, railway side and other public places under the scheme of social forestry (Photo 6.1 & 6.2). An attempt has been made to estimate the area would be available for plantation from the following table (6.2).

Photo 6.1 Social forestry on the river bank at Domohini.

Photo 6.2 Social forestry on the school compound at Jalpaiguri.

Table 6.2

Potential area for social forestry expansion

Sl.No	Nature of land	Total available area in hectre	Number of trees planted	Number of trees to be harvested (50% survival rate)	Expected net revenue in million Rs.
1.	Road side	600	12,00,000	6,00,000	347.4
2.	Railway side & abundant Railway land	300	6,00,000	3,00,000	173.7
3.	Embankments	150	3,00,000	1,50,000	86.8
4.	River bed & bank	2400	48,00,000	24,00,000	694.8
5.	School compound	90	1,80,000	90,000	52.1
6.	Other public places including waste lands	12000	24,00,000	12,00,000	1389.6
	Total	4740	94,80,000	47,40,000	2744.4

Source: Sample Survey, Reports of Forest Dept. and DL & LRO Departments.

Thus, social forestry along can generate a revenue of Rs. 2744.4 million in Jalpaiguri district alone within a period of 10 years rotation. This huge amount of additional fund would have been available to the local Panchayats for various developmental and poverty alevation schemes.

In addition to this, social forestry scheme would also generate huge employment opportunity. The Falakata experiment may also be used to estimate employment potential of social forestry in Jalpaiguri district. The following table depicts the details of social forestry in Jalpaiguri district (Table 6.3). It is observed from the table that it would be possible to generate over 2 million man-days of employment among the rural unskill workers. Considering 180 working days per year, the proposed social forestry would also support 11000 rural families.

Social forestry would also be provided rural families with fuel and manure. It is estimated by the investigator that on an average a tree would provide 2 quintals small twigs, branches and leaves which is approximately equivalent to Rs. 60.00 (after deducting labour cost). Thus, 4.74 million trees would also generate Rs. 284.4 million.

Table 6.3

Employment potential of social forestry in Jalpaiguri district *1

Sl.No.	Nature of work	Cost for the work *2	Man - days needed *3 (in million)
1.	Land preparation	3.40	56,650
2.	Tree planting	27.80	4,63,300
3.	First 3 years maintenance	9.80	1,63,300
4.	Harvesting	24.70	4,11,700
5.	Replanting	54.60	9,10,000
	Total	120.30	2,004,950

*1 Considering total potential area of 4740 hectre.

*2 Estimation of cost at per 2002 rate.

*3 Rs 60.00 is the per man-day cost.

The estimated total revenue generation of potential social forestry would be Rs. 3149.1 million in Jalpaiguri district alone. The present investigator strongly believes that if this vast potentials tapped properly, the rural socio-economic scenario of the district will be changed.

6.4. POTENTIAL ESTIMATION OF NTFPs OR MFP

NTFPs are drawing greater attention today as this can supplement livelihood and income generation to the fringe people. Varieties of NTFPs are collected by the fringe people in the study area. Few small scale industries have been established in the area on the basis of different NTFPs. Production and collection of different NTFPs in the area involve huge number of employment to forest villagers. Scientific exploitation of NTFPs can reduce the increasing pressure on natural resources. Economic condition of the study area can be eveloped with the proper exploitation of NTFPs. So there is a need to study the potential of such resource. A potential estimate of some important NTFPs in the study area has been done on the basis of average annual production which is given in table 6.4

Table 6.4
Potential estimation of NTFPs

Sl No.	Name of NTFPs	Unit	Rate (Rs.)	*Esimated quantity (annual)	Total value (Rs.)
1	2	3	4	5	4 x 5
1.	Citronella Oil	Lt.	400	3,000	1,20,000
2.	Black Pepper	Kg.	300	458	13,740
3.	Turmeric (Green)	Kg.	1000	613	6,13,000
4.	Sal Plates (finished)	No.	1.25	1,00,000	1,25,000
5.	Sal Seed	Kg.	20	5,100	1,02,000
6.	Phul Jharu (finished)	No.	10	4,800	48,000
7.	Bamboo (Matured)	No.	30	10,120	3,03,600
8.	Cardamom	Kg.	200	310	62,000
9.	Cane	Bundle	200	108	21,600
10.	Golden mushroom	Number	5	40502	2,02,510
11.	Others **	-			8,00,000
				Total Rs. -	**24,11,450**

Source- Annual Reports 1994 - 2001 Forest Department Govt. W.B. * Estimation are based on 1994 - 2001 data and field observation.** Other include 158 species of trees, shurbs, herbs of which 20 are more important like Khata, Sabai, Chirata, Til, Satamul etc.

6.5. EMPLOYMENT POTENTIAL

So far we have discussed many advantages of forest in terms of forest produce and environmental quality; but in terms of employment opportunities the contribution of forest is very high specially in the rural areas. Investment in forestry sector has employment potential as it is highly labour intensive (F.A.O, 1974). In labour surplus countries like ours, the investment priorities ought to be decided in terms of employment potential of different schemes, even though they contribute a low proportion to Gross National Product and National Economy. Though forests contribute very little to state exchaquer, yet forestry

by itself can provide large employment both directly by engaging persons in forests and indirectly in many forest based industries. It provides employment opportunities through management of forests, in lumbering, logging, plantation, collection and processing of various minor forest produce, swan wood, transportation and social forestry schemes. Forests of the area have great employment potential. Forest of Darjeeling and Jalpaiguri district provides a large number of mandays every year in addition to regular employment. Employment potential of forests of the districts is given in table 6.5

Table 6.5

Employment potential of forest of the study area

Sl. No.	Forest area	Annual employment potential (man days)*
1.	Hill area	1,10,782
2.	Plain area	3,10,720
	Total	**5,21,502**

* Employment potential estimated on the basis of 1994-2001 data.

Source - Annual Report, Forest Department, Darjeeling and Jalpaiguri.

Employment potential of forests in the area depends upon the developmental work of the forests which will be organised by the forest department. Baikunthapur forest division has created 1,86,108 man days in the year 1998-99 whereas Darjeeling forest division has created only 37,312 mandays (Annual Report 1998-99). This is because of the difference in nature of activities of the forest divisions.

6.5.1. Employment potential of wood based industries

A sample survey has been conducted by the investigator to find the present pattern of employment of wood based industries in the area. On the basis of the sample survey, a picture of average employment in various wood based industries is given below in table

6.6. It is revealed from the table that the number of daily employment in the wood based industries has been estimated at 13,508. This number will remain static in years to come if these industries are properly managed and protected.

Table 6.6

Present pattern of employment in some wood based industries.

Sl. No.	Nature of Industry	Employment (per day)		Total *	Number of industries and total daily employment
		direct work	indirecet work		
1.	Saw mills	15	10	25	162 x 25 = 4650
2.	Plywood and veneer	16	12	28	131 x 28 = 3668
3.	Furniture making	8	4	12	405 x 12 = 4660
4.	Box making & others	6	4	10	113 x 10 = 1130
					Total = 13508

* Constructed on the basis of average data of daily employment in several wood based industries.

Source- Office of the C. F. Northern Circle, Forest Department, Office of the Timber Merchant Association, North Bengal and District Industrial Centre- Darjeeling & Jalpaiguri.

6.6. WILD LIFE POTENTIAL

The potential of wild life is closely related with the floral type found in the area. The study area has a large variety of flora. Moreover, the different types of climate are found in the districts which has resulted in the existence of wide variety of fauna. Tiger, Elephant, Rhinoceros, Bison, Leopard, Sambhar, Spotted deer, Hog deer, Wild bear, are the important animals which are found in the forests of the plain regions. In the northern hilly parts, the important animals which are generally found are Red Panda, Cat beer, Garal and Black beer. About one third forest area of the districts is under protected network. The objective of wild life management in the area is to protect the life of these animals and maintained the bio-diversity and eco-system. The state government has identified some protected areas for the conservation of wild animals which include three national parks, one tiger reserve and five wild life sanctuaries. Buxa Tiger Reserve, Jaldapara Wild Life Sanctuary and Gorumara National Park are the protected areas which have higher poten-

tial in respect to wild animals. The over all conditions of wild life in the area is not satisfactory. The total number of Bengal Tiger in the year 1993 was 40 and in 1997-1998 it was 57 which gives an increase of only 17 tigers within 5 years. The number of elephants have increased only by 42 from the year 1996 to 2000 (As per Elephant Census, 2000). Similarly the number of Rhinoceros was 58 and 66 in the year 1996 and 1998 respectively Only 8 have been increased within the 3 years which is not very significant from the conservation point of view . Some important issues emerge in the ecological and wild life protection in the study area. These are biotic pressure and interferences by the forest villagers, degradation by dolomite mining, shifting of river courses and excessive movement of tourists in the forest areas. These factors are responsible for the destruction of wild animals in the study area (Ghosh & Nandy, 1997,Working Plan, 2000).

A quantitative potential estimation of wild animal in the study area is not possible as several factors are associated with life of animals. The most common factor is natural death or injury . An estimation has been prepared which in given in table 6.7

Table 6.7
Potential of wild life

Sl No.	Name of animals	Potential estimation (annual increase in numbers)
1.	Bengal Tiger	3
2.	Rhinoceros	3
3.	Indian Gaur (Bison)	30
4.	Elephant	10
5.	Small animals such as fish eating crocodile or Gharial	High potential in Jaldapara, Madarihat and Kathambari Bill, Odlabari.
6.	Migratory species	High potential. Rivers of Raydak & Jayanti, Rasik Bill, Jaluapara, Narathali lake and Kathambari Bill are visited by various migratory species every year.

Source - Records of wild life division - I & II, B.T.R, Forest Department, Govt. of West Bengal.

6.7. POTENTIAL OF ECO-TOURISM

The study area has a high potential to develop eco-tourism which can boost up the local economy . Eco-tourism has also employment potential. It provides a large number employment directly and indirectly every year (Boo, 1990). There are some national parks, tiger reserve and wild life sanctuaries in the area which are the main attraction of the tourists. Jaldapara WL.S., Gorumara N.P. and B.T.R. are the important centres which attract more than 40,000 tourists every year. At present, the forest department has set up some Nature Interpretation Centres (N.I.C.) near the natural forests of the area which are getting more attention to nature lovers tourists. On overall basis, the area can attract more than 1,50,000 nature lover tourists at the different eco-tourism spots every year. In addition, the forest department of the area has created some picnic spots near the natural forests through which a good amount of revenue is collected every year. It provides a large number of employment to the forest villagers. The Mangpong and Kunjabehar picnic spots are visited by more than 500 picnic parties from the months of December to February every year.

6.8. ECOLOGICAL POTENTIAL OF FOREST

Forest affect the environment very substantially. They moderate the climate, maintain soil fertility and regulate water supplies. By the process of photosynthetics the plant take carbon-di-oxide from atmosphere and release oxygen thus purifying the air. Forests have great potential to control rainfall and contribute largely towards moderation of flow of water in the catchment areas. They also offer protection to soil against erosion by wind and water (Chandra Sarkar, 1971).

Forests of the sub- Himalayan North Bengal have high potential to maintain the ecological balance of the regions. The most important environmental event in the northern hilly tract is landslide during the rainy season. Extensive heedless deforestation is responsible for landslide in the hilly part which cause heavy damage to property and human life every year (Dutta, 1966 & Sarkar, 2000). From the field survey it has been found that landslides generally occur in deforested areas. Paglajhara is one of the important landslide prone area where the rate of degradation is more than 50% of total forest areas. On the other hand, the eastern part of the river Mahananda and riverine tract of lower Balason river

are the landslide free zones. This is because of the fact that these tracts are still under dense natural forest cover with variety of species. Large scale afforestation is an important step taken by the forest department to control massive landslides in hill areas. During the 1998, 225 ha. of landslide affected areas has taken for plantation by the forest department of Darjeeling district. (Annual Report 1998-99, Darjeeling Forest Division). Moreover 447.50 ha. of lands (Annual Report 1998-99, Darjeeling Forest Division) were taken for plantation at different places of Darjeeling hill areas in the year 1997 with R1, R5, R6, R7, P1, P2 & P5 models of species. This has apparently given increasing result and no further damage has been occurred during 1999-2000. In the year 1998, 265 ha. of lands were also taken for plantation with R1, R2 and R5 models of species (Annexure - 1). Nodoubt, this plantation will protect the hill area from massive soil erosion and landslides.

Forests of the study area have also great potential to contribute rainfall and recharge the ground water. It also played a significant role in moderation of landslide, flood and erosion hazard.

6.9. CONCLUSION

Though the potential productivity of the forest in the study area is much higher, the actual production is much less. Intensive silviculture should be adopted to increase the productive potential of forest which is neglected in many cases like weeding, cleaning and finally periodical thinning in forest plantation. NTFPs should be exploited on sustained yield basis. More involvement of FPC member should be arranged in the different activities of forests specially in the collection of NTFPs. This will provide a large number of employment in the forest villages.

The potential of social forestry in the study area should be increased. Social Forestry can reduce the excessive burden on natural forests. More over, it is a programme of income and employment generation at the village levels. In order to achieve the full potential of social forestry it is essential to have infrastructural development at Block and Gram Panchayat levels. It is essential to develop modern nurseries at the block levels to cater needs of superior seedlings not only for strip plantation but also for distribution to individual farmers in order to improve productivity both at community as well as individual levels. It is also felt that apart from setting up of modern nursery, there is a need of posting forest

officers of the rank of range officer at the block level with specific job of planning at micro level, implementation of social forestry schemes, from nursery to harvesting age.

In order to achieve the full potential of wild life, some natural forest area should be strictly protected. At present, the movement of tourists on natural forest have been increased largely. The movement of tourists should be controlled so that the natural habitation of wild animals will not be disturbed. Dolomite mining in Jayanti hill of Buxa Tiger Reserve should be restricted. The mining activities cause heavy damage to wild life. Other problematic issue on bio-diversity conservation is the increasing man animal conflict due to loss of habitation and increase in population of wild animals in excess of carrying capacity. Therefore, the damaging animals in excess of carrying capacity should be regularly cutted/ captured and transferred, restoring habitat by local closure in protected areas and not encouraging introduction of exotic species. Bamboo, banana and grass should be introduced in appropriate areas particularly for the food of the Elephant.

Ecological potential of forest of the area can only be achieved through the large scale afforestation programme at the government and private levels. Degradation of forest which reduces the ecological stability of the region should be stopped by the forest department. Village people should be motivated about the inter-relationship of man and forest. More awareness programme on forestry and involvement of local people in various activities of forest can only provide the full ecological potential of forests in the districts.

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CHAPTER -7

CONSERVATION OF FOREST RESOURCE

7.1 INTRODUCTION

Indiscriminate exploitation of forest resource of Darjeeling and Jalpaiguri district has resulted in the decline and also in the destruction of some forest areas. Rapid deforestation also causes flood, drought, landslide and soil erosion (Bhutia, 1999). The removal of forest has economic implication also. Existence of agricultural civilisation is intimately connected with the local forests. Few conventional methods are generally used to conserve the forest of the study area. But the conventional methods are not enough today to manage the forest resource properly. Rate of afforestation and exploitation should go side by side. Keeping this view in consideration, the state government has adopted certain non-conventional methods to conserve the valuable forest of the area. This non-conventional method includes **Social Forestry, Joint Forest Management and Agro-forestry or Inter-cropping.**

An attempt has been made in this chapter to visualise the extent of the above mentioned measures. This chapter has highlighted some problems and suggest corrective measures to protect the valuable forests of the region. The investigator has carried out this study through primary data collected from fields and secondary data obtained from local Gram Panchayat, Zilla Parisad, FPCs and Forest Department. A case study on strip plantation has also been undertaker by the researcher.

7.2 SOCIAL FORESTRY

The social forestry programme in Darjeeling and Jalpaiguri district was launched in 1981-82 with the assistance from World Bank to make rural areas self-sufficient in their daily needs of forest produce so as to act as catalyst for overall rural development and to utilise the waste and barren lands along the roads, canals, and railway lines. During last one decade Gram Panchayats and Panchayat Samities of the study area involved in tree planting on barren, vacant, waste lands within their jurisdiction from the funds under J.R.Y and N.R.E.P (Chakrabarty, 1997). There are few instances in the study area, like Kalabari of

Jalpaiguri district, where tree planting has been taken up very successfully on every piece of vacant, barren lands along roads, canals etc. Such efforts in some areas have also won recognition from the government in the form of " Indira Vrikshamitra Puruskar ". The main components social forestry are strip plantation and farm forestry . One of the major achievement of the social forestry projects which indeed in 1992, was that trees have become a common sight on the road side of Darjeeling and Jalpaiguri district. The main objectives of social forestry programme are shown on the following figure 7.1

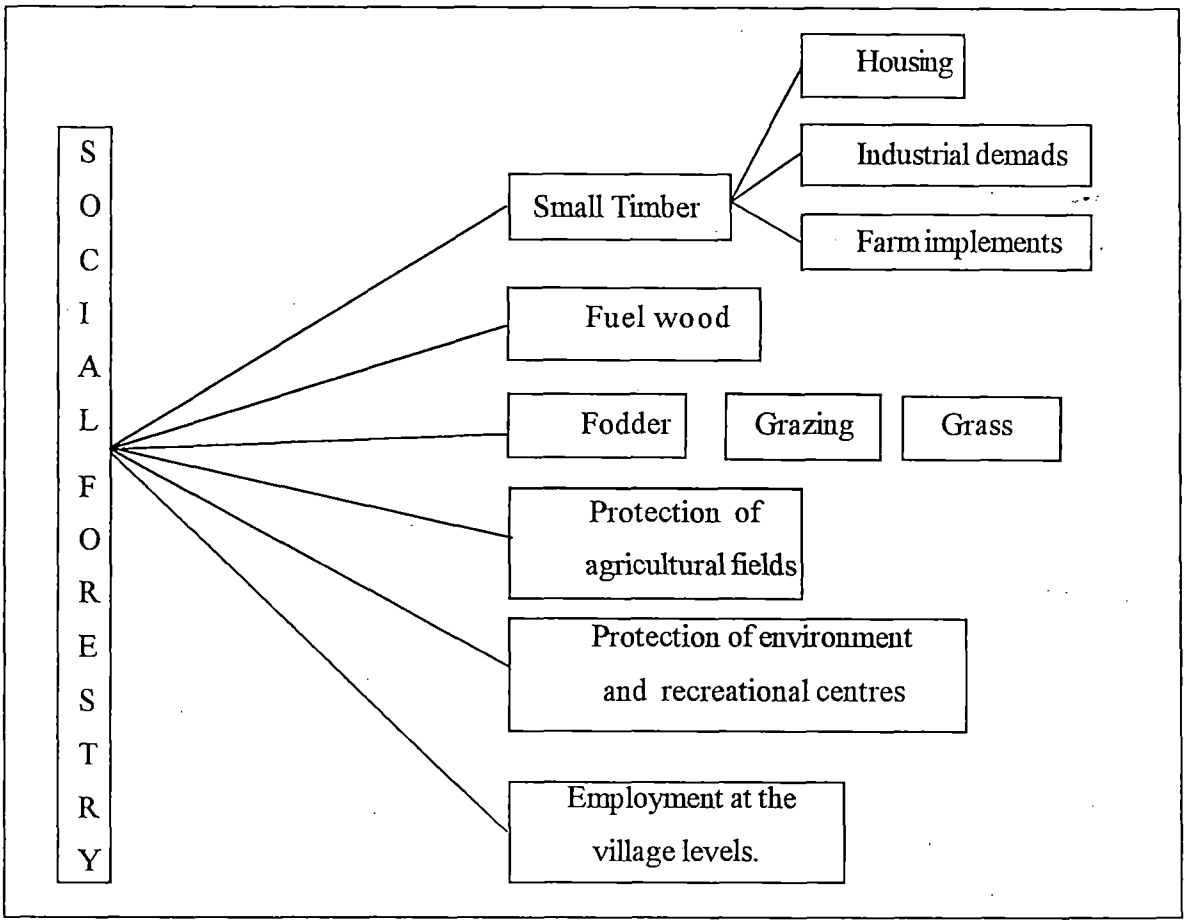

Fig 7.1 - Objectives of social forestry in Darjeeling and Jalpaiguri district.

7.2.1 Farm Forestry

The basic component of operation is the organisation of a substantial programme of the planting of trees of the bunds and boundaries of fields of the farmers, which is to be taken up by the farmers themselves. The basic objective of "Vana Mahotsav " accepted in the planned development of forestry is to encourage farmers to participate in this programme and regenerate forests for their own benefits. The Government has exempted the value of

trees standing on agricultural land from wealth tax .Farm forestry is an important component in social forestry programme of the study area. It meets the fuel wood demand of the rural areas and generates a source of income to the villagers of the Darjeeling and Jalpaiguri district (Pandey, 1997).

Composition of species is an important aspect of farm forestry in the area. A sample survey has been conducted by the researcher to find out the main composition of species in farm forestry. Five important blocks of study area consisting Alipurduar, Malbazer, Dhupguri, Matigara , and Naksalbari have been taken into consideration for sample survey. As per sample survey, the composition of species in farm forestry is given below (Table 7.1). It has been observed that there is a good motivation among the farmers to grow trees on their uncultivated land, boundary of the home and agriculture fields etc. Nowadays the farmers of the region specially, Dhupguri and Malbazer areas are earning a good amount from farm forestry plantation. Kadam is the most important specie which gives a good return within a very short rotation (Photo 7.1)

Table -7.1

Species composition in farm forestry

Sl. No.	Spcies	Percentage
1.	Kadam	60%
2.	Gamar	15%
3.	Akashmari	10%
4.	Sissoo	5%
5.	Eucalyptus	5%
6.	Simul	5%
	Total -	100%

Source-Sample Survey

Table 7.2 provide an interpretation about the status of farm forestry in the study area. Different reaction of the farmers and land owners are observed during sample survey. Some blame the forest department and government effort inefficiency and lack of marketing facilities for their wood produce. On the other hand, there are people who also praise the government efforts in this regard. However, analyses of the relevant data for the year 1992-96 of Darjeeling and Jalpaiguri district is not even 50% of the target.

Table 7.2

Achievement of farm forestry in Darjeeling and Jalpaiguri (1992-96)

Sl.No.	Items	Divisions	
		Darjeeling	Jalpaiguri
1.	Number of wood lots created	10590.00	38178.00
2.	Number of seedlings raised (in '000)	4673.00	5726.50
3.	Total area covered (Ha.)	2182.00	2961.00
4.	Number of Beneficiaries (in '000 person)	82.30	374.80
5.	Survival rate in percentage	40.39	25.86

Source :- Monitoring & Evaluation Cell, North Bengal (Report -1), D.C.F. monitoring (North). 1996.

7.2.2.Strip Plantation in the study area.

Strip plantation raised by the forest department are handed over to Gram Panchayat for management as per existing Government Order (Ref. G.O.No 2914-For dated 22.7.86). In many cases, the Gram Panchayats have started harvesting tree plantation and it is now widely realised that, if managed and protected properly, strip plantation can be a major source of revenue for the Gram Panchayat (Mandal, 1995, Ghosh, 1997). But it will be wrong to evaluate the achievement of strip plantation only in terms of the revenue earned.

The primary objective of strip plantation of the area is to reduce pressure on natural forests by creating sufficient resources on public and private lands for meeting the local demand for timber, fuel-wood and fodder. Strip plantation along the road side were also intended to have an aesthetic appeal. Strip plantation also laid down special emphasis on creating gainful employment for the rural people, generating cash income and improving consumption level of the village poor, producing raw materials for village level cottage industries,

Photo 7.1 Farm forestry (Kadam) at Rajar hat

Photo 7.2 Strip plantation on Maynaguri - Bhotpatty P.W.D. road

protecting and improving indirectly the soil and moisture regime of the degraded areas (Vyas & Dubey, 1997). Thus strip plantation is a valuable asset of the area (Photo 7.2).

Strip plantations have been raised at the different division of Darjeeling and Jalpaiguri district. Jalpaiguri forest division which is under Cooch Behar social forestry department has been taken into consideration as a case study. The data for various plantation raised in Jalpaiguri division are collected from divisional office and annexed in Annexure 3. As per Annexure the following observation are classified :-

- It has been found that the major reasons for failure of plantation and low volume of production has been mainly due to lack of protection provided to these plantations during their establishment and subsequently their illicit felling.

- It has been found that in spite of all odds against an investment of Rs. 12,28,322.00 (Social Forestry Report- 1997) and a total of Rs.3,04,09,641.00 revenue is expected if all plantations are harvested properly.

- A total of 12181 number of 42 species of trees are found in existence.

- In the non-existence plantation sites mainly Teak, Sissoo, Gammar has been felled for commercial reasons where as other species has been mainly felled for plywood and box making industries and to some extent for fire wood. It has been found that in the climatic condition of Jalpaiguri ,16* out of 42 tree species has given reasonably good results in volume production.

7.2.3 Performance of social forestry division

There are two important social forestry division in the area - Cooch Behar & Siliguri social forestry division. A picture of performance of social forestry in these two divisions has been analysed from the 1991 to 1995. Over all position of Siliguri division is not at the satisfactory level on account of illicit collection of timber and fire wood. Only in the year 1995, the plantations have been given some positive results. The position of social forestry division of Cooch Behar has given some significant results. Plantation raised under Cooch Behar social forestry division have achieved the targets. Survival percentage of species is more man 50% (D.C.F. Monitoring, North, Report -1).

Following table 7.3 depicts the number of strip created, area under social forestry and a categorical distribution of the plantations in the study area.

Table 7.3

Appraisal of social forestry in the study area

Division	Year	Number of strips created	Area in Ha.	Plantation status (in Ha.)			
				Good *	Moderate*1	Bad*2	Non-existent*3
Siliguri	1991	4	55			15	40
Social	1992	3	30		17		13
Forestry	1993	2	25			25	
	1994	2	20			20	
	1995	2	30	30			
Cooch	1991	6	120	76			44
Behar	1992	4	55	36		08	06
Social	1993	5	65	38	10	10	07
Forestry	1994	9	335	180	126	25	04

*density above 75%; *1 density 45% - 75 %; *2 density 15% - 45%; *3 density below 15%

Source :- Monitoning and Evaluation Cell, North Bengal (Report - 1), 1996

7.3 JOINT FOREST MANAGEMENT (JFM)

The idea of joint forest management was introduced in the study area to protect and develop the degraded forests with the co-operation of fringe dwellers. Under the JFM, the forest fringe dwellers participate in the protection of the forest and its resources in lieu of which they are granted certain benefits. The dwellers are allowed "25 per cent of the sale proceeds at every final harvesting of the concerned plantation/forests (i.e. timber, pole etc.), They are also entitled to collect "fallen twigs, grass, fruits, flower, seeds etc." as well as " one forth of the produce obtained as intermediate yield from multiple shoot cutting, thinning etc. For all this, the dweller have to form the Forest Protection Committee (FPC) or

Eco Development Committee (EDC). The FPC are formed by dwellers living near ordinary forests, while the EDCs are those who live in the vicinity of a wild life sanctuary. After the formation of the FPC/EDC, the members have to involve themselves at least five years in forest protection before being eligible for the benefits. The FPCs/EDC, are formed by the divisional forest officer in consultation with the local Panchayat Samiti. The committee selects the beneficiaries, identified from amongst the economically backward people.

JFM in the districts was officially adopted from mid 1989. The day to day affairs and up keeping of JFM forest areas are looked after by FPCs. The main objectives of JFM in the area is to conserve and improve forest productivity. This is done through closing of forest for grazing and protection of coppice forests. Besides the afforestation is also done on the same areas. At present there are several problems which are associated with the function of JFM in Darjeeling and Jalpaiguri district (Lama 1999). Several aspects of JFM in the study area have been studied through sample survey and secondary sources which are mentioned in the following sections.

7.3.1 Forest Protection Committee (FPC)

Forest Protection Committee is the main component of joint forest management in the study area. Joint Forest Management is basically done through the establishment of Forest Protection Committee. This committee is also involve in afforestation programme. There are 226 Forest Protection Committees in Darjeeling and Jalpaiguri district with a total member of 27,197. Most of the beneficiaries in Forest Protection Committee are the SC. and ST. Details are given in table 7.4 and figure 7.2

7.2.2 Member from local admistration

As per the objective of joint forest management, there should be some members from local forest department and Panchayat to make the function of joint forest management more effective. As per table 7.5, it is revealed that only one member (96%) is included in joint forest management besides forest villagers. This one member is basically local Panchayat or Forest Beat Officer.

Table 7.4

FPCs in Darjeeling and Jalpaiguri district

Sl. No.	Divisions	No. of FPCs	Composition of FPC members				Area in Ha.
			SC	ST	Other	Total	
I	Cooch Behar SF	23	752	208	319	1279	5,158
II	Jal-CoochBehar	26	883	1467	755	3105	8,390
III	B.T.R.	21	1769	1904	869	4542	25,942
IV	Jalpaiguri	34	4719	2044	2228	8991	11,089
V	Baikunthapur	54	4649	187	700	5536	7,462
VI	Kurseong	12	133	124	572	829	2,137
VII	Kalimpong	24	87	245	839	1171	11,126
VIII	Darjeeling	27	85	225	1434	1744	5,121
IX	Wild life -II	5	-	-	-	-	6,199
	Total	226	13077	6404	7716	27,197	86,624

Source: Annual Report, Northern Circle - 1998 -99.

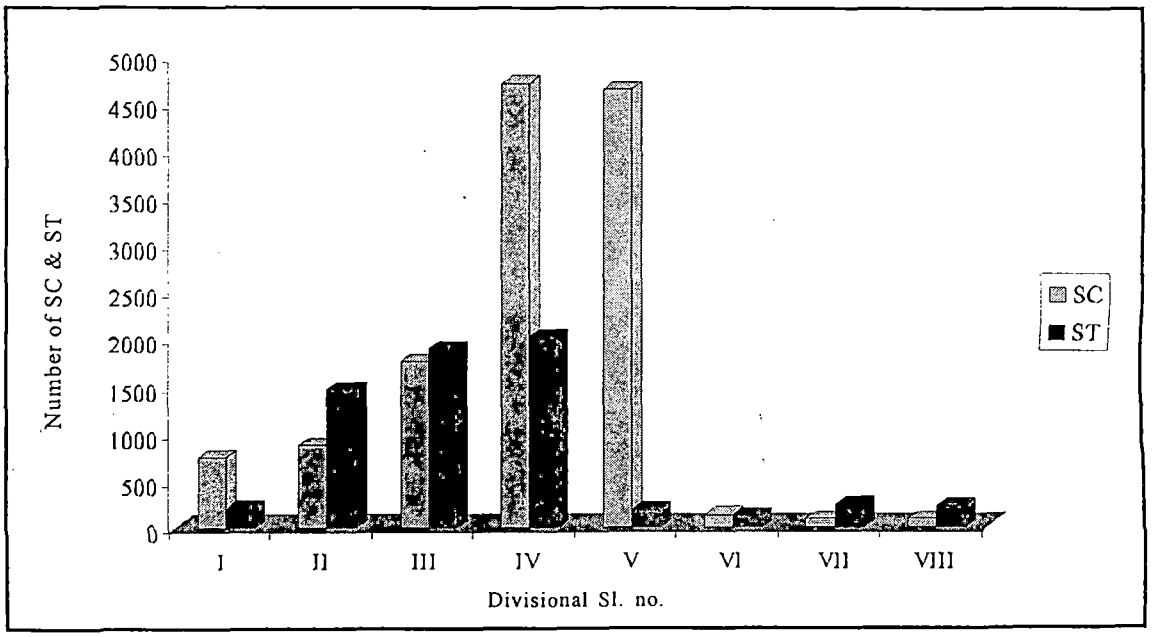

Fig. 7.2 -SC & ST Member in different F.P.C.

Table - 7.5

Member from local administration in FPC (in percent).

No of member	Percentage of FPC
One	96.2
More than one	3.8
Total	100.00

Source-Sample Survey

7.3.3 FPC members by primary occupation

People from several occupation are the members in Forest Protection Committee. This study is conducted to find out the nature of occupation of members (Table 7.6). It is seen that about 35% members are daily workers or labourers employed in the local tea garden. Members who are involved in various forestry activities are the second largest percentage (25%) by primary occupation. Persons involved in agriculture are also the members of Forest Protection Committee (11%)

Table 7.6

FPC members by primary occupation (in percent)

Sl No	Primary occupation	Percentage of FPC
1.	Agriculture	10.8
2.	Forestry	24.8
3.	Daily workers / Garden labour.	34.8
4.	Cottage Industry	4.0
5.	Fishery/goatery/poultry	15.4
6.	Others	11.0
	Total	100.00

Source-Sample Survey

7.3.4 Right enjoyed by the FPC members

FPC members of the study area have the right to collect leaves, inter-cropping, plantation, collection of firewood and fodder as well as 1/4th of the net sale proceeds at every final

harvesting. Through sample survey it is noticed that members are enjoyed to collect firewood and plantation, inter-cropping on the forest lands(Table 7.7). But the most important aspects of the Joint Forest Management of Darjeeling and Jalpaiguri district is the distribution of 25% of the net sale proceed at every final harvesting of the concerned plantation / forests. But this aspects is totally neglected (Chakrabarty, 1999). This may be the cause of restriction on clear felling by the Honourable Supreme Court of India. Most the respondents have given no response on this issue. Members are not satisfied with the present system of Joint Forest Management

Table 7.7

Rights enjoyed by FPC members (in percent)

Sl. No.	Nature of rights	FPC member (%)
1.	Leaf Collection	
	a) Tendu leaf	6.4
	b) Sal leaf	8.0
2.	Inter - cropping	24.6
3.	Right to grow corn	4.0
4.	Collection of fire wood	28.0
5.	Collection of fodder	00.5
6.	Plantation activities	28.5
7.	25% return after the final felling	-
	Total	100.00

Source-Sample Survey

7.3.5 Distribution of FPCs - by suggestion

This sample survey brought various suggestions for the improvement in the working of FPCs, from the respondent, interviewed. These suggestion are given in the following table 7.8. As per suggestion which are stated in the table, it is seen that work for more few days is one of the principal demands by the members. Provision for drinking water, electricity, medical facilities and irrigation are other demands. Respondents also demanded more funds.

Table 7.8

Distribution of FPCs by their suggestions (in percent)

Sl.No.	Suggestions	FPC member (%)
1.	Need more day work in plantations	15.0
2.	Improved road for better transportation	8.7
3.	Proper drinking water	11.0
4.	More funds for village development	10.0
5.	More house hold should be included in the programme	11.8
6.	Irrigation facilities	7.0
7.	Medical facilities	5.7
8.	Short rotation fuel wood	11.9
9.	Arrangement of electricity in the village	13.7
10.	More work on lean seasons through provided various training.	5.4
	Total	100.00

Source-Sample Survey

It is also found from the sample survey that most of these FPCs are representing class of beneficiaries who are extremely poor, many of whom are uneducated and hardly have any resource of their own for subsistence. About 30% of the members are landless and 65.6% are having only less than 2 ha. land holdings. Only 3% families have "Pacca" houses and the rest live in either thatch or mud houses. Only 2% members are educated upto tenth class . The facilities from Panchayat and other government department, hardly reach to them(Roy, 1993).

7.4 AGRO-FORESTRY / INTER-CROPPING

The term "Agro-forestry" encompasses any and all techniques that attempt to establish or maintain both forest/tree and agricultural production of the same piece of land. Agro-forestry is a system of land use which combine growing or raising crops (and or livestock) with woody plants. Land can be used to produce agricultural crops -agriculture; animals and their products-animal husbandry; and trees and their products-forestry. The product

can be obtained by either growing or raising them separately or in different combinations (Figure 7.3a)

In classifying agro-forestry systems, vergara (1982) considered the relative allocation of land to trees, crops, pastures in various agro-forestry systems. For example, in figure 7.3b point A, at the extreme left show, that 100% of the land is allocated to agriculture. Similarly, on the right (point E), the area is wholly assigned to forestry. At any point between these two extremes will be found agro-forestry practices with various ratio of land allocation. At any point left of point C, agriculture is more than 50% and at any point right of point C, forestry is more than 50%

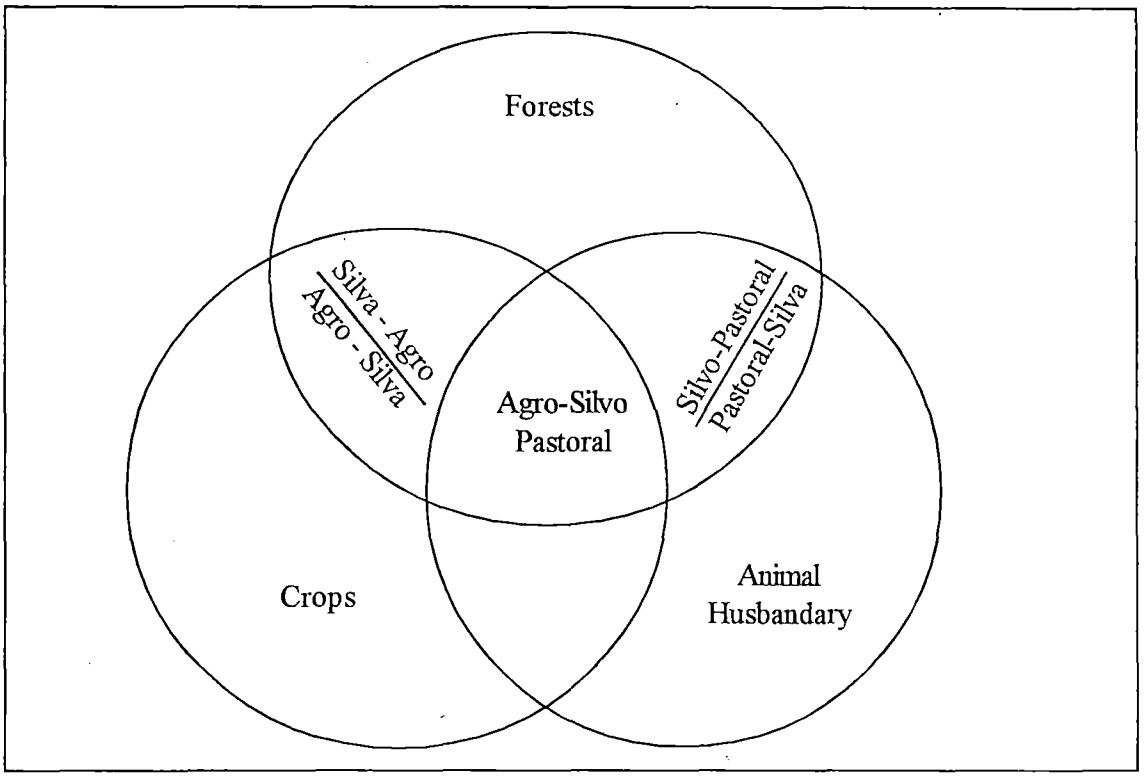

Fig 7.3a Land production systems and classification of agro-forestry.

(Source - Combe 1982 by Tejwani 1998a)

Intercrop is prescribed over 50% of the area under model R-5 and R-6 and 100% of the area under model P1, P3, P4, P5, and P6 (Annexure - 1). Taking into account the above prescription, total prescribed area under inter-crop for all the models in study area in 1432 ha. But actually 986.5 ha. area has been covered under inter-crop in 1996 plantation. Percentage of inter-crop done in various divisions of the Jalpaiguri and Darjeeling district is given below table 7.9

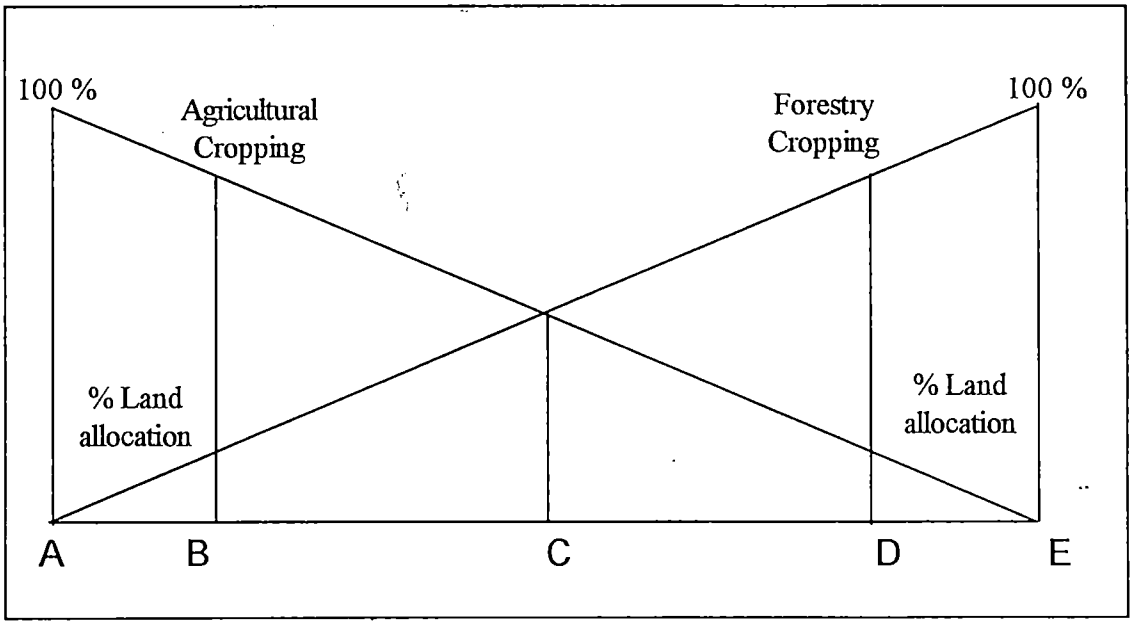

Fig. 7.3b Relative allocation of land under agricultural, forestry and agro-forestry production system (after vergara, 1982)

Table 7.9

Division wise inter-crop

Baikunthapur	BTR(E)	BTR(W)	COB SF	Darjeeling	Kurseong	Jalpaiguri	Kalimpong
56.8%	50.7%	75.9%	18.5%	22.1%	124.6%	40.6%	93.0%

Source : Monitoring & Evaluation Wing, Forest Directorate, Survey Report - 1996-97.

It is observed from the above table no 7.9 that in case of Kurseong division inter-crop percentage is more than 100% because in R models they have done 100% inter-crop. The same is true to some extent in case of BTR (w) and Kalimpong division. In general the inter-crop status of the study area is satisfactory.

7.5 CONCLUSION

The social forestry plantation have not yet been able to take the pressure of natural forests of Darjeeling and Jalpaiguri district. Strip plantation in Madarihat and Falakata block,

have generated good amount of revenue to the local Gram Panchayat , but the forest of Jaldapara Sanctuary and Madarihat Range continue to be disturbed. Similarly, despite excellent social forestry works in Naxalbari, Kharibari, Phansidewa and Matigara blocks of Darjeeling district, the adjoining forests of Kurseong division continue to suffer heavily on account of illicit collection of timber and firewood. The strip plantations are also prone to theft, damage, fire, grazing and encroachment and therefore, not much timber and firewood remain availanle at the time of harvesting to meet the local demands fully. Truly speaking neither the Panchayat nor the forest department have enough legal power to protect strip plantations. Position is further complicated by the fact that the land on which these plantaions are raised, often belonging to some other departments (i.e.P.W.D, Irrigation, Railway etc) who play virtually no role in protection these plantation.

There is no doubt that there is a need for changing the approach of social forestry so far adopted both by the Panchayat and forest department specially in view of more emphasis on conservation of natural forests and growing need of forest produce by industries. Joint collaboration between forest and Panchayat department will not only improve the productivity of strip plantation to a very great extent but would also go long way in generating huge surplus of revenue for Panchayats to attain self sufficiency apart from meeting the raw materials needs of local wood based industries thereby supplementing employment opportunities for local populations. There is how ever , a need for change in infrastructural setup and administrative guidelines to achieve the desired results.

The Joint Forest Management in the study area has not grown it potentials. Most of the forest fringe dwellers in Darjeeling and Jalpaiguri district are involved in the lucrative illegal timber trade. The forest department has apparently has failed to interact with the committees on a regular basis. The key word in JFM is co-operation and it is obvious that interaction between the forest department and the committees are free and frank. The forest department should keep the member involve right from the stage. A steady interaction will not only be way of monitoring the motivation levels of the members, but also help to ensure that financial dealing do not fall through because of doubt. It is correct to mention that the share of people i.e. FPC, in the final harvest varies. In the study area, FPCs are entitled for 25% where as in Gujrat it is 50% of the net proceeds. The forest department should provide more incentives to participate in JFM.

Inter-cropping system has not flourished to a great extent in the study area. Awarness of intercroping among the village people is very poor. Even today they think that the forestry is not the lucrative in comparision to other activities because it requires long incubation period. Only Kurseong division has occupied a significant place. The area is slowly geeting the experience of inter-crpping. People should be motivated about the benefits of inter-cropping.

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CHAPTER -8

STRATEGY FOR FUTURE MANAGEMENT

8.1. INTRODUCTION

Management is a kind of action and like other kinds of action, it depends on many things. The focus of management right at the very out set is on result- oriented performance. Forest as a living organism is to be nursed, protected and developed. The continuous onslaught on forest resource and the consequent massive environmental degradation interms of floods, soil erosion, landslides, lives and property etc., on the other hand, and the desirability of sustained yield of goods and services on the other, call for steps towards rational management of forest resource (Desai, 1991 and Sukla, 2000). However, it is very simple to talk about the management of forest resource but the reality is some what different. From the view point of layman, forest resource management is to stop or check the deforestation and to promote afforestation. Though these two related issues act as stepping stones in the management of the forests, there are several other issues, which should be taken into consideration.

Before proceeding towards the different components of management of forest resource, the clarity regarding what is forest management is necessary. If people are unaware of desirability and aims of forest management, there is little or even no hope to achieve the targets of management. Therefore, let us begin with 'what' rather than 'how' to manage the forest resource. In a very simplified version the management of forest resource is basically "the management of forest eco-system". The forest eco-system encompasses all micro and macro features, conditions and influences of the environment that affect growth and perpetuity of forest. Dwivedi (1984) has rightly emphasized that the forest resource management involves the management of (i) forest land, (ii) forest flora and (iii) forest fauna. The investigator feels that few more variables like marketing, finance, research and development, population both of cattle and of human, need-system, awareness, carelessness of resource managers as well as of inhabitants, political - legal complexities, etc. should be considered. In particular, science and technology provide a boost to forest productivity. The need for scientific management is very much essential for the accelerated growth of forests in the sub - Himalayan North Bengal.

From the environmental and economic stand point investigator broadly categorises the strategy of forest resource management imperatives into :

- Management of protecting existing forest resource and increasing forest productivity.
- Scientific management for social forestry, joint forest management, farm forestry and other.
- Management of natural, cultural and economic environment.

8.2. MANAGEMENT OF PROTECTING EXISTING FOREST RESOURCE.

The state of West Bengal has no forest policy of it`s own. It generally follows National Forest Policy. But the following are the policy issues which can be the basis of framing legislature for legal support.

(i) Optimum vegetative cover that can be achieved:

In the study area, there are 32,46,155 people (Census,1991) reside in rural areas. If average family comprises of 5 member then we will have 6,49,231, families. If by intensive planting process each family rears additional 4 mature trees, preferably multipurpose trees to yield timber / fodder / fruit, then each family can add 6,49,231 x 4 = 25,96,852 trees. In this way private marginal and fallow land can be planted. The trees planted by villagers will create employment opportunity, supplement their fuel and fodder requirement. This village plantation will be able to meet the growing demand of raw materials to wood based industries. On the other hand it can reduce the pressure on natural forest of the study area. Forest department should take necessary initiative to fullfil this goal.

(ii) People's participation :

From the late eighties forest administration of the study area has taken a new strategy in forest management by involving people residing in the fringe of the forest and Forest Protection Committee were formed. Large scale extensions should be done to motivate the people for this joint forest management programme. The advantage of Panchayati

Raj in the study area should be taken and at least two members from local Panchayat to be included in the **Forest Protection Committee**. The forest management is atpresent urban- oriented and preservative. In view of the changes in priorities and emphasis on rural development and afforestation, the National Committee on Environmental Planning (NCEP) has emphasised the need to improve forest management. Further, forest management should be the rural oriented and should endeavour to cater to the needs of the rural society. For a better utilisation of forest resource and rapid afforestations, there is an urgent need to decentralise the administration of management process. At the village level, the management of village forests, social or farm forests should be entrusted to village Panchayats (Chakrabarty,1997). The working of the village Panchayats in the area should be co-ordinated by the forest department. (Figure 8.1)

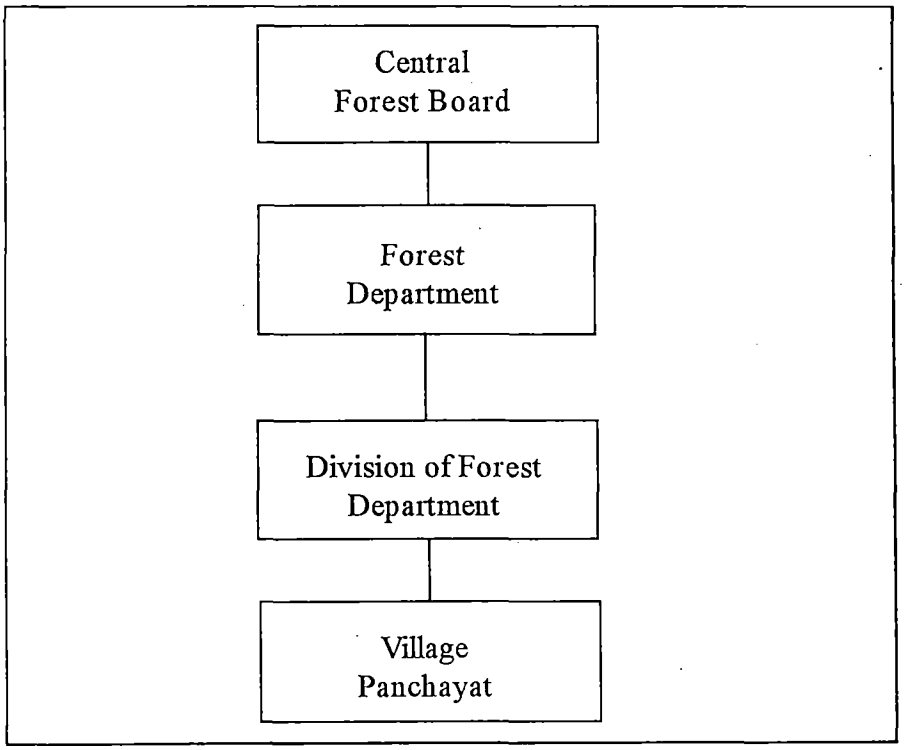

Fig - 8.1. Four - tier forest management process.

In addition to strengthening and expanding the on-going programmes in forestry, the following three new programmes may be introduced:

- **Tree for Every Child Programme :**

This programme envisages the promotion of school forestry programmes based upon the interest of the children themselves in the trees of their choice. Under this project, assistance, the training and supply of relevant seedlings will be provided to all the schools which are

, willing to join in a programme for enabling children to plant and protect one or more tree in their homes. Those schools which have the necessary land and water facilities will be enable to raise nurseries of appropriate seedlings within the school compound itself with the participation of children.

- **Eco-Development Force :**

An eco-developmental force, consisting predominantly of ex-servicemen, will be formed for the purpose of restoring damaged hill eco-system through afforestation and soil conservation.

- **Eco-Development Camps :**

College students draw from the different colleges of the area will be enable to taken up extensive tree planting work in suitable areas such as hills, river bank ,and road side etc. It is hoped that the foregoing programmes, together with the extensive tree planting work which will be under taken under the National Rural Employment Project, will help to arrest the degraded of forests and build up the ecological infrastructure necessary for sustained development.

(iii) Rural energy policy :

Even in urban of the study area a lot of firewood is consumed. So the forest department should have a rural energy policy. Within 5 kms. of forests, people may get free fuel in the form of headload from intermediate thinning and final harvesting in lieu of protection afforded by them. Also 5 kms. from havitation, intregated fuel-fodder plantations should be created, whereas the forest beyond 5 kms. should be devoted on highly productive forestry otherwise the community in the fringe will suffer due to depletion of resources which they otherwise could use for a longer period, if indiscriminate and free access to the forests can be prevented. People residing beyond 5 kms. from the forests or (out side FPCs) should grow their own fuel biomass in their own land. For that proper technology transfer and intensive extension work should be done by the forest department .

(iv) Fodder policy :

The study area has high density of cattle population (1.18 millions as per Census, 1991).

In addition to this, large number of goats, sheep, pigs also add to these and hardly any agricultural or non-forest land is earmarked for fodder cultivation in the area. Forest department should register all the cattle of the village and they should be graded. To certain limits no fees to be levied but beyond that fees should be levied and that income should go to the village development committee/FPC/Panchayat etc. The state government should also frame policy to reduce the number of unproductive cattle and replace the same by high breed cattle by artificial insemination, castration etc.

(v) Wild life conservation :

The action plan of wild life wing of forest department should be divided into three categories-

(a) Species conservation (conservation of particular species)

(b) Protected area conservation and

(c) General public awareness.

As mentioned earlier that there are some important animals existed in the study area which require special attention for their preservation . Such animals are- (i) Tiger, (ii) Elephant, (iii) Rhinoceros, and (iv) Mammals specially Red Panda. National parks and wild life sanctuaries of the study area should be protected and conserved. Few forest area of the districts should be declared as reserve and protected areas. Wetlands and some bird sanctuaries in the study area also need some special attention. There is a proposal for external funding for eco- development at Buxa Tiger Reserve (by global environmental facility which is a window of World Bank), a grant plus IDA (Soft loan) for eco-management of fringe dwellers, 16 FPCs and 16 EDCs at BTR for five years (Working Plan, 2000). This sort of work programme should be extended in other protected areas. The State Government should contribute some funds for public awareness in general and for publicity on the wild life of the area. This programme may reduce the man-animal conflict (Ghosh and Nandi, 1997 & Mani, 2001).

8.2.1. Increasing forest productivity

In order to increase the forest productivity ,the silvicultural practices for multiple use forestry may be used .Clear policy should be adopted regarding the silvicultural system to be followed

in the districts. Considerable areas have been kept reserved in the study area for bio-diversity conservation. So in rest of the areas highly commercial species should be planted. No clear-felling should be allowed in fragile areas of natural forests. Extraction should be limited within sustainable capacity of the forest, following selection system wherever possible and creating condition conducive to natural re-generation of valuable species, by limiting the grazing within carrying capacity, limited collection of leaf litters and fuel wood. But the past experience in the study area indicate the problem of natural regeneration under diffused regeneration system, and so there is no reason why in suitable areas of natural forest clear-felling followed by artificial regeneration should not be adopted. So, it will be unwise to keep the assets locked up and try to follow a silvicultural system which failed in the past and where the natural regeneration is not assured. For the time being clear felling may be extended atleast up to 60% crown density of natural forest, except in fragile areas.

8.3. MANAGEMENT OF FORESTRY PLANTATION

The investigator has catagorised the forestry plantation from the view point of the following :

- Management of social forestry
- Joint Forest Management
- Farm forestry .

8.3.1. Management of social forestry plantations :

Social forestry management aim at putting as much area as possible under forest cover and also to meet various needs of people viz. fuel, fodder, small wood for house building and agricultural implements etc. Changes in management practices, participation of local people and sharing of benefits added a new dimension and also gave impetus to the aspirations of the people living in the vicinity of the strip plantation, who are the target - beneficiary in the management machinery. Commensurating with the avenues provided in the Joint Management of such plantation, coupled with change in social- need, it has become imperative to shift our attention to the primarily objective to give maximum financial return at quickest possible time to the target beneficiary which shall make them interested for the protection of these plantations (Vyas & Dubey, 1997).

8.3.1.1 Species Selection : It is proposed to plant only 5-7 fast growing species in the strip plantation suitable according to site factors. The following species which have been found to grow well in the districts of Darjeeling and Jalpaiguri will be planted in the strip plantations. (Table 8.1)

Table 8.1

Species for strip plantations

Sl. No.	Local name	Scientific name	Best location
1.	Simul	*Bombax ceiba*	School compound
2.	Kadam	*Anthocephalus kadamba*	Road side
3.	Gamar	*Gmelina arborea*	Vested land
4.	Sirish	*Albizzia species*	River embankment
5.	Teak	*Tectona grandis*	Road/Railway line
6.	Sissoo	*Dalbergia sissoo*	River/Road side
7.	Bakain	*Melia azaderach*	Pond/Bill embankment

These species not only grow quite fast but also have great demand as raw material for plywood, veneer, match industries and furniture making industries in the districts.

8.3.1.2 Proposed administrative measures :

In view of lack of technical expertise and trained manpower with Panchayats it is proposed to vest technical aspects of social forestry schemes with officials of forest directorate. While the forest officials would be responsible for raising nursery, soil testing, suggesting fertilizer/growth hormones applications and subsequent silviculture operations such as cleaning, mulching and thinning if necessary, the Panchayat functionaries will be responsible for selecting of beneficiaries who will be engaged in implementing these schemes and also subsequently protecting the strip plantations. It is suggested that selection of beneficiaries should be done from the initial stages of implementation of these schemes.

A part of sale proceeds or net income at the time of harvesting of these plantations

may be shared with these beneficiaries on the lines of sharing of revenue under **Joint Forest Management** in forest areas. For these purpose the beneficiaries may constitute **"Strip Plantation Protection Committees"** on the model of Forest Protection Committees.

It is proposed that Joint Management of strip plantations should be implemented from planning stage to harvesting stage and both Forest Department as well as Panchayat functionaries should participate from the inception to harvesting to make the schemes successful. (Figure 8.2)

In view of change strategy, it is also felt, that there is a need of amending the existing government orders relating to management of strip plantations issued by forest department in this regard.

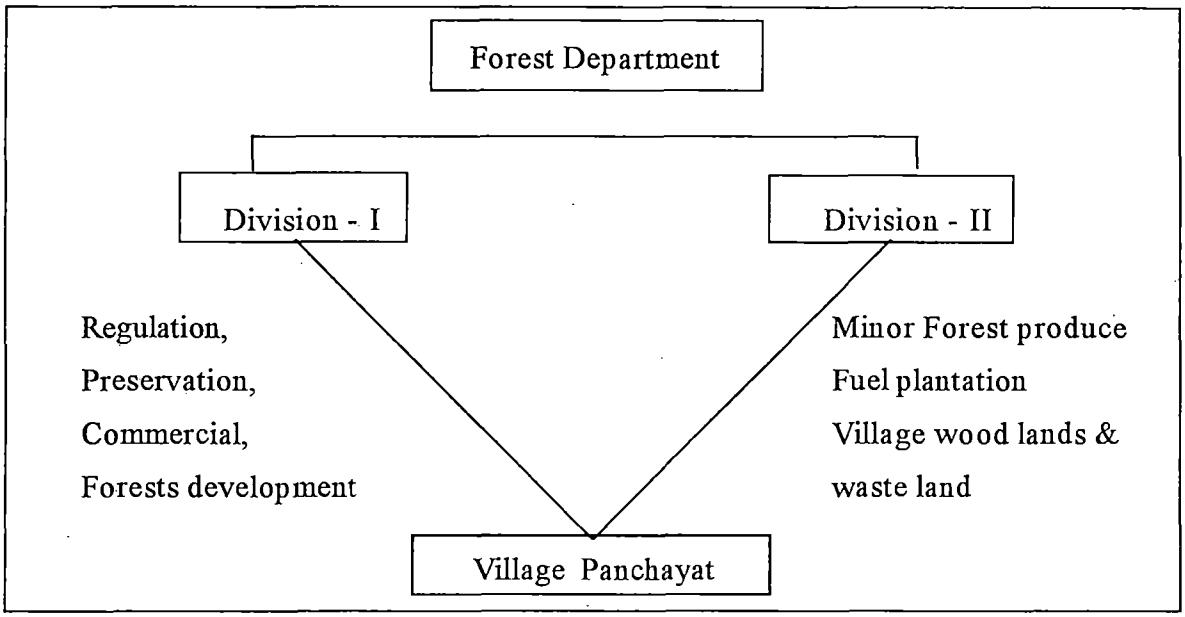

Figure 8.2 - Role of Forest Department and village Panchayats in Social Forestry.

8.3.2. Joint forest management

In joint forest management the objective of both partners, the local community and forest department, must be clearly understood and agreed upon jointly. It was initially assumed that these process of micro-planning will automatically take care of setting up of correct objectives. The present micro-planning will automatically take care of setting up of correct objectives. The present micro-planning process tend to revolve a round the assessment of resource and of community needs. The discussion of these problems and their remedies often obscures the central issue of why, how, by whom and for whom the forest itself

should be managed. For successful implementation of the JFM, micro-planning of individual FPC/EDC areas is most essential. Micro-planning entails extensive ground level survey of both villages and forest resource. The EDC can play a crucial role in stemming the degradation of environment in the hills. The training is also important. The official at the ground level (who are responsible for maintaining liaison with the committees) have to be suitable trained before they can successfully interact with the villagers. The human aspects of JFM demands an imaginative approach and more commitment on the part of the official. Involvement of more tribal people in the afforestation programme should be increased. (Figure 8.3). It will be advantageous to go in for mixed plantation with particular emphasis on some of the species which will be benefit to the tribal (Basu, 1987). There are other tress whose produce falls under minor forest produce. The development of such tree will provide a supplementary source of income for the tribal. Some support activities should be provided by the forest department for the proper implementation of JFM in the study area which include -

(a) Work for more days

(b) Provision of drinking water, electricity and

(c) Medical and education facilities for the children.

In addition to the above, allotment of more funds for the various activities of JFM should be provided by the state government . One of the most important factor is the share of people i.e. FPC in the final harvest. In the districts at present FPC are entitled for 25% whereas in Gujrat it is 50% of the net proceeds. So the share of FPC in final harvesting should be increased from the 25% to 50%.

8.3.3 Management of Farm Forestry

In farm forestry it was found that people interested to grow timber species, like Kadam, Gamar, Sissoo. This trend continued till early nineties. Since last two years there has been noticed that large number of veneer mills have been established in the districts and farmers have become interested to sell even immature trees to these mills at nominal price. This clearly indicates two very important distinctive features (i) expectation for quick financial return and (ii) increasing demand for plywood industries.

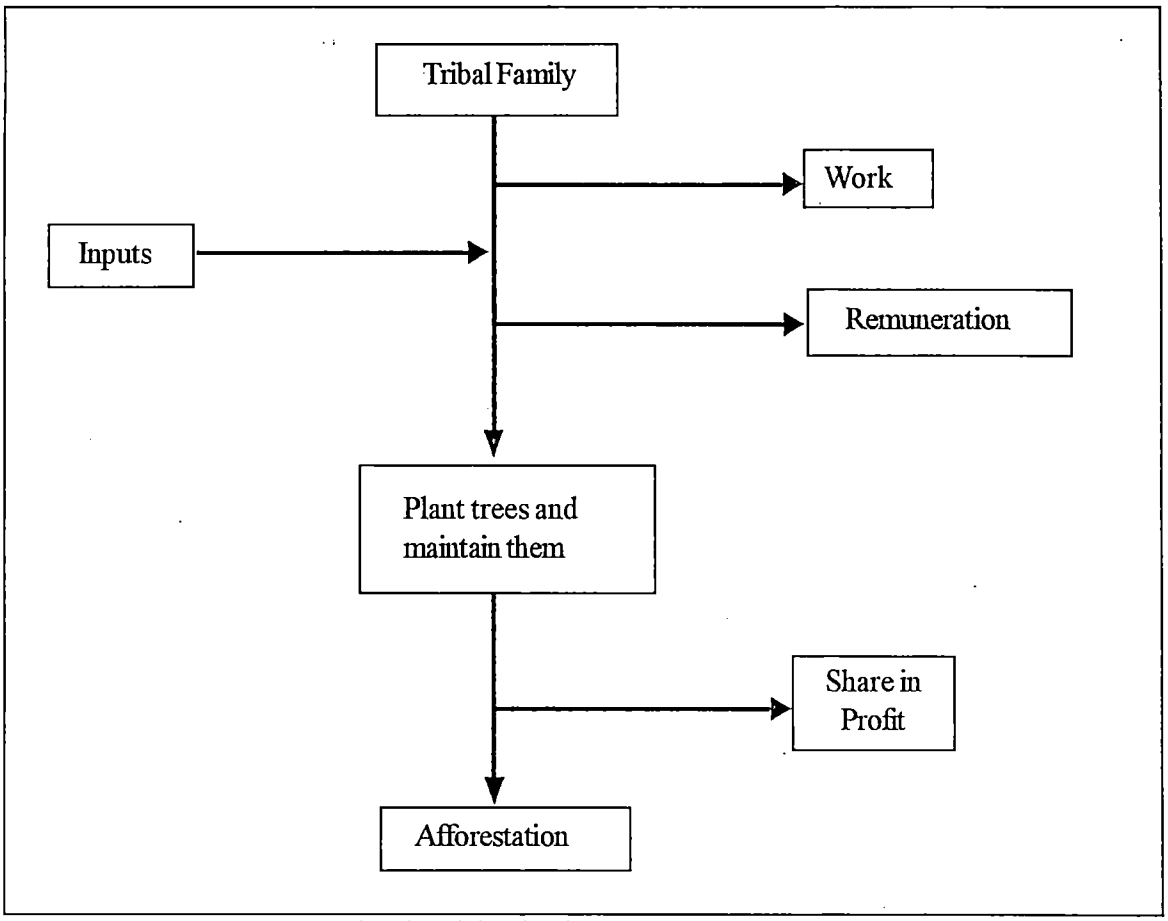

Figure 8.3 - Tribal Participation in afforestation programme of JFM.

8.3.3.1 Finance for farm forestry - A proposal

In the strategy for overall forestry development designed by the Government of India, social forestry has been given great importance, in view of the need to meet the ever-increasing demand for fuel wood, manure, fodder etc. Forming part of the social forestry programme is farm forestry, that is , raising of trees on private agricultural lands for producing timber, fuel, leaf, fruits, flowers, gums, resins, wax and roots. Commercial Banks, Regional Rural Banks, State Land Development Banks and State Co-operative Banks should provide loan facilities for farm forestry. Loans can be had from banks for planting of trees on bunds/boundaries of farmer's agricultural lands and uncultivated lands owned by farmers, for switching over from existing lands cultivation agricultural crops with low yields and low income returns to tree-farming on degraded government lands obtained by farmers or farmers' organisations such as co-operative societies on lease from state governments. Loans should be against mortgage of land and hypothecation of tree crops. The farmers are required to make down payment of 5 to 15 per cent of the capital cost,

depending upon whether they are small, medium or large farmers. Such payment is not necessary if capital subsidy is available from state government. The interest charged is 10.25 per cent for small farmers and 12.5 per cent for other farmers. Repayment period is fixed with reference to the species of trees, gestation period, yield and income from year to year.

The areas selected should be by catchments and satisfy the ecological needs, indigenous requirements or consumption and industrial needs. They may cover recognised agricultural zones based on potential productivity , current uses of produce and legal status of land, as well as on research on matching trees to the appropriate systems of agricultural practices. Compact and contiguous blocks should be selected to that better supervision and monitoring are easily ensured. Inter-cropping may be considered in marginal agricultural lands taken up for growing tree crops. If protection is available, fodder (leaf) and palatable grass can be grown. Depending on the agro-climatic conditions, inter-cropping of groundnut, cotton, bajra, chillies, tapioca, coarse millets and oilseeds can also be done. The three species proposed to be grown should be selected keeping in view the soil, agro-climatic conditions of the area, range of agricultural crops, degree of local adaptation, land development and managerial treatments available in combination with the tree crops. They should be sufficiently quick growing and capable of yielding high economic returns.

Financial assistance may have to be provided to meet the expenditure on land development, raising of mounds and digging of pits, cost of planting material, cost of fertilisers, labour and maintenance expenditure in subsequent years till the trees come up to the yielding stage. No loan should, however, be given for development of infrastructure like roads and buildings. The working capital requirements should be adequately met and the tree crops are to be insured against risk of fire. It is to be ensured that there is a tie-up arrangement with a marketing agency for purchasing the marketable surplus after the farmer's own requirements are met. It is also realised that to achieve the true potential of farm forestry and improve productivity, the individuals should be provided with improved inputs specially planting materials, technical advice for selection of proper species, proper time of planting, spacing and silviculture operation etc. The forest department should make arrangement of the above with the local Gram Panchayats.

8.4 MANAGEMENT OF NATURAL,CULTURAL AND ECONOMIC ENVIORNMENT

This aspects of Forest Management includes three dimensions which are discussed in the following sections.

8.4.1 Management of Natural Enviornment

Natural environment consists of natural features, influences and conditions. The life-system is the replica of prevailing conditions of the natural environment upto a certain extent. Natural environment is composed of climatic conditions, soil and water status, vegetational conditions, and land characteristics etc. All these singularly as well as collectively affect the nature, growth, prosperity and so many things related with forest eco-system (Ali, 1994).

8.4.1.1 Management of Soil Environment.

The role of soil in determining the growth of natural vegetation hardly needs emphasis. The management of soil environment is an urgent need of the day from the qualitative as well as quantitative perspectives of forest resource. Soil can be managed in many ways through different techniques and also by various approaches. The first and foremost aim of soil management is to check the heavy loss of soil. In the area under study, the problem of soil erosion has become very critical specially in the hill areas of Darjeeling and in the southern plain region. Control over rapid soil runoff can be exercised through the following measures:

Terracing : The most common practice to control the soil erosion in the hill areas is terracing of lands. The practice of terracing requires some basic knowledge of surface gradient, nature of parent rock and the intensity of rainfall. Despite low density of population, the regions of steep slope with high intensity of rainfall face acute problem of soil erosion, hence it is advisable to make inward terracing in such areas instead of outward and flat terracing.

Gully checking : Gully actions cause little erosion in initial stage, but after some time with increasing gully action soil erosion increases tremendously. Thus, it is a must to prevent the process of gully formation at the initial stage itself. However, the main technique to control gully action is plugging through boulders, pebbles and other resistant eartnen ,materials.

Check dams : The quantum of soil erosion can be reduced to a considerable extent by constructing check dams at suitable sites and elevations. The number and size of check dams should be based on the water catchment area.

Nutritional management of soil : Soil is the basic source of nutritional stock and the amount of various organic and inorganic constituents present in the soil directly affect the amount and growth rate of different and divergent forest species. Thus by doing the nutritional management of the soil by alternation or additions of proper organic/inorganic nutrients, the targets of forest resource management can be achieved to a certain extent. For the purpose of better output of the forest flora, manuring and chemical fertilization are necessary.

Soil moisture and water management : Soil water is the basic ingredient for seed germination and for the sustenance of plant growth. On account of a canopy of tree leaves and an under growth of grass, seedling and herbs along with a dense litter of leaves and twigs, forest floor, water loss through evaporations is reduced. Further, permeability is increased, a significant amount of water infiltrates into the soil and surface runoff of water is reduced. Excess water in the subsoil is transpired and water logging is prevented. Thus, through proper afforestation programmes, soil water of a given area can be maintained and even enhanced and higher levels of natural regeneration target can be achieved. Through the process of organic manuring also, soil moisture relations can be improved.

8.4.1.2. Management of slope failure

Slope failures are the basic problems of the Darjeeling Himalayan region. Among the main causative factors - geological conditions, slope and gradient, hydrological conditions and biotic activities are worth mentioning. Emphasis should be given on the role of vegetative component of the system. In many areas in spite of favorable geo-hydrological conditions, the failure of slopes is due to the destruction of vegetations. The management and control of slop failures is necessary because of their dual role in disturbing the vegetation .Firstly in the places where slope failures occur, the loss in vegetation is an obvious feature. Slope failures can be checked considerably by controlling the hapazard construction of road networks which is being done without considering the local environmental conditions, and by planting vegetation in affected areas. The construction should be avoided on steep

slopes and if the constructional works are necessary they should be along the lower terrace of rivers. The other important factor to be taken into account is the nature of rocks because weak and friable rocks are specially susceptible to slope failures. Thus, be avoiding areas with such rocks, roads can be constructed for the overall development of Darjeeling hill areas. Even then, the local environmental conditions should not be overlooked. Indeed, there is a requirement to develop new techniques for constructing the roads in the hills of Darjeeling district.

8.4.1.3 Management of Natural Regeneration :

Since long, natural regeneration has been the main source of sustained forest wealth. However, the forest wealth can be sustained only if the exploitation does not exceed regeneration. In recent times the concept of massive afforestation has originated because of a rapid decrease in the forest cover and consequent natural regeneration (Mukherjee, 1995). Natural regeneration means production and successful growth of seedlings of plants under existing suitable environmental conditions without interference of man. In fact for the seeds falling naturally on the ground, there is a greater possibility of germination provided natural conditions of the environment are undisturbed. But during recent times, the situation has reversed. The whole process of natural regeneration is crying for immediate help. This is true not only for the Darjeeling Himalaya but also for the plains of Jalpaiguri district. Due to the paucity of natural regeneration, several species are endangered and many among them are on the verge of extinction.

8.4.1.4 Management of landslide affected areas in Darjeeling Himalayas.

The major problem in hill areas is mainly landslide caused forest degradation, unauthorised quarrying of boulders from the natural streams, faulty agricultural practices and faulty building construction etc. Though, apparently water conservation may not be necessary due to heavy rainfall but actually the rain concentrated within 4 to 5 months of a year followed by a long dry spell. So, both water disposal and water conservation measures should be taken up along with soil conservation.

For safe disposal of water during rainy season, excess water should be channelised though catchwater drain, chutes with proper apron, to break the velocity of the speeding water. For stabilizing the landslide, grassy and suitable vegetation which can sprout naturally are

to be planted after making backward terraces. Palisade with self-sprouting species will check soil erosion. Ground vegetation should be restored by preventing grazing.

Quarrying in natural stream should be strictly prohibited as this practice leads to widening of channel, loss of cushion and subsequent bank erosion and sliding. Toe cutting in streams rivulets should also be prevented by sausage work at the bottom. Along the slope cultivation and construction work on steep are should also be avoided.

8.4.2. Management of cultural environment

The scale of developmental speed and also the degree to which environment is exploited, must be correlated to under stand 'what are the actual gains' and 'what are the actual losses'. Modern resource planners have started thinking about the developmental impacts and the degradation of environmental niches. This is indeed a good sign for whole of the contemporary civilization.

Developmental activities of the man, ostensibly for the man, have generated many more problems by destructing the natural vegetation. Thus, there is an urgent need to reduce the scale of man-made activities in forest exploitation. Under the heads of cultural environment following are the prime importance and may not be kept in isolation especially from management approaches of forest resource.

Population management :

The management of rapidly increasing population can help in reducing the burden on various resources. Population management is concerned basically with the demographic aspects of population and their spatial distribution. The increasing population means more land for building, more pressure on agriculture, more fuel, more fodder and more infrastructural development, etc. And all these additional requirements are directly or indirectly related with the forests. In short, population governs the level and rate of consumption of various forest products directly and various associated influences indirectly in the study area. The decadal population growth rate (1991-2001) in the area is 22.53%resulting in heavy pressure on forests. It will be difficult to keep pace with the clearing of forests by the present rate of plantation. For this purpose, it is essential to control population growth on the one hand and to plan plantation of trees on available

denuded and vacant areas, on the other. This can be achieved by legal tools and through the creation of awareness among the people with the help of mass-media. It is imperative that the state government should also come forward with necessary forestry courses from the primary school levels itself to educate children regarding the importance of forests in shaping the environment and economy.

Research Work :

Research should be conducted to find out suitable plant species for different bio-climatic regions. Care should be taken that such plan species be grown on village lands which can provide oilseeds, honey and seasonal fruits. In the materialistic society man has forgotten that there are other lives also on planet earth. We have not spared any component of environment for their survival in a healthy and prosperous condition. In forest management programmes emphasis should be given to plantation of those species which can provide leaf fodder. It is advisable to grow fast regenerating scrubs of such variety which can provide firewood on a sustained basis. The State Government should establish a Forest Research Institute (F.R.I) in the area. A short course on Forestry Management can be introduced at the North Bengal University. The State Government as well as forest department should take necessary initiative in this regard.

8.4.2.1. Management of Intersectoral Linkage :

There are some sectors/departments in the study area which have close linkage with the forest department. The policy of forest department and other linkage sectors should be property linked. This will bring a bright future of the forests of the area. These sectors include the followings :-

Land Revenue Department

- Large areas of forest / waste land are still under the custody of Tea Gardens for their future expansion. But at present they are not utilising their land and not making any working scheme for management of such excess land, though they have huge labour force in their gardens who consume lot of fuel wood. Therefore, the Land Revenue Department should ensure that all the tea gardens manage their land properly, particularly the forest and waste land, so that short rotation fuel wood species should be grown there to meet the demand of their labours and thereby minimise the pressure on adjacent forests. Further they allot their excess land to their surplus labour force

in an unplanned manner which delink the continuity of the tree cover and that hinders easy movement of wild animals from one part of forests to another particularly the elephants which cause lot of depredation in such situation.

- The Land Revenue Department of the study area also distribute the agriculturally unproductive land to the farmers (beyond Class - IV Land) which cause serious soil erosion due to faulty agricultural practice there. Therefore, the lands which are above Class - IV should be allotted to forest department for afforestation purposes.

- In the past large forest areas were allotted to the Defence Industries for refugee rehabilitation and to other developmental agencies. In this way valuable forests were lost for establishment of Sevoke Cantonment and to the Medicinal Plants Directorate in Darjeeling hills and plains. Therefore, the use of forests land for non-forestry purposes should be examined very carefully before releasing it for other developmental purposes.

Agricultural Department :

This department is primarily concerned with development of agriculture taking least responsibility for pasture development or fodder production. Though agricultural residues supply about 60% of the cattle feed, but it has no nutrative value and only it is used as a ruffages with low or nil C.P.C. (Consumable Protein Content). So, policy should be framed and effort should be made by this department for pasture development

In the catchment areas of important river Mahananda, W. P. R. (Watershed Project Report) is made for entire catchment on sub-watershed basis which also includes agricultural lands and the forest officers are made the Nodal Officers. So, close co-ordination of this department should be established for proper saturation of the entire watershed.

Tribal Welfare Department

Lot of fund of this department can be utilised in forestry development, as the tribals are generally inhabiting inside or in the fringe of forests. If proper planning can be made it will generate lot of employment to the tribal people from the fund received from various agencies

which includes central and overseas assistance.Further, monopoly rights for collection and disposal of sal leaves, were given to Tribal Cooperatives. But due to organisational weakness, the resources are not fully collected and disposed of at reasonable rate. Thereby the tribals are deprived of the benefits of these monopoly rights. This can be improved with close linkage with the forests department, so that timely collection, disposal and reasonable rates are received from such products.

Animal Resource Development Department. (A.R.D.D)

There are two major reasons for which forest resource is depleting rapidly. One of such is the collection of fuel wood and the next is pressure of grazing. The study area has a largest cattle population, but most are unproductive. Due to development of agriculture and introduction of multicrops on the same land, the cattle get very little time to graze in the agricultural land and most of them are diverted into the forests causing rapid degradation of the latter as it is beyond its carrying capacity.So, A.R.D.D. should try to minimise the number of cattle by enriching the livestock and encouraging stall feeding as far as practicable and the close co-ordination will help producing fodder crop and tree within and outside forests by people's in participation and under farm forestry.

Home and Customs Department

To prevent felling and smuggling of the forest produce and killing of wild animals, close co-ordination with the Police and Customs Departments is a must. Only then the biodiversity can be restored properly.

Small Scale & Cottage Industry

The small scale and cottage industry should conduct the training programme on processing of wood based small industry such as artifact from Sabai rope, decorative wood, Sal leave plate making, apiculture, mushroom culture etc.

Department of Alternative Energy Resource

The Department of Alternative Energy Resource should arrange to supply and establish manufacturing units for fuel-efficient chullhas in cluster of FPCs, so that sufficient quantity of fuel wood can be saved in the study area.

Local University

The North Bengal University has a big role in biotechnological aspects particularly initiating various types of pilot projects, so that effective technology will be transferred from laboratory to land. A course on forestry should be introduced at the degree course level of different colleges under North Bengal University

Local Development Council

Recently in the study area a local development council has been establised in the name of Uttar Banga Unnayan Parisad to promote socio-economic development in the North Bengal as a whole. It is a state government agency. This parisad should allocate some funds for the development of local forests . The local forest department and this parisad should work together specially in afforestation programme and controlling rapid deforestation .

Local Panchayat

There is a strong Panchayat Raj in the study area. Recently the tea garden and forest villages of Darjeeling Himalaya has brought under Panchayat raj. The linkage of forest department and Panchayat system should be improved specially in the social forestry plantation. All village level plantation should be handed over to Panchayat. Members of Panchayat should also be included in the local FPCs to frame a joint policy for protecting and conserving the forest plants of the study area.

8.4.3 Management of economic environment

Economic environment of the forests basically means the industrial aspects of the forests. A large number of forest based industries of the study area is dependent on forest products. These industries consume huge amount of forest produce and provide large number of employment to the villagers resulting in rural development. There are various NTFPs on which the tribal people are closely related (Shiva,1998). Management of economic environment of forest, indicates the management of wood based and non- wood based industries in the study area with the people who are involved in the forestry activities.

8.4.3.1 Forest Based Industries

Forest industries play an important role in the economic development of the districts. These industries are the important sources of employment in the study area. At present, the wood

based industries are facing various type of problems. The most serious problem is the lack of supply of raw materials to the local wood based industries due to the imposition of restriction on clear felling by the government. Moreover, the National Forest Policy 1988 clearly mentions that the forest can not only be exploited for industrial purposes. Natural forests serve as genepool resource and help to maintain ecological balance. So the forest based industries which have a direct impact on local economy should be managed properly. The investigator has suggested some guidelines for the survival of forest based industries. These guidelines should be as follows:

- A forest based industry should raise the raw material needed for meeting its own requirements, preferably by the establishment of a direct relationship between the factory and the individuals who can grow the raw material by supporting the individuals with inputs including credit, constant technical advice and finally harvesting and transport services.

- Emphasis should be given on the use of labour intensive technologies, and preferential encouragement should be given to small scale industries.

- Forest industries must not only provide employment to local people on priority basis but also involve them fully in raising trees and raw materials.

- Industries should be encouraged to grow their own raw material on the land assigned to them or preferably through contract with smaller tree farmers. If the industry is assigned land on a large scale , it should be obliged to grow a fixed quantum of fuel and fodder on this land and guarantee employment to the local population.

In addition to the above consideration, there are some steps which should be taken by the state government . Government regulations and present methods of auction of timber by forest department should be more flexible. Import of wood and wood products should be liberalised. There should be greater liberalisation and freedom in trading of wood. Marketing networks for the sale of forest products should also be developed.

8.4.3.2 Development of Eco-tourism Industry

Management of forest will certainly beautify the hilly landscape of Darjeeling and *duars* regions of Jalpaiguri district, which will help in encouraging eco-tourism. There are some national parks, and wild life sanctuaries as well as one tiger reserve project in the study

area. Very recently the forest development corporation has establised some nature interpretation centres on the way of some reserve forests . These centres are getting more attention to the nature lover tourists. Forests of the area can give much aesthetic satisfaction to the tourists. So there is a bright prospect for the development of eco-tourism industry which will be the engine of economic development of the districts. Theinvestigator has prepared a model through which the eco-tourism industry in the study area may be developed. The model is given in figure 8.4.

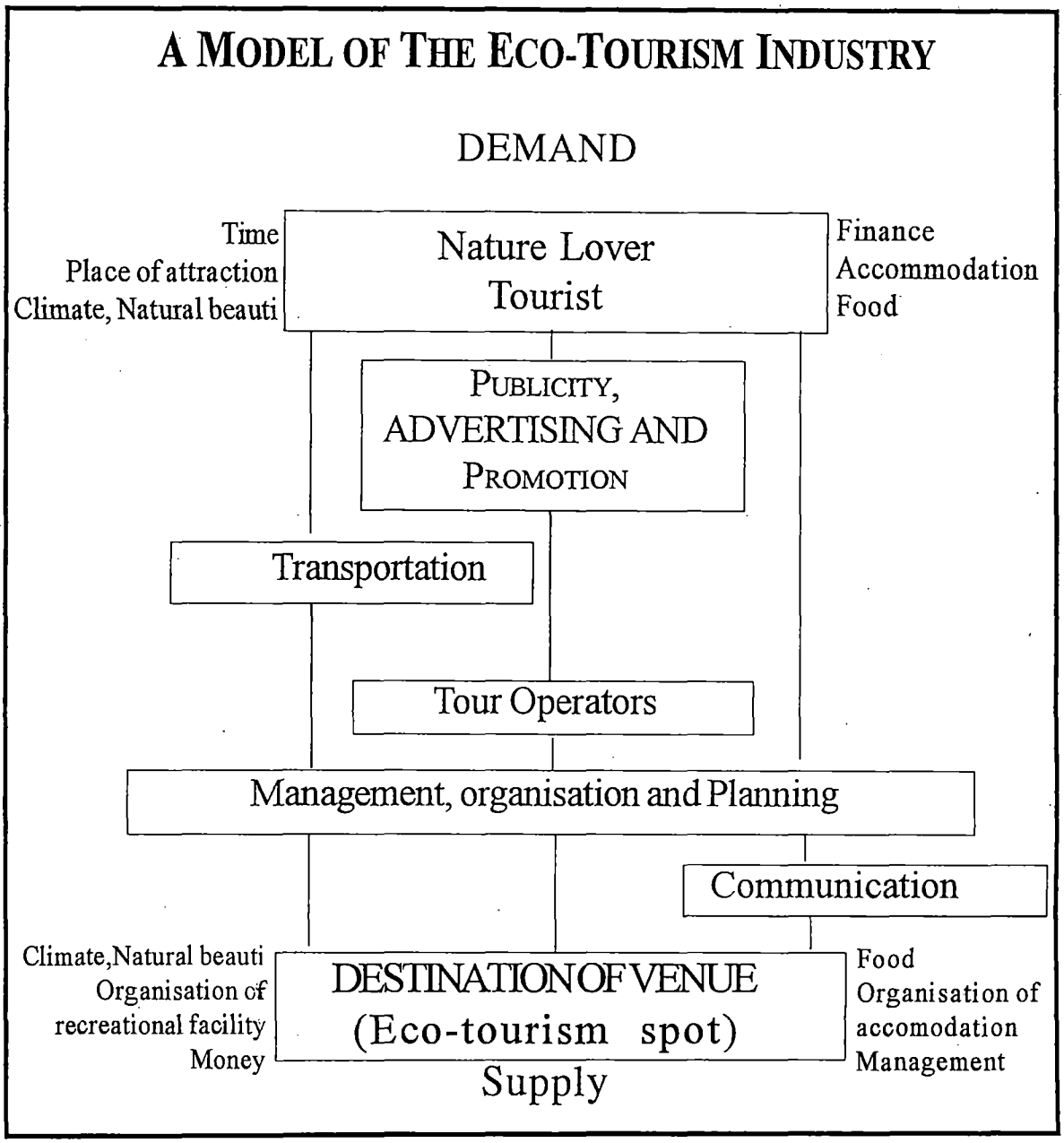

Figure 8.4 Model of eco-tourism in the districts

8.4.3.4. Economic Policy for NTFPs and Tribal Welfare in the Study Area.

The tribal population in the area primarily subsists on NTFPs and the major objectives of the state government in managing NTFPs have been to increase tribal welfare through income and employment generation. Income generation can be enhanced through the development of local value addition activities and NTFPs market. Though there are some limitation about market and value addition opportunities, the self-interest motive of tribal collectors is the prime force to invigorate the NTFPs economy. Forest department's role is very important in this regard. Enough income and employment opportunity must be generated in the study area and for which forest department must intervenes in the price formation of NTFPs market. Stocks of NTFPs should be extracted on sustainable basis and they should not decline (Figure 8.5)

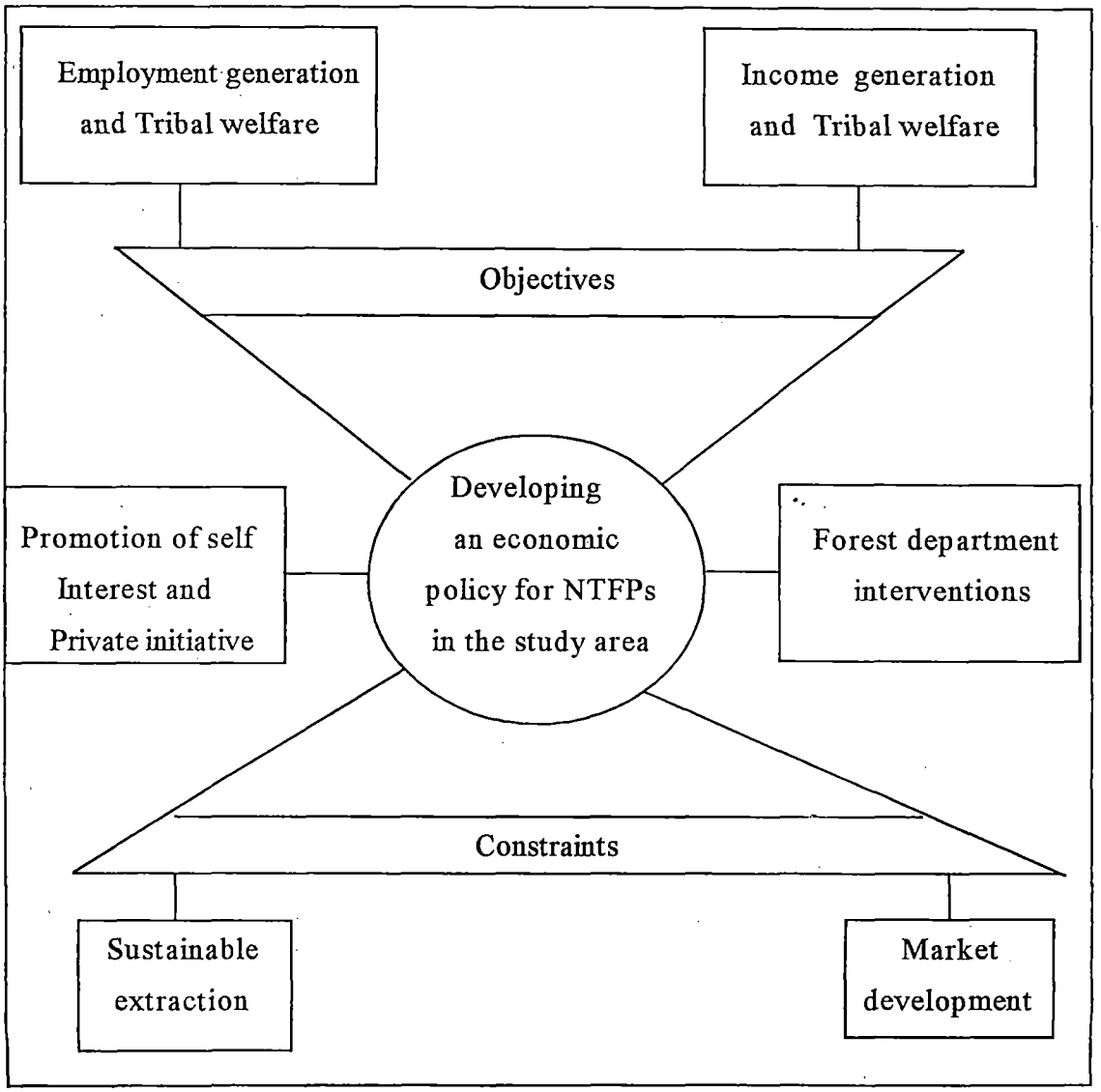

Figure - 8.5 - An economic policy for developing NTFPs and tribal welfare in the study area.

8.5 CONCLUSION :

The success of government policy will not only depend on what the government itself does but on what it can do to motivate the people. Induced development may be far more successful than the policies imposed through laws, departmental activities and sanctions. If villages can be given incentives for the development of farm forestry and of building timber stock by planting trees between fields and on village common lands etc., it would not only result in greater awareness and education concerning the importance of trees but would also generate more physical production. Selected species of trees and hedge crops can supply both fuel and fodder. Similarly, forest based industries and commercial establishment in the towns of the study area can be motivated through incentives, laws and through moral pressure on plant trees on their plant sites. There is also a considerable amount that can be achieved through education and in making each school adopt ecology programmes in their own compound and surrounding areas. The subject may also be included in school curricula.

It is imperative to assess the level and magnitude of degradation of forest cover through satellite image at regular intervals. Besides, like population census, there should also be a census for assessing regeneration of major species in different altitudinal zones / water sheds at regular intervals taking into account individuals of all ages. Simultaneously for the development and conservation of forests, there should be allocation of more funds because in all previous plans, the forest development was accorded very low priority in the hierarchy at state's and national budgets.

Before executing various development activities like construction of big dams, reservoirs, roads and bridges etc., particularly in forested areas, their overall environmental implication should be taken into account. Keeping these facts in view, it is suggested that a District Ecology Council should be setup under the chairmanship of leading ecologists to decide the future course of development and forestry. The activities of this council should be find out various ecologically sensitive zones and to suggest appropriate measures for their speedy recovery.

It is expected that if the above mentioned strategies are adopted, the study area will be richer in forest resource resulting in both economic and environmental development.

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ABSTRACT

The sub-Himalayan North Bengal is endowed with many natural resource, of which "forest" is the most important. Being renewable resource, the forests are performing a number of functions including ecological, recreational and economic. The area is still blessed by 3037 sq.km. as forest which is 32.39% of the geographical area of the districts. The most remarkable feature of forest of Darjeeling and Jalpaiguri district is the wonderful variety of species that it contains. Few places in the country in which so many different types of forest exist within so small an area. Forest being green gold play an important role to boost up the local economy and maintain the ecological stability of this strategically important part of the country.

The region was under dense cover of natural vegetation 150 years back (estimated to be over 80% of the geographical area). Major portion of which had been cleared by the so called developmental processes during the British occupation. Extensive heedless deforestation invites soil erosion and inumerable landslides in the hilly parts and devastating floods in the foot hills and plains during the monsoon months. The forest based industries, which play a prominent role in the economic development of the study area are also showing a sign of stagnation. Unscientific and unplanned exploitation of forest resource have led to the establishment of vicious cycle of degradation and endangering the ecological balance of the area.

Geologically, the study area is composed of several types of rock formation of different characteristics. The northern hilly part is composed of highly metamorphosed rocks like gneiss, schists, phyllites, slates and quartzities. The foot hills tract is composed sandstones, siltstone, shall etc. The southern plains is composed of recent to sub-recent alluvium and fan materials.

Topographically, the area is divided into three distinctive segments. (i) the hills (ii) the piedmont and (iii) the plains. The hilly region is restricted within Darjeeling and extreme north-eastern part of Jalpaiguri district. The piedmont which is locally known as *terai* and *duars* includes the entire Siliguri sub-division of Darjeeling district and northern part of Jalpaiguri district. This is formed due to the coallescing of several alluvial fans with the catchment area of the Mahananda, Tista, Torsha, Sankosh, Raidak and Jaldhaka. The

plain region is located to the further south of Jalpaiguri. Perceptible gentle gradient of land is a significant feature of this region.

The study area is endowed with an intricate network of river systems. Most of the rivers are considered to be highly notorious for their unpredictable nature, letting loose fury of flood and problem of extensive and regular bank erosion, shifting course and render thousands homeless during rainy season. The majority of the rivers of *terai* and *duars* originate in the Himalayas to the north and northwest and flow along south to southeasterly direction.

Large latitudinal extent and physiographic variation of the area have brought diversity in climate with contrasts in meteorological conditions resulting in the development of greater degree of seasonality. Rainfall in the area follows the typical monsoon pattern. It occurs mostly during the four months from mid-May to mid-September. Many parts of the area enjoy a warm rainy season which is advantegeous for the growth of vegetation. Annual rainfall varies from 2,500 to 5,000 mm. The mean annual temperature ranges from 10 ^{0}C to the extreme north to 24^{0}C to the southern plain.

Forest of the study area performs some productive functions which can be achieved through the exploitation of forest. The local economy associated with it is called extractive economy. Assesment of forest resource is done on the basis of primary data collected from the fields and from multifarious secondary sources. The region is endowed with a variety of climate and edaphic conditions resulting in rich and varied flora. The distribution of forest is shown by geographical area, legal status and spatial distribution of forest land . The forest is classified into seven types which includes Sal forest of the plain, Reverine forest, West mixed Sal and Moist deciduous forest, Middle hill forest, Lower hill forest, Wet temperature montane forest and Alpine forest. Tree species are categorised into two types - General species which include timber bearing trees and Miscellaneous species indicate non-timber bearing trees. A total of 42 wood species are identified by the investigator and out of which 14 species are of economic important. Non-timber forest productsare Citronella oil, Sal leaves, Sal seeds, Mashroom, Turmeric, Medicinal plants, Khata etc. A picture of degradation of the forest of Darjeeling and Jalpaiguri district is also highlighted. Among the various reasons, the most important is the illegal felling. Other causes include landslide and soil erosion, flood induced river shifting and dolomite mining along Indo-Bhutanese

border. Total growing stock of timber is estimated 32787.69 (in thousand cu.m.) which is made from the several records of forest department. Annual growing stock of NTFPs is also prepared by the investigator through sample survey and secondary sources. The production of the forest of the area can be increased manifolds if proper management is followed and more inputs in the forms of quality multipliers i.e. seed, clone, graft, nutrients and irrigation can be provided.

The forest of Jalpaiguri and Darjeeling district is the store house of variety of major and minor products. The important forest products are wood and a number of non-timber forest produce. The forest based industries occupy a prominent place in the economy of Darjeeling and Jalpaiguri district. These industries are traditionally dependent upon forest and consume huge quantity of wood and provide employment opportunities to the rural population. There are large number of wood based industries in the area namely saw mills, veneer mills, ply wood, furniture, packing box etc. Some industries are also based on non-timber forest produce. The condition of forest based industries in the study area is not so bright due to the introduction of Forest Conservation Act. 1980, and National Forest Policy 1988, which severely restrict the clear felling of natural forests. So the major problem faced by the industries is the shortage of raw materials. Import of timber is also limited and costly. It is, therefore, imperatives that the effort be made for meeting the demands of these industries by growing trees outside the forest areas. Economically important trees should be planted. Three approaches are suggested which include **farm forestry or growing of trees by individual on their farm lands, strip plantation or growing of trees on strips along roads, cannels, river and the agro-forestry or inter-cropping culture.**

For analysis of marketing of timber, poles, small wood and fire wood, some market centres are selected to understand the marketing scenario of the area. The market centres are important because they provide lot of information to understand the trends in marketing of forest product of the districts as a whole. The bulk of forest product in the study area comes from government forest. Forest department supplies the major quantity of timber to the wood depots (40.8%). Sample survey reveals that Sal (43%) and Sissoo (14.5%) are the main species in the wood depots. There are some non-timber forest products which are marketed by the W.B.F.D.C. Ltd. The major market centres in the area are Siliguri,

Bagdogra, Alipurduar and Madarihat. Other than these local markets, a big secondary market existing in Kolkota. Various types of traders are involved in wood trading. Retailers are the major trader in the wood market. There is a wide variation in the price of wood due to quality, size and measurement. It is noted that Sal, Teak and Sirish are the premium species in view of annual growth rate of prices. Two type of buyer are involved in trading of wood (i) **Timber merchant both local and outsiders and (il) General users.** To make the marketing of forest product more effective, the state government should get into the marketing intelligence to enable it to monitor market price on weekly if not daily basis. A simple one page news bulletin may be issued indicating market location, market size, information, quality etc. Such news bulletin may be updated from time to time and broadcast or telecast through AIR/DD under "farmers" programme.

The study area possess a large variety of fauna from the largest Elephant (*Elephas maxima*) to the smallest Hogbadger. The high altitute of the Darjeeling Himalaya is the house of Red Panda (*Alurus fulgins*). Apart from this the Royal Bengal Tiger (*Panthera tigris*) and one horned Rhinoceros (*Rhinoceros unicornis*) are the important fauna of the area. Eco-tourism is developing with the exploitation of the natural resource including forest. The study area attract more than 40,000 nature lover tourists to the forest site every year. The ecological usefulness of forest 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 protect soil from erosion. The occurrence of landslides are found much less in densely forested tracts in the study area. The virgin forest area which are practically landslide free zones. During the year 1998, 225 ha. of landslide affected areas have taken for plantation. The eastern part of the river Mahananda is still under dense forest cover and perhaps prevents the occurrences of major flood in the *terai* foot hills. On the contrary, occurrence of flood are found more frequent in degraded forest areas. The case study of soil erosion on the upper Mahananda basin clearly reveals that the rate of soil erosion is much less in densely forested tracts. Large scale afforestation programme at the government and private level is needed in the study area to improve the environmental quality. However, plantation of exotic species like Dhupi, Ecalyptus and Teak shuold be avoided as they have adverse affect on soil and water balance.

A picture of potential of various forest resource like timber including fuelwood and poles, non-timber forest produce, employment potential, wild life potential, tourism potential

etc. are taken into consideration. It is observed that the potential of timber, fuel wood and poles in the hilly region of the study area is more than that of plain areas. The northern hilly tract still posses a fair amount of natural forest with variety of species. The social forestry of the area has great potential to generate large number of employment. It would be possible to generate over 2 million mandays of employment among rural unskill workers. The case study of strip plantation of Madarihat-Falakata range proves the points that strip plantation if properly protected can generate a revenue of Rs. 2744.4 million in Jalpaiguri district alone within a period of 10 years rotation. Production and collection of NTFPs in the area involve huge number of employment to the forest villagers. Scientific exploitation of NTFPs can reduce the increasing pressure on natural forest. The study area has high potential to develop eco-tourism industry which can boostup the local economy. Eco-tourism has also employment potential. There are some National Parks, Tiger Reserve and Wild life Sanctuaries in the area which are the main attraction of the tourists. The forest of the districts has also ecological potential. Several case studies and field survey reveals that the forest may contribute largely towards moderation of flow of water in the catchment areas. They also offer protection against landslide, soil erosion and flood.

Few measures are adopted in the study area to conserve the valuable forest resource. These include Social Forestry, Joint Forest Management and Agro-forestry or Inter-cropping. The **Social Forestry** plantation have not been able to take the pressure of natural forests of Darjeeling and Jalpaiguri district. Strip plantation in Madarihat and Falakata Blocks have generated good amount of revenue to the local panchayat but the adjoining forests of Jaldapara sanctuary, Kurseong and Siliguri division continue to be disturbed. The strip plantation are also prone to theft, damage, fire, grazing and encroachment and therefore, not much timber and firewood remains available at the time of harvesting to meet the local demand fully. At the village level a **Strip Plantation Committee** consisting of local villagers and the Panchayat should be formed to protect the plantation of social forestry. This joint collaboration between forest and local people will improve the production of social forestry to a very great extent and would also generate huge surplus revenue for Panchayat to attain self sufficiency apart from meeting the raw material need of local wood based industries thereby supplementing employment opportunities for local population. There is, however, a need for change in the infrastructural set up and administrative guidelines to ahieve the desired results. Another important measure which is adopted in the

area is the introduction of **Joint Forest Management** through the establishment of FPC/ EDC by the forest department. The forest department has apparently failed to interact with these committees on a regular basis. It is correct to mention that the share of people i.e. FPC, in the final harvest varies. In the districts, FPCs are entitled for 25% whereas in Gujrat it is 50% of the net sale proceeds. The forest department should provide more incentives to participate in JFM. For successful implementation of the JFM in the study area, micro-planning of individual FPC/ EDC area is most essential. The third measure is the **Agro-forestry or Inter-cropping culture.** This practise has not developed to a great extent but the overall performance of inter-cropping practice in the study area is good. Kurseong forest division has occupied a significant place in inter-cropping.

Thus it is apparent that forest resource of the Darjeeling and Jalpaiguri district which play an important role in the economic development of the region should be managed properly. Three dimensions are suggested by the investigator for the forest resource management imperatives. The first approach is **Management of protecting the existing forest resource** through the application of modern silviculture practice . The next imperative is the **Scientific management of social forestry** and others. Under this approach, more stress should be given in the villagers participation in forestry programme. It is observed that the government policy will not be able to protect the valuable forest resource unless local people are motivated systematically. If villagers are given proper incentives for farm forestry, it would not only result in greater awarness but would also generate more employment and income at the village level. The third dimension of the forest resource management is the **management of natural, cultural and economic environment of forest.** Natural imperatives highlights management of soil environment, slope failure and landslide affected forest areas of Darjeeling Himalaya. Cultural aspect focuses on population management and more research work on forest. There are some sectors or departments in the area which have close linkage with the forest department. These sector include land revenue department, agricultural department, tribal welfare department , animal resource development, local Panchayat, local university etc. The policy of forest department and other linkage sectors should be properly linked. It will bring a bright future of the forest of the area. Economic environment of forest indicates the management of forest based industries. At present the most serious problem is the lack of supply of raw materials to the local forest based industries due to the imposition of restriction on clear felling by the

government. It is suggested that the forest based industry should raise the raw material needed for meeting its own requirements, preferably by the establishment of a direct relationship between the factory and the individuals who can grow the raw material by supporting the individuals with inputs including credit, constant technical advice and finally harvesting and transport services. Economic management of forest will certainly beautify the hilly landscape of Darjeeling and *duars* region of Jalpaiguri district, which will also help to promote eco-tourism industry. In addition, a **District Ecology Council** should be set up under the chairmanship of leading ecologist to decide the future course of development and forestry in the area. With these views, it is expected that if proper attention and methods of utilisation are adopted, the study area will be richer in forest resource which will ultimately provide environmental and economic development.

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ANNEXURE - 1

PLANTATION MODEL CODE

The functional technical models of forest have undergone significant changes. It is primary due to the incorporation of social, economical, environmental and productivity concerns, in existing forests of Darjeeling and Jalpaiguri district. Prevalent models are given below:-

Model code	Main feature of model
R-1	Forest Regression from valuable Rootstock
R-2	Forest Regensation by Enrichment
R-3	Reforestation with Tasar Host Plantation
R-4	Multi-tier Reforestation
R-5	Multi- Reforestation (Plains)
R-6	Multi-tier Reforestation (Hills)
R-7	Reforestation with fuel wood plantation
P-1	Sal plantation
P-2	Teak plantation
P-3	Riverine plantation
P-4	Miscellaneous plantation
P-5	Hill Timber plantation
M-1	Afforestration of Intertidal Baks
S-1	Strip plantation
F-1	Farm Forestry.

ANNEXURE - 2

NEW NATIONAL FOREST POLICY ,1988.

Forest -based industries :

The main considerations governing the establishment of forest - based industriesand supply of raw materials to them should be as follows :-

- As far as possible, a forest- based industry should raise the raw material needed for meeting its own requirements, preferably by establishment of direct relationship between the factory and the individuals who can grow the raw material by supporting the individuals with inputs including credit, constant technical advice and finally harvesting and transports services.

- No forest-based enterprise, that at the village or cottage level, should be permitted in the future unless it has been first cleared after a careful scrutiny with regard to assured availability of raw material. In any case, the fuel, fodder and timber requirements of local population should not be sacrificed for this purpose.

- Forest-based industries must not only provide employment to local people on priority nut also involve them fully in rasing trees and raw-material.

- Natural Forests serve as a gene pool resource and help to maintain ecological balance. Such forests will not, therefore, be made available to industries for undertaking plantation and for any other activities.

- Farmers, particularly small and marginal farmers would be encouraged to grow, on marginal / degraded lands available with them, wood species required for industries. There may also be grown along with fuel and fader species on corporations on degraded forests, not earmarked for natural regeneration.

- The practice of supply of forest produce to industry at concessional prices should cease. Industry should be encouraged to use alternative raw materials. Import of wood and wood products should be liberalised.

The above considerations will, however, be subject to the current policy relation to land ceiling and land-laws.

ANNEXURE - 3

Strip plantation in Jalpaiguri division

Sl. No.	Scientific name	Species (local name)	No. of tree	Total vol. in cu.m.	Total value Rs.
1.	*Mangiferi indica*	Aam	8	5.674	23829.93
2.	*Acacia auriculiformis*	*Akashmani	818	84.312	442637.46
3.	*Emblica officianalis*	Amlaki	58	1.426	4243.42
4.	*Terminalia arjuna*	Arjun	9	2.920	11678.75
5.	*Terminalia belarica*	Behera	1	0.085	159.18
6.	*Michelia campaca*	*Champ	105	35.130	351300.70
7.	*Alstonia scholaris*	*Chhatian	80	31.723	88825.01
8.	*Chukrassia tabularis*	Chikrasi	6	0.714	3569.25
9.	*Schima wallichi*	Chilouni	47	12.251	57822.83
10.	*Garuga pinnata*	Dabdabe	1	0.528	792.19
11.	*Eucalyptus*	*Eucalyptus	130	94.793	379170.89
12.	*Gmelia arborea*	*Gammar	736	83.035	830346.42
13.	*Melia azaderach*	*Ghoraneem	241	64.413	281807.27
14.	*Ailanthus grandis*	Ghokul	12	8.037	23910.82
15.	*Syzygium cumini*	Jam	4	0.703	6149.15
16.	*Lagerstroemia flos-reginae*	*Jarul	1039	100.295	521534.12
17.	*Anaeardiceae*	Jiga	6	0.491	945.49
18.	*Anthocepthalus cadamba*	*Kadam	136	66.248	197087.62
19.	*Castanopsis indica*	Katus	1	0.360	1386.00
20.	*Acacia catechu*	Khair	159	10.557	63340.75
21.	*Delonix regia*	*Krishnachura	84	22.197	69920.96
22.	*Castanopsis*	kutua	20	2.078	2078.17
23.	*Careya abrorea*	Kumbhi	9	1.218	2436.56
24.	*Baccaurea sapida*	Kusum	20	0.656	2625.00
25.	*Amoora wallichi*	Lali	40	2.276	13655.25
26.	*Duabanga india*	Lampati	3	1.901	15210.00
27.	*Hymenodictyon excelsum*	Lati Kadam	1	0.250	375.00
28.	*Artocarpus*	Latore	6	0.439	2631.69
29.	*Acrocarpus fraxinifolius*	*Mandane	51	42.985	214923.70
30.	*Cassia seamea*	*Minjiri	3791	566.185	1698554.65
31.		Misc.	76	4.387	14429.30
32.	*Tetrameles nudiflora*	Moina	1	3.906	23437.50
33.	*Tetreminalia crenulata*	Pakasaj	21	1.554	6216.50
34.	*Trewia nudiflora*	Pitali	12	3.233	9051.88
35.	*Peltoforum rubiginosa*	Radhachura	11	3.280	8036.33
36.	*Lagerstroemia parviflora*	*Sidha	57	19.552	106008.94
37.	*Bombax ceiba*	*Simul	27	33.516	167579.82
38.	*Albizza species.*	*Sirish	229	125.820	396332.33
49.	*Dalbergia sissoo*	*Sisoo	3477	1866.123	22393481.49
40.	*Leuceanea leucocephala*	Subabul	5	0.928	3572.30
41.	*Tectona grandis*	*Teak	640	163.632	1963581.12
42.	*Cedrella toona*	Toon	3	0.828	4965.00
	Total		**12181**	**3470.368**	**30409641**

* Important timber species

ANNEXURE -4

GLOSSARY OF FOREST MANAGEMENT TERMS.

Ban - O- Bhumi Sanskar Samiti :

Standing committee of forest and land development.

Coppice Forest :

A forest consisting of tree derived from coppice shoot or root suckers.

Coppice with standard :

It is that coppice system in which part of the crop is retained to form an uneven- aged, overwood.

Coupe :

A felling area usually one of an annual succession unless otherwise stated.

Felling cycle :

The time that elapses between successive main fellings on the some area.

High Forest :

A forest, which originated from seed. A crop or crops of trees normally with a closed and high canopy and usually of seedling origin.

Improvement Felling :

The removal or destruction of less valuable trees in a crop in the interest of better growth of the more valuable individual, usually applied to a mixed uneven- aged forest.

Irregular Forest :

A forest composed of trees of markedly different ages.

Normal Forest :

A forest which for a given site and given objeet of management is ideally constituted as regards growing stock, age class distribution and increment and from which the annual or preiodic removal of produce equall to the increment can be continued indefinitely without end angering future yields.

Regular Forest :

A forest composed of even aged wood i.e. trees of approximately of the same age. Difference upto 25% of the rotation age of the rotation age is considered even aged where rotation is about 100 years

Rotation :

The planned number of years between the formation or regeneration of a forest crop and it`s final felling.

Selection feling :

The annual or periodic removal of exploitable trees individually or in small groups in an uneven-aged forest in order to realise they yield and natural regeneration.

Silviculture system :

A method of silvicultural procedure worked out in accordance with accepted sets of silvicultural principles, by which crops are tended, harvested and replaced by new crops of distinctive forms.

Silviculture :

That branch of forestry,which deals with the establishment, development, care, and reproduction of stands of timber.

Taungya :

The plantation in which the forest department gets agricultural crops also raised along with the forest plants in the interspaces of their lines by Mazdoors or daily wages or by lessees or by vilagers who have settled down in a village inside the forest for the purpose.

Unclassed forests :

Forest which are not legally demarcated and categorised.

Van mahotsava :

In early fifties this culture was promoted by the forest department as annual feature to create tree consciousness amongst the people.

Working circle :

A forest area (forming the whole or part of a working plan area) organissed with a particular object and under one silvicultural system and one set of working plan prescription.

Working plan :

A written statement of management aiming at continuty of policy and action and controlling the treatment of a forest. Synonym with management plan.

✶ ✶ ✶ END ✶ ✶ ✶