CHAPTER 5
BIODIVERSITY MANAGEMENT PLAN

5.1 Introduction

The varied topography, geological formations, climatic conditions and the altitudinal ranges has made the Himachal Pradesh a veritable treasure house of biodiversity both wild and domesticated. The range of biodiversity elements represented in the state varies from those of subtropical region to that of temperate and alpine regions. Biodiversity provides a fundamental base to the mountain agriculture and to the overlap economic systems of the state. Enriched biodiversity of the State is reflected through State's emblems of pride such as. Deodar (*Cedrus deodara*) as State Tree, Brass (*Rhododendron arborium)* as State Flower, Musk Deer(*Moschus moschiferous*) as Sate Animal and Monal Phesant (*Lophophorus impejanus*) as State Bird.

Forest are very important natural resources of the State and are confined to higher hills and interior valleys. The forest not only saves as a haven for biodiversity but is also mainstay far rural life and livelihoods. As per the classification of Champian & Seth (1962) a total nine major forest type & 33 subgroups of forests are observed throughout the state. The recorded forest area of the state is 3.54 million hectare, which constitutes 63.60% of the total geographical area of the state.

5.2 Threats to Biodiversity of Himachal Pradesh

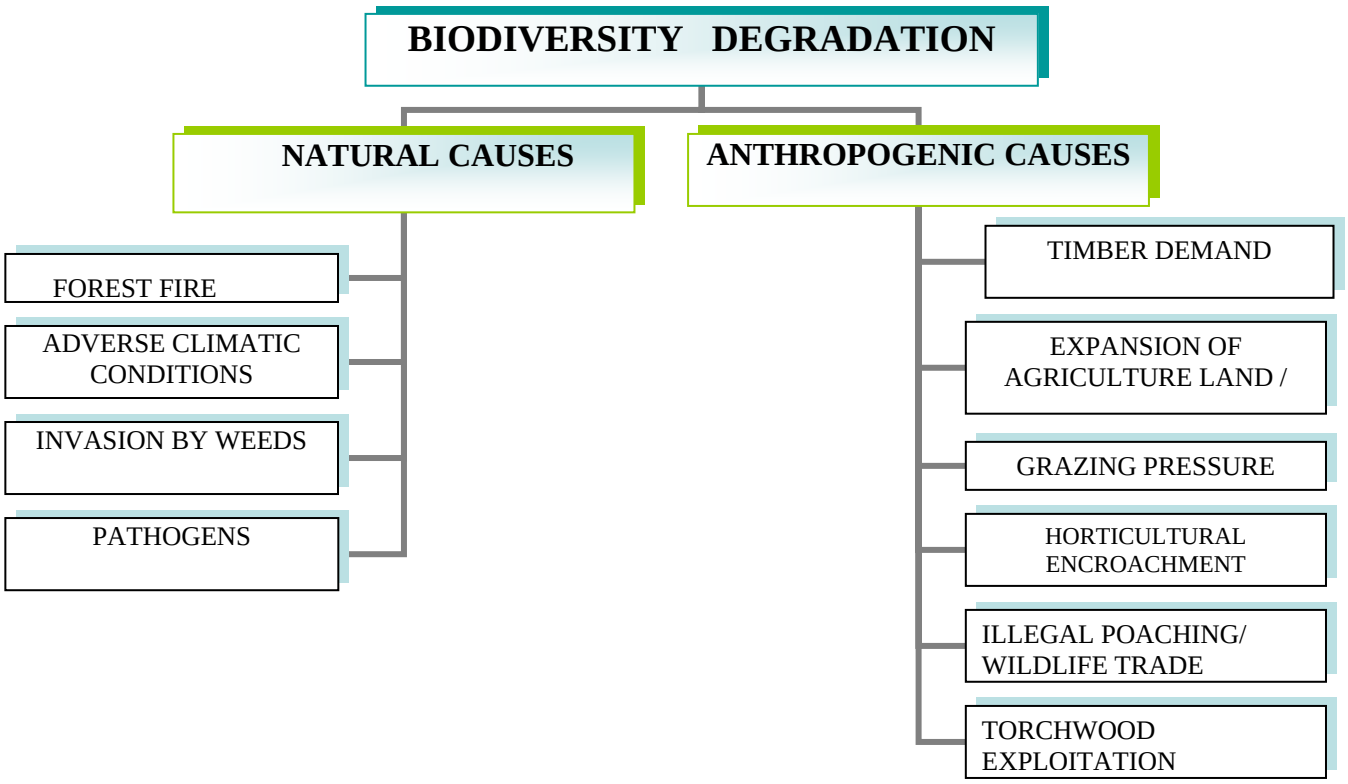

Fig 5.1 Existing threats to Forest

Himachal Pradesh has the highest percentage of rural population (90.21%) in the country residing in the more than twenty thousand villages across the state. The rural population is primarily dependant on agriculture based economy for livelihood. Biodiversity in the state is under tremendous pressure due to various social issues related to agriculture, horticulture, and traditional rights.

Agriculture is the major occupation of the people residing in rural area. It is estimated that out of the total cultivated area of 522,000 ha, the hills occupy about 40% of the total area of the state. Most of the agriculture is of subsistence type, hence, inadequate to fulfill the total livelihood requirements of the people. Hence, farmers have to do many jobs such as horticulture, animal husbandry, floriculture, collection of major/minor forests produces etc. to supplement their livelihood.

Rural population depends largely on forest for their day-to-day demands of life such as fuel, fodder, grazing, timber etc. The net demand for fuel wood from the forest is estimated to be 27.6 Lakh tones and that of fodder 92 Lakh metric tones. Per annum. In addition, 1.06 Lakh m^3 of timber and 11.62 metric tones of non timber forest products are also removed from the forest annually by right holders. In view of this, demand of timber, fuel, fodder, medicinal plants or non timber forest produces is borne only by a few choice species, the major threat to their continued survival.

Horticulture possibility of a high food yield per unit area of land. Important horticultures crops of the state are Apple, Almond, Apricot, Walnut, Guava Pomegranate, Peach, etc. The area under horticulture was approximately 35,300 hectares (1985-86), which rose to 37,183 ha in 1996-97. The increase area is derived either from agriculture land or forest clearance and thus associated with loss of forest and thereby biodiversity.

5.3 HISTORY OF DEFORESTATION

Although a relatively small state within India, there are ranges of altitude, climate and geology that contribute rich and diversified flora of Himachal. 66 percent area of the state is legally classified as forestland. The recorded forest area is 3.54 million ha, which constitutes 63.60% of the geographic area. Forest in Himachal Pradesh constitutes the biggest land use. The cause of degradation of biodiversity is given below:

At present 25.78 percent is currently under tree cover out of which only 2 percent is dense forest and 14.10 percent as moderately dense forest. Within the legally classified forestland there are large areas which can neither be cultivated nor sustain forests, comprising barren land, alpine pastures and areas above tree line. The pressure on forest is continuously increasing leading to rapid deforestation.

Forest Survey of India (FSI) an organization of Ministry of Environment and Forests (Government of India) is engaged in generating information and database on forest cover and forest resources in the country. The status of forest covers in Himachal Pradesh since 1987 is presented below:

Table No.5.1
Assessment of Forest Cover Himachal Pradesh

Year of Assessment	Area Under Forest Cover (Km^2)
1987	12,480
1989	12,480
1991	12480
1993	12,502
1995	12,501
1997	12,521
1999	13,032
2001	14,360
2003	14,353

Source: State of Forest Report 2003

The assessment of forest cover since 1987 depicts that forest cover of Himachal Pradesh has increased from 12,480 Km^2 to 14,353 Km^2. Forest Survey of India has recorded an increase of 1,873 Km^2 in forest cover as per the State of Forest Report.

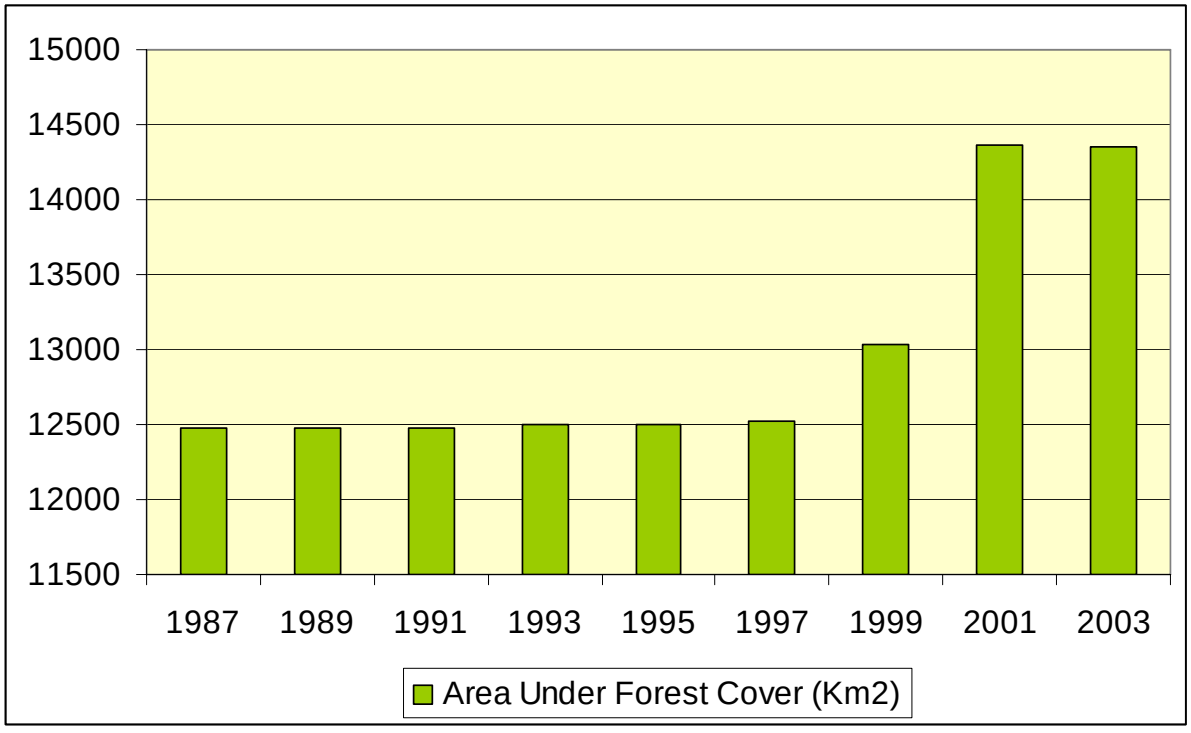

Fig: 5.2 Assessment of Forest Cover for Various Years in Himachal Pradesh

The increase of forest cover is due to inclusion of large-scale block plantations of Pine, Khair, Deodar and Robinia taken up during 1989-93. The Table given below depicts the plantation carried in Himachal Pradesh

Table No 5.2
Species-wise plantation by Forest Department up to 1997

Species	Total Area (ha)	Percentage
Pinus roxburghii	250.92	32.6
Acacia catechu	139.61	18.2
Cedrus deodara	92.83	12.1
Robinia spp.	36.61	4.8
Eucalyptus spp.	31.11	4.0
Abies pindrow	15.64	2.0
Poplar spp.	11.32	1.5
Pinus wallichiana	10.58	1.4
Dalbergia spp.	10.38	1.4
Others	169.53	22.1
Total	768.53	100

Source: Himachal Pradesh Forest Department

However, the increase in forest cover is also associated with change in forest cover type i.e. dense forest has degraded to open forest. The increase in forest cover is presented in the figure 5.3 while change in forest cover assessed during 1987 to 2003 is given in table 5.3

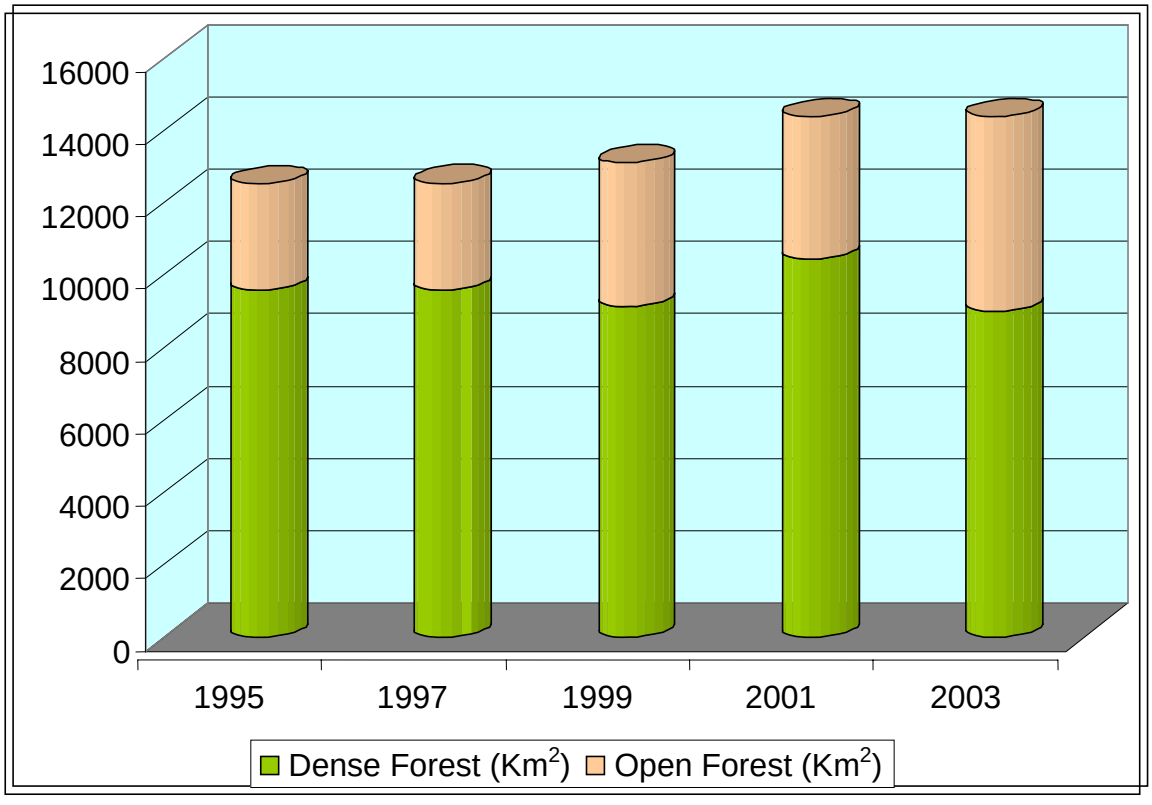

Fig : 5.3 Change in Forest Cover of Himachal Pradesh

Table No.5.3
Himachal Pradesh Forest Cover Change Matrix

1997 Assessment (Data) Oct.94 & Nov.95	1999 Assessment (Data Oct.-Dec. 98)				Total 1997 Km^2
	Dense Forest Km^2	Open Forest Km^2	Scrub Km^2	Non-Forest Km^2	
Dense Forest	8,887	640	0	33	9,560
Open Forest	92	2,864	0	5	2,961
Scrub	42	253	558	972	1,825
Non- Forest	99	205	8	41,015	41,327
Total 1999	**9120**	**3962**	**566**	**4025**	**55,673**
Net Change	**-440**	**+1,001**	**-1259**	**+698**	

Source: State Forest Report 1999

The change matrix, given in above reveals that, an overall decrease of 440 sq. km of dense forest is due to the conversion of 640 sq. km of dense forest to open forest and 33 sq. km to non-forest are with the increase of 1001 sq. km of open forest area.

State of Forest Report for the year 2003 shows that, the area of open forest has increased by 1,446 sq. Km whereas the area of dense forest has decreased by 1,453 Km^2. The table given below depicts the change in forest cover in Himachal Pradesh from 2001 to 2003.

Table No.5.4
Himachal Pradesh Forest Cover Change Matrix

2001 Assessment	2003 Assessment				Total 2001 Km^2
	Dense Forest Km^2	Open Forest Km^2	Scrub Km^2	Non-forest Km^2	
Dense Forest	8146	1126	20	1137	10429
Open Forest	661	2892	7	371	3931
Scrub	20	140	196	210	566
Non-forest	149	1219	166	39213	40747
Total 2003	**8976**	**5377**	**389**	**40931**	**55673**
Net Change	**-1453**	**1446**	**-177**	**184**	

Source: State Forest Report 1999

Table No. 5.5
Change in Forest Cover in Himachal Pradesh

Year	Dense Forest (Km^2)	Open Forest (Km^2)	Total Forest (Km^2)
1995	9565	2936	12,501
1997	9,560	2,961	12,251
1999	9,120	3962	13,082
2001	10,429	3,931	14,360
2003	8,976	5,377	14,353

Source: State of Forest Report

5.4 Biodiversity Conservation Initiatives Taken by GoI & GoHP.

In order to protect rich biodiversity of country which plays significant role in livelihood & cultural sustenance of the country, Government of India, under Ministry of Environment & Forests (MOEF) constituted National Biodiversity Strategy & Action Plan (NBSAP) a, firm step towards addressing the various issues related to the use, status and conservation needs of biodiversity in the country. Under this initiative, it has been envisaged to produce a series of planning documents dealing with various facts related to the conservation of National Biodiversity. The biodiversity of India has been globally ranked amongst the 12-megadiversity countries and two of its bio-geographic provinces. These are all government initiatives and approximately 5% of the country's surface area has been successfully declared as legally protected areas.

In order to conserved enriched biodiversity of the Government of Himachal Pradesh constituted State Biodiversity Strategy and Action Plan (2001) under the nodal agency i.e. State Council for Science & Technology and Environment. The present SBSAP covers the varied natural ecosystems like forests, grasslands, alpine meadows cold desert, wetlands across the state along with the range of species diversity harbored by these ecosystems. It also covers the agricultural & horticultural ecosystems including the domesticated species of plants and animals. Various approaches followed by Government of Himachal Pradesh for implementation of proposed SBSAP are discussed below

(a) Institutional Approach

Institution of Framework for implementation of Biodiversity Strategy and Action Plan has been set up by Government of Himachal Pradesh constituted sub committee comprising of Vice Chancellor, Palampur (H.P.), Head Dept. of Bio-Sciences, H.P. University , Shimla and Member Secretary (E.C.) State Council for Science Technology & Environment. Thematic groups and institution responsible for implementation of biodiversity action plan is given below.

Table No. 5.6
Institutional Framework for Implementation of SBSAP

S.No.	Theme	Institution
1	Domesticated Biodiversity	Biodiversity Centre, CSK Agri. Univ., Palampur.
2	Wild Plant Diversity	Director Research, University of Himachal Pradesh (UHP) Nauli Solan.
3	Wild Animal Diversity	Zoological Survey of India Solan
4	Micro Organism Diversity	Department of Bio Sciences HPU, Shimla
5	Culture and Bio Diversity	IGRMS, Bhopal, Chapter Shimla
6	Technology, Industry and Bio Diversity	Director IHBT, Palampur
7	Economics and valuation of Biodiversity	UHP, Nomini Solan
8	Health and Biodiversity	Director of Ayurveda, Shimla
9	Policies, Laws, Institutions and Planning	Human Right Commission Shimla
10	Aquatic Eco System	Department of Fisheries Bilashpur
11	Livelihood, life style and biodiversity	Regional Station, NBPGR, Shimla

S.No.	Theme	Institution
12	Education Research and Training	Department of Education HPU, Shimla
13	Public Airiness	AIR Station Shimla Local News Papers etc.

Source: HP State Biodiversity Strategy and Action Plan, 2002

(b) Legislative Approach

Himachal Pradesh has also adopted the National Forest Policy (1980) that seeks to integrate biodiversity conservation and sustainable use by local people. A complete ban on hunting (1982) and green felling (1984) has been imposed in the state .A number of legislation having a bearing on biodiversity conservation in the state have been enacted in the state. Some of these are as below

- Indian Forest Act 1927.
- Wildlife (Protection), Act 1972,
- Himachal Pradesh Land Preservation Act, 1978
- Forest conservation Act, 1980
- Environmental Protection Act, 1986
- Water (Presentation & control of Pollution) Act 1974
- Air (Presention & control of pollution) Act, 1981
- Himachal Pradesh Non-biodegradable Garbage (Control) Act 1995
- Bio- diversity Act 2002
- Bio- diversity Rule 2004

(c) Management Level Approach

At management level, conservation of biodiversity now forms an integral part of Forest working plan, Management plans for the National Park and Wildlife sanctuaries lay special emphasis on conservation of biodiversity. Some of the important schemes implemented by the Govt. are

(i) Sanjhi Van Yojana
(ii) Eco-development in and around protected areas
(iii) Development of Minor Forest Produces
(iv) Wildlife wing in the state has been strengthened for management of National Park
(v) National Sanctuaries, Zoos and Peasantries for ex-situ conservation

(d) Biodiversity Evaluation Approach

The State Government has assigned “environmental value” to forest land @ 8.00 Lakh & Rs. 5.00 Lakh per hectares for the areas having forest cover exceeding 10% and for the remaining forest areas respectively. Cost equivalent to this value towards compensation for loss of environmental values of forest land will have to be borne by the user agency for every hectare of forest land diverted for non-forestry purposes. (Department of Forest GOHP Notification No. FFE-B-C (8)1/2002 dated 24/06/2002).

In order to exercise some control over the exploitation of medicinal plants, specially herbs, the forest department has prescribed a four year exploitation cycle and has also fixed, an export permit fee in respect of heavily exploited species. The list of few plant species are given below.

Table No. 5.7
Export Permit Fee for Medicinal Plants

S.No	Scientific Name	Common Name	Export Fee (Rs. Per Quintal)
1	Morchella esculanta	Guchchi	10,000
2	Aconitum chesmanthum	Karvi patish	7,500
3	Dactylorrhiza hatageria	Salam Panga	6,000
4	Viola odorata	banafsha	2,250
5	Banium persicum	Kala zira	2,000
6	Aconitum heterophyllum	Patish	1,500

Source: HP State Biodiversity Strategy and Action Plan, 2002

5.5 Previous Experience of Implementing Nathpa – Jhakri Hydro-Electric Project

In order to know previous experience of implementation of Compensatory Afforestation Plan and Catchment Area Treatment Plan of NJHEP , the review of above mentioned documents were carried out. The plantation sites under compensatory of afforestation and CAT plan was visited. The details of review are as below.

5.5.1 Compensatory Afforestation Plan of NJHEP

The Nathpa Jhakri Hydro-electric Project is run off the river scheme envisaged to utilize a drop of 444 m available in the river bed of Satluj between village Nathpa in Kinnaur district and village Jhakari in Shimla district. For execution of project NJHEP acquired 123 ha of forestland and 224 ha of private land. In order to compensate the loss of forestland compensatory afforestation Plan was implemented by Forest Department Govt of Himachal Pradesh since 1991-92 for a period of 10 Years. The detailed review of plan is discussed below.

(i) Site Selection for Compensatory Afforestation

The compensatory afforestation plan was implemented under degraded forest area development scheme. A total number of 41 unprotected forestland with scanty or no vegetation was brought under afforestation. Out of 41 unprotected forests 17 falls in Sarahan range, 13 in Kinnaur range and 11 Rampur range. The areas identified by forest department were quite refractory, the peculiar features of land were, poor soil & rainfall conditions, harsh winter with high wind velocity and excessive human and cattle interferences.

(ii) Species Recommended for Afforestation.

The afforestation was carried out main three schemes as Forest Establishment & Improvement, Pasture Improvement and Subsidiary Silvicultural operations. Based on climatic conditions, adaphic factors and suitability of plant species to existing conditions the mixture of confer and broad leaved tree species were selected by forest department. the species were recommended by forest department for compensatory afforestation is given below:

Table No. 5.8
List of Plant Species Recommended for Compensatory Afforestation

S. N.	Name of Plant species		S. N.	Name of Plant species	
	Scientific Name	**Comman Name**		**Scientific Name**	**Comman Name**
1	*Cedrus deodara*	Deodar	8	*Dalbergia sissoo*	Shisham
2	*Pinus roxbenghsi*	Chir	9	*Aejculas indica*	Aesculus
3	*Fraxinus xenthoxyloides*	Ash	10	*Asesculus indica*	Asculus
4	*Lancia lecocephala*	Subabul	11	*Populus citiata*	Paplar
5	*Melia azadirach*	Dreak	12	*Salix sp*	Willow
6	*Prunus americana*	Chulli	13	*Sapindus mukorossi*	Retha
7	*Abies spectablities*	Silverfir	14	*Grewia oppositifolia*	Biul

Source: Catchment Area Treatment Plan 2002 State Forest Department HP

(iv) Compensatory Afforestation in Synergy with Various Plantation Schemes

In order to fulfill the demand of local people for timber fuel wood and fodder replenishment afforestation has been carried out along 195 ha and 600-800 number of plants were planted per ha. The forest areas which are suitable for natural regeneration, forest floor was cleared of slash, debris and felling refuse to afford a clean seed bed to the falling seeds. A total 160 ha land has been identified for Assisted Natural Regeneration of native species to increase forest cover through natural regeneration.

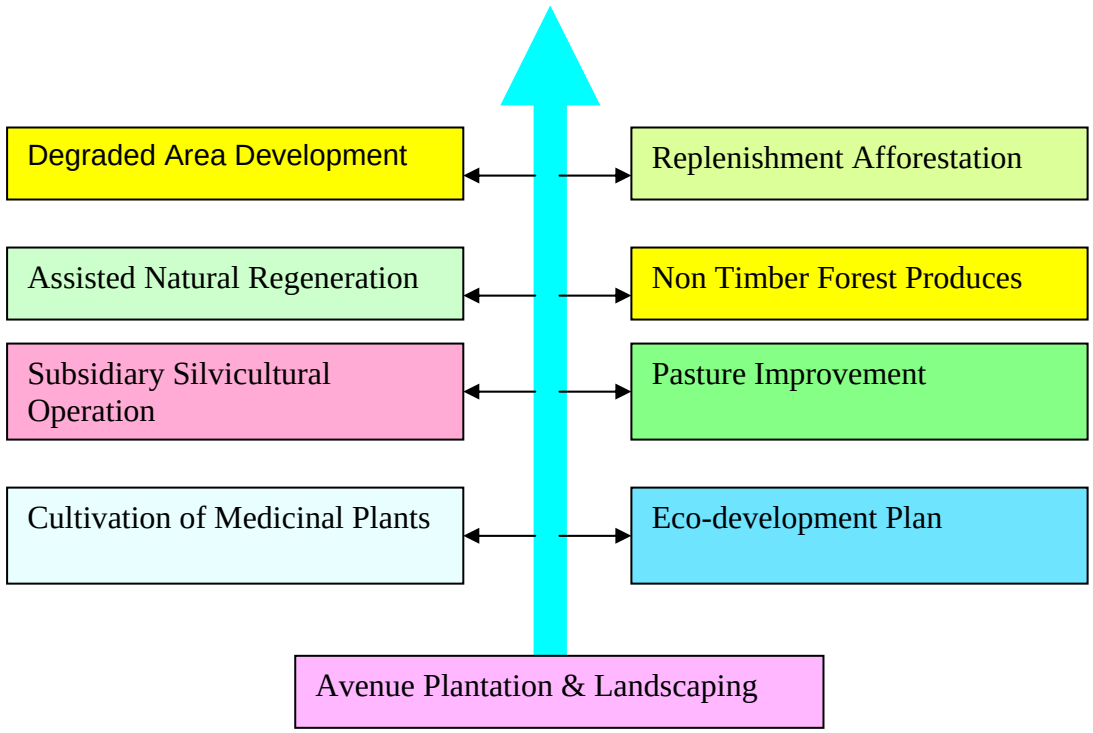

Fig.5.4 Compensatory Afforestation: Synergy with Plantation Schemes of Forest Department

The local rural communities are directly dependant on various commodities which are obtained from surrounding forests. In order to fulfill the demand for biomass resources development of Non Timber Forest Produces scheme was implemented along 670 ha of degraded forestland. Mainly plantation of medicinal herbs such as Karoo, Dhoop, Chaura, Salam Panja, Patis was planted. A total number of 2000 plants/ha was planted.

Table 5.9
Details of Various Plantation Schemes Implemented Under Compensatory Afforestation

S.N.	Name of Scheme	Total Area (Hect.)	No. of Plants/ha	Amount (% of Total Cost)
1	Degraded Area Development	629	1100	6.49
2	Replenishment Aff.	195	6800	1.6
3	Natural Regeneration	160	500	0.75
4	Development of NTFPS	670	2000	5
5	Pasture Improvement	375	-	2.04
6	Low -lying Pasture	125	-	1.03
7	Silivicultural Operation	125	-	0.10

Source : Catchment Area Treatment Plan 2002 State Forest Department HP

The pastures and grasslands plays significant role in rural economy. These are the main sources of herbages and roughage. They are spread on the natural slopes and form considerable portion of the Satluj catchment. Heavy grazing pressure by cattle population of the surrounding villages led to elimination of palatable grasses & legumes and replaced by non palatable and undesirable grasses & bushes.

In view of this, Pasture improvement plays significant role in restoration of ecosystem as well as to fulfill the demand of fodder for existing cattle population. An area of 375 ha degraded pastureland of Alpine range & 125 ha of Low-Lying pastureland was brought under pasture improvement program.

In order to improve silvicultural management of existing forest area where plantation has been carried out in past, as well as closure areas where natural regeneration was found to be improved, subsidiary silvicultural operations such as cleaning of forest floor, removing of weeds & climbers, slash disposal and burning of debris was carried out over 125 ha of forestland so as to improve the growth conditions of climax species of forests such as *Cedrus deodara* (Deodar), *Pinus wallichiania* (Kail), *Pinus roxburghii* (Chir), *Quercus incana* (Ban) etc.

The site visit conducted at the places of compensatory afforestation sites revealed that, it has been carried out successfully as large number of plantations raised under the plan has come up in the tract. The dense patches of *Pinus roxburghii* were seen throughout the tract.

5.5.2 Catchment Area Treatment Plan NJHEP

River Satluj is a major river of Western Himalayas, originating from lake Mansarover in Tibet at an altitude of 4570 m. The total catchment area of River Satluj, upstream of the dam at Nathpa is 49820 sq. km. The catchment area of directly draining rivers to the Nathper diversion dam and the catchment to sholding Khad is estimated to be 280 sq. km. The cathcment area under project falls in Kinnaur, Sarahan and Rampur forest division. In order to compensate adverse impacts such as soil erosion, land slides, sedimentation due to various project activities during construction and operation phase of the project, Catchment Area Treatment plan was formulated and implemented by State Forest Department, Govt. of Himachal Pradesh since 2001-02 to 2010-11. The CAT plan addresses important issues such as damage to infrastructure, changes in drainage pattern, increased pressure on natural resources, impacts on wildlife and damage to visual & aesthetic nature of the catchment area.

The total period of implementation of CAT plan is ten years from 2001-02-2010-11. The total cost of project is 29.51 crores. The details of various erosion control measures, along with number of sites and total cost of the under each heading is given below.

(i) Treatment of Erosion Prone Areas

The areas which are already eroded or prone to erosion has been undertaken to provide land stability. The treatment of such areas include provision of engineering measures such as check walls, protection walls, gully plugging, diversion channels, for stabilization of area. In order to improve soil status of the area vegetative measures such as vegetative shrub barrier, brush wood check dams, planting of grasses etc. Various schemes were implemented to control soil erosion in catchment area under proposed plan are discussed below.

Table No. 5.10
The details of Erosion control Measures for sites under catchment Area of Project.

S.N.	Name of Scheme	No. of Sites	Measures to be Taken	Amount (% of Total Cost)
1	Treatment of Erosion prone Areas	76 Ha	Engineering Mes. Vegetative Mes	1.4
2	Stabilization of Landslides prone area	31	Engineering Mes Vegetative Mes	0.14
3	Treatment of Nala	38	Engineering Mes Vegetative Mes	6.9
4	Roads Site Erosion	-	-	1.4
5	Treatment of Private Land	-	Contour bunding Terrace Repaining	1.7

Source: Catchment Area Treatment Plan 2002 State Forest Department HP

The total 76 ha of eroded land was treated by applying various engineering as well as vegetative measures A total of 31 active landslide site was also treated which were rapidly extending to engulf the forestland. In order to check the velocity of runoff, detention of silt and prevention of cutting & banks. A total of 38 main nallas were treated by providing suitable engineering & biological/vegetative measures under treatment of nallas.

The existing roads are the potential sources of erosion/land slips. In order to prevent flow of loose excavated material into the river with runoff the road stretches were stabilized by providing appropriate engineering/vegetative measures. The sites visited at Nathpa diversion dam, plantation carried out in staff colony and along the roads of Guest house and office complex. The Bottle Brush, Ticoma, Silver fir, Pinus roxburghii, Crismus Trees were found to be well grown throughout the tract.

(ii) Infrastructure Development.

The construction phase of the project has resulted in disruption/damage to rural/forest infrastructure. Hence CAT plan has supported the restoration and up gradation of such infrastructure in the project area. The infrastructure development includes development of forest path, forest buildings, village paths, springs, traditional water sources, bridges, minor irrigation channels, village ponds etc. The details of various infrastructure developments are given below.

Table: 5.11
Details of Infrastructure Development Schemes Implemented under CAT Plan

S.N.	Name of Scheme	Item	Amount (% of Total Cost)
1	Forest Infrastructure Development	14 Roads (147 Km, 25 Buildings)	4
2	Rural Infra structure Development	Restoration/Up gradation of Village Path, Springs, Bridges and Irrigation Canal	5
3	Village Ponds	37 Sites	0.95
4	Soil and Water Conservation Structures	13 Sites	0.95
5	Improvement of Water Resources	102 Sites	0.95
6	Strengthening of Village Path	58 Nos.	1.59
7	Construction of Foot Bridges	14 Nos.	0.71

Source: Catchment Area Treatment Plan 2002 State Forest Department HP

5.6 Conservation of Project Influence Area

The altitudinal variation in project influence area leads to various forests types such as, Northern mixed deciduous forests, Khair-sissu Forests, Himalayan Subtropical Pine forests, Ban Oak forests etc. the forests are interrupted with various human activities among which agriculture, horticulture, grazing of animals, timber demand, etc are predominant. The forests are under threat due to over exploitation for timber, fodder, fuel, medicinal plants and collection for minor forests produces. The threats to the forests are discussed in brief below while recommendations for the management of biodiversity of project influence area are given in **Chapter 6.**

5.6.1 Major Threats to Biodiversity

(a) Timber Demand

The climax species of natural forests are under tremendous pressure due to increased timber demand. The timber species of forests such as *Cedrus deodara* (Deodar); *Pinus roxburghii* (Chir), *Pinus wallichiana* (Kail); *Quercus incana* (Ban oak), *Quercus himalayana* (Moharu oak); *Picea smithiana* (Rai); *Grewia oppositifolia* (Biul) etc. are under pressure due to high timber demand by right holders as well as due to illegal felling of trees.

(b) Agriculture & Horticulture Activities

Intensive agricultural acuities were concentrated from foothills to mid-hills valley areas where irrigation facilities exist. Horticulture, a crash crop/profit graining activity i.e. cultivation of fruits, vegetable, flowers is increasing at the cost of forestland leading to loss of forest area year by year. There is also tremendous demand of timber for packing cases for marketing of fruits due to horticulture bloom, leading to increase pressure on forest.

(c) Grazing Pressure

Animal husbandry is an important vocation for agriculturist and almost every family rears livestock for rears livestock for their day to day requirement the livestock is mainly defendant upon natural resources mainly forests for sustenance. Extensive grazing of livestock and severe lopping of trees for fodder had adversity affected the forests of probed-influenced area.

Ban oak forest area under pressure due to grazing, browsing, severe lopping for fodder & fuel and manufacturing of agricultural implements. It has reduced oak to low, stunted, unsound growth and form of busty trees. Due to these activities ban oak forests area is gradually denuded.
Kharsu oak (*Quercus semicarpifolia*) forests are slowly gaining importance on account of their demand for various commercial uses. Heavy grazing, lopping and fire have thinned out forests to varying degree, destroyed all undergrowth except for plants of inedible species. It is grazed by enormous flocks of sheep/goats/etc commonly seen in Sarhan range.

(d) Torchwood Exploitation

The local people cause extensive damage to Chir (*Pinus roxburghii*) and Kail (*Pinus wallichiana*) by cutting deeply the resinous wood from the base portion of the stem. The forests situated in proximity of villages and along road sites are the worst suffers. The damaged trees are weakened at the base and fall due to wind action. This resinous wood is used by the villagers for igniting fires in their houses and as torch moving from one place to another or one house to another house.

(e) Forest Fire

Forest fire is commonly recorded throughout the forest. As the agriculture are always associated with burning of remnant of corps. Most of the fires are due to local incendiaries with the belief that burning forest areas improve the resources by getting fresh grass & tender herbages.

5.7 Proposed Management Plan For Project Affected Area

The Biodiversity Management of Project Affected Area is the joint responsibility of SJVNL, State Forest Department and Local Community. As Compensatory Afforestation Plan, Catchment Area treatment Plan and Wild Life Management Plan will be implemented by State Forest Department; Govt. of H.P. where as Muck/Quarry Area Redevelopment Plan, Avenue Plantation and Landscaping will be implemented by SJVNL. In order to suggest vegetative measures, the abovementioned documents were reviewed and recommendations are given in **Chapter 6.** The implementation of abovementioned plans will be helpful for conservation of terrestrial biodiversity of the Project Affected Area as well as surrounding Project Immediate Influenced Area. The review of above mentioned plans are discussed in brief below.

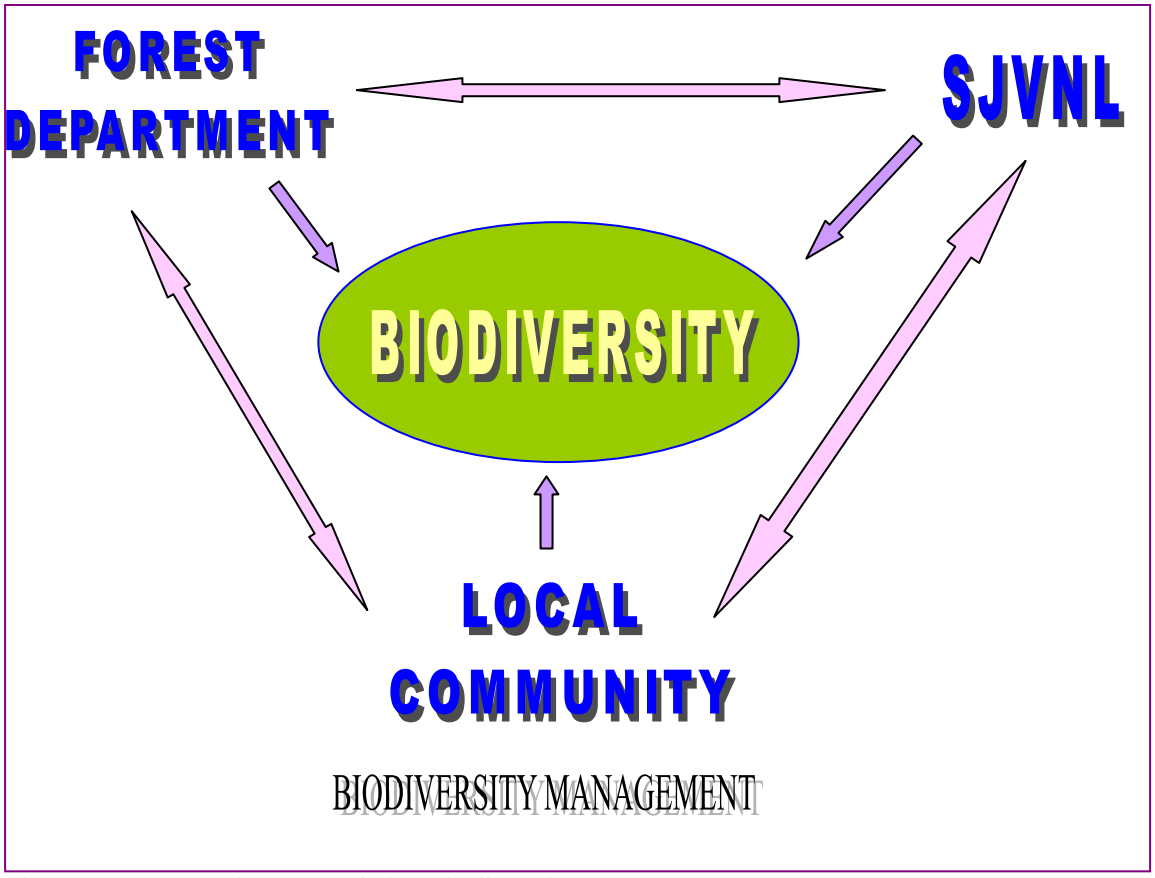

Fig. 5.5 Integrated Approach for Biodiversity Management

5.7.1 Proposed Compensatory Afforestation Plan for RHEP

In order to compensate diversion of forestland i.e. 69.38 ha for establishment of various project units, end 21 ha for Notional land for underground work, the compensatory afforestation plan is proposed to be on 139 ha as per the Forest (conservation) Act (1980). The compensatory afforestation will be carried out in unprotected forests of Arsu and Nither ranges of Ani forest division of Kullu District of Himachal Pradesh. The cost of compensatory afforestation has been estimated to be Rs 74.49,400. The details of sites selected for Compensatory Afforestation Plan is given below

Table: 5.12
Site Selected for Propose Compensatory Afforestation for RHEP

Sl.No.	Status of Land	Name of Range
1	Unprotected Forest	Bail C-9
2	Unprotected Forest	Chebri C-83
3	Unprotected Forest	Kindla C-38
4	Unprotected Forest	Karnon C-11
5	Unprotected Forest	Rallo C-14
6	Unprotected Forest	Shalt C-6
7	Unprotected Forest	Sisu C-10

Source : Catchment Area Treatment Plan (2005) State Forest Department HP

5.7.2 Proposed Catchment Area Treatment Plan for RHEP.

The total catchment areas of River Satluj, above Bhakra dam site is 56,875 sq. km of which 50,880 sq. km area is up to Rampur. The area covered in the cat plan is only 1,062.50 sq. km. Out of which 612.50 sq. km falls in Rampur Forest Division while 450 sq. km. in Ani Forest Division. The catchment Area Treatment Plan of proposed Rampur HEP includes Rampur Range, Bahil Range, Machhada catchment of Nankhari Range and of Sarahan Range.

The proposed plan is formulated by state forest Department for the period of ten years starting from 2006-07-2015-16. The 2005-06 will be considered as zero year of plan and emphasis will be given to develop and maintain nurseries to raise sufficient planting stock. Most of the activities will be completed within initial 5 years and later half of the plan will be be mainly for maintenance. The total cost of plan will be 23.37 crores.

The CAT plan is designed to address the basic environmental issues such as increase soil erosion, high rate of siltation, surface runoff, sheet & gully erosion and to mitigate these impacts through adoption of site specific bio-enginering technologies to reduce soil crosion, conserve water and improve vegetal cover in the catchment. The proposed catchment treatment plan comprised of four sections i.e. Forest conservation & Improvement, Soil and Moisture Conservation Works, Infrastructure Development and Implementation of Ecodevelopment Plan for reducing pressure on forest by local population. The details of various sections are discussed below.

(i) Forest Conservation & Improvement.

In order to improve forest cover of the catchment area it is proposed to increase vegetation cover through implementation of various forestry schemes such as Afforestation of degraded forestland, Replenishment, afforestation, Assisted Natural Regeneration, Development of Medicinal Plants, Pasture improvement and subsidiary silvicultural operations barren, areas which are devoid of tree growth or the degraded forestland with scanty vegetation shall be brought under afforestation. The details of various schemes will be implemented under forest conservation and improvement program is given in detailed below

Afforestation of Degraded Forestland includes blank areas devoid of vegetation or degraded forestland will be taken up for plantation. A total 780 ha area have been identified available for taking under this scheme. Out of total 300 ha falls in Rampur while 480 ha in Ani forest division. Replenishment Afforestation includes plantation of forest areas of the track depleted due to excessive pressure of local community due to fodder, fuel, timber etc. to restore such areas to their optimum productive potential. Such forest areas will be planted by artificial means to increase their stocking to the required level.

Table: 5.13
Details of Various Schemes Implemented Under Forest Conservation & Improvement Program

Name of Scheme	Total Area (Hect.)	No. of Plants/ha	Amount (% Total Cost)
Degraded Area Development	780 R:480 A:300	1100	17.31
Replenishment Afforestation	460 R:260 A:200	700	8.25
Assisted Natural Regeneration	400 R:195 A:205	300	5.17
Development of NTFPS/ Medicinal Plants	170 R:80 A:90	2000	2.92
Alpine Pasture Improvement	125 R:100 A:25	-	0.47
Low-lying Pasture	240 R:80 A:160	-	3.92

Source : Catchment Area Treatment Plan (2005) State Forest Department HP

The Assisted Natural regeneration scheme will be implemented to forest areas where conditions are conductive to natural regeneration. Forest floor will be cleared of slash, debris and felling refuse to afford a clean seed bed to the falling seeds & to germinate large number of villagers depends on medicinal plants as their livelihood. In order to meet their demand as well as for in-situ conservation of Medicinal plants, herbs such as Karoo, Dhoop, Chora, Salam Pania, Discorea, Patish will be planted on 170 ha of forestland.

Under Pasture improvement schemes, Alpine pasture and Low-lying pastures will be taken up for treatment. A total of 3200 ha of pasture area is available in catchment. It is an important source of herbage/roughage for cattle, sheep & goats. The well developed crop areas within the forests will taken for subsidiary silvicultural operations to improve the growth conditions & hygiene of the forests floor such as, climber cutting (de-weeding), slash disposal, debris collection & burning.

(ii) Species Selected for Afforestation

Based on climatic & adaphic site-specific conditions following species are selected by Forest Department for afforestation. However, preference of local communities as regard the choice of species will be planted under this scheme. The species recommended for low-lying pastures are *Lancia lecocephala* (Subabul), *Salix sikkimensis* (Willow), *Grewia oppositifolia* (Biul) and *Morus alba* (Tut).

Table: 5.14
List of Trees Recommended for Afforestation RHEP

S. N.	Name of Plant species		S. N.	Name of Plant species	
	Scientific Name	**Common Name**		**Scientific Name**	**Common Name**
1	*Cedrus deodara*	Deodar	8	*Dalbergia sissoo*	Shisham
2	*Pinus wallichiana*	Kail	9	*Aesculas indica*	Aesculus
3	*Robinia pseudoacacia*	Robinia	10	*Ailanthus sp*	Maharukh
4	*Lancia lecocephala*	Subabul	11	*Populus citiata*	Paplar
5	*Melia azadirach*	Dreak	12	*Picea smithiana*	Spruce
6	*Albizzia lebbek*	Siris	13	*Queruces incana*	Banoak
7	*Abies spectablities*	Silverfir	14	*Grewia oppositifolia*	Biul

Source: Catchment Area Treatment Plan (2005) State Forest Department HP

(iii) Soil & Moisture Conservation Work

In order to control soil crosion in catchment area due to various project activities during construction & operation phase, various soil & moisture conservation work will be carried out. The soil stabalization measures such as construction of check walls, protection walls, vegetative barriers, bushwood check dams etc. Various schemes implemented under this head are detailed out below.

Table: 5.15
Proposed Soil & Moisture Conservation Measures in Catchment Area.

S.N.	Name of Scheme	No. of Sites	Measures to be Taken	Amount (% of Total Cost)
1-	Stabilization of Landslides prone area	71 R:34 A:40	Engineering Mes. Vegetative Mes.	9.22
2-	Treatment of Nallas	150 R:99 A:51	Engineering Mes Vegetative Mes	17.83
3-	Roads Side Erosion	-	-	0.48
4-	Treatment of Private Land	-	Contour bunding Terrace Repining	0.64
5-	Avenue Plantation/Landscaping	-	-	0.15

Source : Catchment Area Treatment Plan (2005) State Forest Department HP

A total number of 71 sites were identified in catchment area which are severely eroded and need soil stabilization measures. Similarly about 150 number of Nalla's are to be treated so as to stop excess silt load in main river other erosion control measures includes road side erosion control, avenue plantation and landscape works surrounding project site.

(iv) Infrastructure Development

Infrastructure development is an important part of Forest Management. In order to maintain roads/path in serviceable conditions are needed to be improved. Various schemes implemented under this head are discussed below.

Table: 5.16
Proposed Infrastructure Development in Catchment Area

S.N.	Name of Scheme	Item	Amount (% of Total Cost)
1	Forest Infrastructure Development	(i) Forest Path (ii) Construction of Buildings	0.69 2.18
2	Rural Infrastructure Development	Repair of Village Road and Path	2.29
3	Village Ponds	31 Nos. R:13 A:18	0.63
4	Soil and Water Conservation Structures	17 Nos. R:8 A:9	1.09
5	Improvement of Water Resources	-	0.86
6	Strengthening of Village Path	-	2.29
7	Construction of Foot Bridges	-	0.17
8	Fuel Saving Devices	LPG, Pressure Cooker, Smokeless Chullas	0.1
9	Rain water harvesting	14 Sites	0.65

Source : Catchment Area Treatment Plan (2005) State Forest Department HP

Forest infrastructure development includes repair of forest path, construction/repair of operational buildings, farm ponds, soil & water harvesting structures. While rural infrastructure development includes construction/repair of village ponds & tanks, repair of springs, wells & other water resources, repair of village roads & paths and construction of footbridges & rainwater harvesting structures.

5.7.3 Proposed Wildlife Management Plan

The wildlife in the forest is exposed to lot of human disturbances besides stray cases of poaching. The excessive cattle population, traditional rights of local people, lopping of trees for fodder, illegal felling of trees etc resulted in depletion of forests and thereby reduction/loss/disturbance to wild habitat. The wildlife Management plan is formulated by State Forest Department Govt of H.P. to maintain viable, healthy and productive population of wildlife, to improve habitat of wildlife by proving forest cover, water holes, saltlicks etc and protect them from natural & anthropogenic hazards. Following measures are suggested to protect wildlife.

(i) Protective Measures

The protection of wildlife can be afforded by implementing preventive and control measure for preservation and propagation of wildlife, as below-

- Ban/Reduction in issuing crop protection licenses
- Provision of Forest Guards to control hunting & poaching
- Protection from forest fire
- Prevention from diseases spread by domestic animals
- Increase in Public Awareness about wildlife
- Reward/Incentives to informers

(ii) Habitat Improvement

In order to provide suitable condition for growth, development and reproduction of wildlife following measures are suggested

- Increase in forest cover through implementation of various afforestation schemes
- Plantation of tree species, which are major sources of fodder for wildlife
- Provision of Saltlicks at various places as a source of essential nutrients required for growth of wild animals
- Increase in pastureland by sowing suitable local species of grasses, bamboo plantation etc

Besides this, there is also provision conducting of wildlife census in forest areas, as well as conducting Public Awareness Programs, display of sign and slogan boards in forest areas for protection of wildlife. The budgetary provision for wildlife management plan is given detailed below

Table: 5.17
Budgetary Provision for Wildlife Management Plan.

Sl. No.	Name of Scheme	Amount (Lakhs)
1	Wildlife Improvement	47.10
2	Protection of Forest	25.48
3	Training and Studying	5.00
4	Awareness and Publicity	2.00
5	Eco Development	12.50

Source : Catchment Area Treatment Plan (2005) State Forest Department HP

5.7.4 Proposed Muck Disposal Plan

The large quantity of muck will be generated during construction phase; it should be properly disposed to avoid siltation/sedimentation of river. In order to prevent sedimentation due to muck generated during construction activities muck disposal plan is formulated by SJVNL.

The four sites are identified for disposal of muck. Three of the four disposal areas are close to river Satluj, but are located at safe distance from high flood level. The bioengineering measures are recommended at disposal site to prevent sedimentation & stabilization of soil.

(i) Engineering & Mechanical Works

Following engineering structures are recommended for stabilization of slope

- The construction of retaining wall varying from 2 to 7 m height to prevent dumped material from sliding/rolling down
- Once meter terracing along the contour at 5m intervals along the slope in staggered manner

- The Uphill side of the terraces will be provided with the walls/edging of 50cm height & 50 cm thickness to protect Uphill side of the terraces from slipping
- Fencing of dumping areas with barb wires in strand with two diagonal strands using wooden fence ports

(ii) Vegetative Measures

The vegetative measures includes plantation of suitable species for slope stabilization.

- Plantation of ornamental plants such as *Robinia*, *Ailanthus*, Poplar, Silver oak, Bottle brush, Subabul, Baken to increase aesthetic nature of the disposal area
- The soil binders are recommended for slope stabilization includes *Heteropogon, Chrysdoopgon, Rumex* etc
- The plan will be implemented by SJVNL and there is budgetary provision of Rs 2.36 Crores for various items to be implemented

5.8 Proposed Management Plan For Mitigation of Impacts

In order to mitigate various impacts due to various project activities during construction and operation phase of the project management plan is suggested which is described below

Table: 5.18
MANAGEMENT OF IMPACTS AND MITIGATION MEASURES

S N	Activities/ Type of impact	Impacts	Mitigation Measures	Responsibility
1.	**Direct Impact** (i) Acquisition of Forests Land	The proposed project does not involve either construction of dam/reservoir hence major loss to the existing forest is not at all envisaged. Loss of Forests land i.e. 48.9 ha which is just 0.9 % of the total forests land available in Rampur Forest div. Hence impact will be insignificant	Strict implementation of approved Compensatory Afforestation Plan in accordance with Forest (conservation) Act 1980 and Himachal Pradesh Forest Policy (1980). The compensatory Afforestation will carried under the Degraded Forest Area Development scheme hence there will be increase the	Forest department/ SJVNL
	(II) Felling of Trees	The clearing of project sites for construction requires felling of trees, a total number of 1075 trees are be felled. Out of total 92.6 % of trees are Eucalyptus Plantation , the exotic the natural forests and rest are commonly distributed throughout the project immediate influence as well as project influence area hence, the impact will be insignificant .		
	(iii)Clearing of Project sites for construction activity	The project site is dominated by weedy shrubs which are commonly distributed throughout and none of rare,		

S N	Activities/ Type of impact	Impacts	Mitigation Measures	Responsibility
		endangered or threatened or endemic species was observed during survey /reported in the project sites. Therefore no impact on biodiversity is envisaged.		
2	**Indirect impact** (i) Generation of dus**t** by movement of vehicles and construction work, crusher operation	This may cause increase in SPM and RPM level in the area. Dust is also likely to settle on the surrounding flora. The impact will be temporary, localized and reversible. No significant impact on Project Influence Area and Satluj Basin.	***** All vehicles delivering materials to the site shall be covered to avoid spillage of materials. * All exiting approach road used by vehicles shall be kept clean and clear of dust * The roads surfaces shall be host or watered using necessary equipments. * Plants, machinery and equipment shall be handled so as to minimize generation of dust. * All earth work shall be protected to minimize dust generation. * All crusher used in construction shall confirm to relative dust emission devises * The machineries, vehicles and equipments use in construction shall strictly confirm to	Contractor /SJVNL

S N	Activities/ Type of impact	Impacts	Mitigation Measures	Responsibility
			CPCB standard.	
	(ii) Generation of Noise	The noise level of the construction site is likely to increase due to various activities, which may cause disturbance to the fauna in the area. However this impact would be insignificant as the increase in noise shall be intermittent and temporary	* All vehicles equipment machinery used in construction shall be fitted by exhaust silencers. * Equipments should be maintained regularly and soundproof gadgets should be used.	Contractor /SJVNL
		No significant impact on fauna of Project Influence Area and Satluj Basin	* Blasting shall be carried out as per the statutory laws, regulation and rules pertaining to acquisition, transport, storage, handling and used of explosives * Blasting should be carried out during fixed hours preferably during midday.	
	(iii) influx of labours	Large number of labor population will influx the project influence area leading to destructions of flora due to provision temporary labor camp Laborers may cut trees for cooking purpose as fuel	*No tree should be permitted to cut or destructions of flora for provision of temporary construction camp * The contractor should arrange alternate	

S N	Activities/ Type of impact	Impacts	Mitigation Measures	Responsibility
	(iv) Movement of Labors force and Technical Staff	Impact due to sewage/ solid wastes /garbage generated from labor camp The labors force and technical staff may poach on occasionally invaded wildlife in the area No endangered, rare and threatened wildlife is reported in the project area hence no significant impact is anticipated on fauna. No significant impact on Project Influence Area and Satluj Basin	source of energy such as Kerosene or LPG * Their should be provision of proper design / collection / handling and disposal system for sewage and solid wastes * The Wildlife conservation Act should be strictly adhered. Environmental awareness training should be provided to the Contractor and workers.	Contractor /SJVNL

S N	Activities/ Type of impact	Impacts	Mitigation Measures	Responsibility
3.	(v) Borrow and Quarry activities	Extraction of rocks soil and sand shall be done for the construction work. Borrow and quarry sites require felling of trees. No significant impact on Project Influence Area and Satluj Basin.	* The extraction of material should be done from the identified borrow and quarry site only. * If new borrow & quarry sites are required then prior permission has to be taken from the owner. The quarry and borrow area should be reclaimed back. The pits formed should be backfilled by construction waste and site should be stabilized. * The top soil (150 mm) from all areas should be preserved in stockpiles. * Such a stockpile shall be utilize for redevelopment of borrow / quarry areas.	Contractor /SJVNL
	(vi) Control of Soil Erosion (vii) Muck Disposal	The construction of activities may lead to the erosion of soil in catchments area of Satluj Basin. The muck produced by the construction work shall be disposed at the dumping sites.	* Grasses and shrub species should be planted. *Strict implementation of approved Catchment Area Treatment Plan for control of soil erosion.	Forest Department /SJVNL
	Induced Impacts	The disposal of muck shall destroy the flora at the sites. However the sites identified for muck muck disposal has low diversity for trees and shrubs and ranges from 0.59 to 0.97 which is very low.	* The muck should be disposed at the identified sites only. Before disposal of muck retention wall should be constructed at the base to retain the muck	

S N	Activities/ Type of impact	Impacts	Mitigation Measures	Responsibility
		disposal has low diversity for trees and shrubs and ranges from 0.59 to 0.97 which is very low. Loss of flora due to logging of timber trees which are Climax species of natural forests Requirement of living places, hotels, filling stations, service stations and extra workers will arise. This will provide job opportunity to the local skilled and unskilled population.	* Before disposal of muck retention wall should be constructed at the base to retain the muck as the sites are just above the river Satluj. *The increased in timber prices for right holders as per the prevailing market rate Reduction in permitting timber demand by right holders *Provision of alternate building material to timber such as provision of breaks/concrete blocks for building houses, tin/ asbestos/ plastic sheets as roof material at concession rates to right holders *Cutting of trees should be strictly prohibited in the area for other construction work. *Forest clearance should be obtained if there is any requirement for cutting trees. *Any new colonies developed in area should have provision for plantation in the colony.	
		Development in Rampur town and		

S N	Activities/ Type of impact	Impacts	Mitigation Measures	Responsibility