FREEP-GHNP 01/04

Assessment of Issues Related to Soil Erosion, Landslides and to Provide Technical Support to the Park Management

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CHAPTER - 1

INTRODUCTION AND TERMS OF REFERENCE

1.1 The Great Himalayan National Park is one of the very few high attitude parks which is so rich in biodiversity of fauna and flora. It supports about 31 species of mammals (Park authority, Per. Com.) and over 300 species of avifauna (Garson P.J. & Gaston A.J. - 1992) including several endangered species of mammals and pheasants such as Musk Deer, Serow, Brown, Bear, Blue Sheep, Western Tragopan, Cheer and Monal. The famous and most beautiful but endangered pheasant the Western Tragopan inhabits in this park. Only one other park in the world supports this rare bird (Collar & Andrew 1988). The flora includes dense forests of moist Himalayan Temperate Forests between 1500m to 3600m characterised by both coniferous and broad leaved species. Almost 14 Forest Types based on classification by Champion and Seth are found in the park (Management Plan of GHNP - R.C. Sharma 1987). Undergrowth and ground flora is also diverse. Beyond the tree line upto the limit of perpetual snow we find alpine pastures with wide range of medicinal and aromatic plants. Besides extraction of large quantities of medicinal herbs, the alpine pastures also provide grazing grounds to about 35,000 to 40,000 sheep and goats both local and migratory which come to park area including Parvati valley during summer months from May to October.

The park has numerous streams with a drainage density of 15.79 meters/ha. and drainage texture of about 1.85 Nos/100 ha., with order of streams varying from Ist order to 6th order. The park with its wild life, forests, pastures, water streams, rocks, valleys and peaks presents most picturesque panorama. The trekking route from Manikaran to Pin Parvati pass passing through the famous vast stretch of plain meadow of Mantalai and considered trekkers paradise also lies in this park.

1.2 For an ecological study of the conservation of biodiversity and biotic pressures in the Great Himalayan National Park with an ecodevelopment approach, the Wildlife Institute of India in collaboration with Wildlife Wing of Department of Forest Farming and Conservation, Himachal Pradesh has assigned following twelve tasks to faculty members of WII and other consultants:

Task No.1	-	Research leadership, coordination and integration and biological monitoring.
Task No.2	-	Assessment of social context and socio economic conditions of people using the GHNP and WLSs.
Task No.3	-	Intensive micro-study to assess socio-economic conditions of people using the GHNP and WLSs.
Task No.4	-	Feasibility review of identified village ecodevelopment investments and appraisal of the practicality of the eco development approaches in the project area.

Task No.5 - Assessment of floral and habitat diversity and collection of baseline data to monitor vegetation of GHNP and WLSs.

Task No.6 - Assessment of faunal diversity, ecological requirements, responses to human activities.

Task No.7 - Study on livestock grazing (resident and migratory) impacts on the GHNP and WLSs.

Task No.8 - Study of herb, mushroom and other minor forest products including medicinals collecting in GHNP, their impact on eco systems and possible mitigating measures through eco development.

Task No.9 - Study of potential for *ex situ* cultivation of medicinal plants around GHNP and Ecodevelopment Project area.

Task No.10- Survey of current market pressures on medicinal plants in and around GHNP and Ecodevelopment Project area.

Task No.11- Evaluation of crop damage in the project area to suggest mitigating measures.

Task No.12- **Assessment of issues related to soil erosion, landslides and provide technical support to the Park Management.**

1.3 Terms of Reference

This project deals with task No.12 and has following Terms of Reference:

1. Assess the extent of soil erosion and landslides in the National Park and surrounding areas.
2. Prepare maps of soil, water and landuse features of the study area with the help of existing information with various agencies.
3. Develop plans for experimental, cost effective approaches (Physical, biological, cultural and traditional) to undertake soil conservation measures and stabilize landslide prone areas and landslide slopes.
4. Evaluate the merits of such measures, involving local people and park management.

1.4 The project area comprises of GHNP and adjoining Sainj Sanctuary, Tirthan Sanctuary and Ecodevelopment area and has in all an area of 1,17,100 ha. There are only 2 villages inside the park but its surrounding areas have about 127 villages. Thus the park has to bear the brunt of maximum biotic pressure from the large number of villages in its surrounding areas particularly in the Ecodevelopment area. The biotic pressure is in the form of sheep and goat grazing, cattle grazing, extraction of medicinal plants, collection of Guchhi mushroom

(*Morchella esculanta*), collection of fuelwood and fodder, timber demand etc. and to some extent poaching and illegal extraction of charas from Cannabis leaves. These biotic pressures are gradual but certain causes of ecological degradation and soil erosion. According to study conducted by Conifer Research Centre, Shimla on effect of grazing on soil erosion in Forest ecosystem it was found that grazed plots had approximately seven times more soil loss per annum compared to ungrazed/control plots under Deodar Forest (Indian Forester August 1995). There are about 27,700 cattle, sheep and goats (Park authority, Per. Com.) and only 32.53% forests in the project area. So, one can well visualise the immense soil loss due to grazing by such large population of livestock in unforested slopes.

The park area particularly the Sainj Khad and Tirthan Khad valleys are highly prone to landslides mainly due to toe cutting of banks by these two streams. As many as 28 landslides were noticed in a stretch of 5 kms. from Shakti to Maror causing disruption of communication, bridle path and normal life. The land slides occur in the park area year after year causing widespread damage. Protection of stream banks at vulnerable curves to check toe cutting and stabilization of land slides is direly needed. The cultivation fields are highly sloping. No bench terracing or improper bench terracing of fields results in sheet, rill and gully erosion. This calls for either change of land use from agriculture to horticulture or bench terracing of sloping fields. Large chunks of barren slopes in Eco development area are devoid of trees and its degradation and soil loss continues unabated. Afforestation of such barren slopes with fuelwood and fodder species is desirable.

1.5 The villagers are dependent on natural resources of the project area for their sustenance and exploitation of natural resources by them is continuing since several generations. So, a multidisciplinary holistic approach has been considered desirable to address to both ecological and economic concerns. Accordingly, this project has been prepared to provide technical support and guidelines for undertaking preventive and remedial measures in the project area to tackle the problem. The total cost of the project is about 5.15 crore Rupees in 5 years. It is hoped that the Park Management will be able to procure funds to meet the project cost from World Bank, H.P. Forest Department or other funding agencies. It is expected that the implementation of the project will go a long way to achieve the goal of soil and eco conservation and landslide stabilization in the project area.

CHAPTER - 2

THE TRACT DEALT WITH AND LANDUSE PATTERN

2.1 Area

The project area is spread over 1,17,100 ha. and comprises of the Great Himalayan National Park and its surrounding area as under:

i)	Great Himalayan National Park (GHNP)	-	76,500 ha.
ii)	Sainj Sanctuary	-	9,000 ha.
iii)	Tirthan Sanctuary	-	6,100 ha.
iv)	Ecodevelopment area	-	25,500 ha.

		Total	1,17,100 ha.

When initially constituted in the year 1984 and 1990, the area of GHNP was 62,000 ha. In the year 1994, Sainj Sanctuary with 9000 ha. area was carved out of the park and 23,500 ha. area of Parvati valley was added to it. Thus now the existing revised area of the park is 76,500 ha.

2.2 Situation and Boundaries

The project area is situated in Western Himalayas in Kullu district of Himachal Pradesh and lies between 31^0 33' 00" and 31^0 56' 56" latitudes and between 77^0 17' 15" and 77^0 52' 05" longitudes. Its geographical boundaries are as under:

North and N.E

- Starting from B.M. 3236 M along Laru dhar to Kasal dhar, Drasal dhar, Kaili dhar, Plangcha dhar, Rohnidhar and Ori dhar (forming watershed between Jiwanal and Hurla Nal catchments) to
- Phangchi dhar and Khande dhar (forming watershed between Jiwa Nal and Parbati Nadi catchments) to
- Jaraun dhar (forming watershed between Sainj Khad and Parbati Nadi catchments) to
- Bakar Bihar Khol, Bakar Bihar Thatch, Parbati Nadi, Bari Deuri Thatch to S.O.I. Bench Mark 5741.
- To Ridge from B.M. 5741 to 6110 (forming watershed between Parbati Nadi and Bauli Khad-Killung Khad)

East and S.E

Ridge from B.M. 6110 to Pin-Parbati Pass, Kokshane Peak to Gishu-Pishu.

S.E., South and S.W

Ridge from Gishu-Pishu to Chakri, Sri Khand Mahadev, B.M. 5148, Dunga Thua, Mungradwari, B.M. 3644, Basleo Pass to ridge between Palchan gad and Rohu Nal catchments to B.M. 3621, 3594, along Chatri Nala to Palchan gad, Gushaini along Tirthan Khad to confluxion of Kalwari Nala and Tirthan Khad.

West and N.W

Along Kalwari Nala to 3498, Thanigalo along Nuhara gad to Sainj Khad, along Sainj Khad to Seund (confluxion of Jiwa Nal and Sainj Khad) along Bangidhar to Tiskana Thatch, Murda Thatch to B.M. 3236 on Laru dhar.

The geographical location of different areas of the project, subwatershed wise is given in Annexure - 11.1

2.3 Subwatersheds

The project area lies in four subwatersheds (S.W.Ss) viz., Tirthan Khad, Sainj Khad, Jiwa Nal and Parbati Nadi S.W.Ss. These four rivers drain the water of the project area into Beas river.

The S.W.S.- wise distribution of area is as under:

Table 2.1 : Subwatershed wise distribution of Project area in ha.

Sl No.	Name of area	Area in Ha.				
		Jiwa Nal S.W.S.	Sainj Khad S.W.S.	Tirthan Khad S.W.S.	Parbati Nadi S.W.S.	Total
1.	GHNP	13,270	24,000	15,730	23,500	76,500
2.	Sainj Sanctuary	-	9,000	-	-	9,000
3.	Tirthan Sanctuary	-	-	6,100	-	6,100
4.	Eco development area	2,350	10,623	12,527	-	25,500
	Total	15,620	43,623	34,357	23,500	1,17,100

2.4 Altitude

The altitude of Project area varies from a minimum of 1344 M near Seund at the confluxion of Jiwa Nal and Sainj Khad to a maximum of 6248 M at an unnamed peak in Khirganga P.F. in the east of Mathaun dhar. The distribution of area under various altitudinal zones is given in Table 2.2. below:

Table 2.2 : Distribution of area under different altitudinal zones

Sl. No.	Name of area	Altitudinal zone wise are in ha.							
		<1600mts.	1600 -2400 mts	2400 - 3200 mts.	3200 - 4000 mts.	4000 - 4800 mts.	4800 - 5600 mts.	5600 - 6400 mts.	Total
1.	GHNP	-	1149	8363	12743	29647	24134	464	76500
2.	Sainj Sanctuary	-	235	2723	3068	2518	456	-	9000
3.	Tirthan Sanctuary	-	80	2135	2900	985	-	-	6100
4.	Ecodevelop-ment area	505	8394	13474	3083	44	-	-	25500
	Total	505	9858	26695	21794	33194	24590	464	11710000
	% of total area	0.4%	8.4%	22.8%	18.6%	28.4%	21.0%	0.4%	100%

Details of subwatershed wise and area wise distribution of Project area under different altitudinal zones is given in Annexure 11.2

2.5 Slope

The distribution of area according to slope is given in table 2.3 below:

Table 2.3 : Distribution of area by slope classes

Sl. No.	Name of area	Slope-wise distribution of area in ha.				
		<33% (<19^0)	33 - 50% (19^0-27^0)	50 - 100% (27^0-45^0)	>100% (>45^0)	Total (ha.)
1.	GHNP	23469	12225	35252	5554	76500
2.	Sainj Sanctuary	112	1197	7372	319	9000
3.	Tirthan Sanctuary	232	713	5060	95	6100
4.	Eco development area	1127	4524	19552	297	25500
	Total	24940	18659	67236	6265	117100
	% of total area	21.3%	15.9%	57.4%	5.4%	100%

Details of subwatershed wise and area wise distribution of Project area under different altitudinal zones is given in Annexure 11.3.

2.6 Drainage Pattern

The classification of streams and the drainage pattern is indicated in table 2.4 below:

Details of subwatershed wise and area wise drainage pattern is given in Annexure 11.4.

2.7 Geology, Rock and Soil: (Working Plan - Seraj Forest Division, - R.P. Jaiswal)

Geology, rock and soil effect the vegetation of a place by influencing the moisture regime, structure, texture and drainage of the soil. The underlying rock found in the area are quartzites, schists, phyllites, dolomites, limestones, shales, slates, gneisses and granites, which are responsible for a variety of coniferous and broad-leaved vegetation. The underlying rocks play an important role in the formation of soils. Quartzites produce sandy soils after disintegration while granites, schists, shales and gneisses produce loamy and sandy loam soils. While the physical contents of soil are made after weathering of underlying rocks, the mineral and organic contents of soil are influenced by climatic conditions, vegetational cover and host of other factors and in turn the type of soil determines the type of vegetation in a broad climatic zone.

Alluvial soils are formed due to erosion mainly by water and landslips. In the process the weathered material is transported and deposited at a place other than its origin. In such cases the underlying rocks have little role to play in influencing the vegetation on alluvial soils. Such soils are found deposited in the basins of rivers and along the banks of the rivers.

Podsolic soils are found developed in temperate climates and generally hold conifers in the Himalayas. It is formed under coniferous vegetation. The soil is covered with thick layer of humus which remains undecomposed due to low temperature and short summer, Humic acid is formed. The leaching medium is acidic because of presence of humic acid. The microbiological activity is very low. The PH of soil is acidic. The chlorides, sulphates, alkali and alkaline earth substances get leached. These become degraded soils because of break of nitrogen cycle in temperate coniferous forests. These soils get improved by a mixture of broad leaved species.

Brown forest soils are formed in temperate climate under broad leaved vegetational cover. There is no accumulation of thick humus on top and humus is of neutral type.

The underlying rocks influence the structure and texture of soils as some rocks on disintegration give rise to fine grained material and others coarse grained material which effects the water holding capacity of soil and consequently influences the type of vegetation which can come up on various structures and textures of soils.

Deodar cannot regenerate on calcareous parent rock. It requires heavy soil with good moisture retaining capacity while chil requires coarse grained sand particles having good drainage.

Therefore, the chil prefers the soil formed out of quartzites and deodar is happy on the soil formed due to disintegration of granites. Kail requires shallower soils with boulders in the subsoil and silver fir and spruce come up on all soils and can tolerate more acidic conditions. Cypress loves to be on calcareous soils.

The soil of almost entire tract has been formed *in situ* and belongs to podsolic group.

2.8 Climate and Rainfall

There are prominently three seasons in the area viz. Summer from April to June, Rainy season from July to September and winter season from October to March. Depending on variation in altitude, upper reaches are colder than the valleys. Winter is severe and main precipitation is received in the form of snow during winter. Rains are mostly confined to rainy season and heavy downpours in rainy season cause landslides and soil erosion.

Rainfall recorded at Niharni (inside the project area) and Sainj (near the project area) rainguage stations during last three years is given below:

Table 2.7 (i) : Rainfall recorded at Niharni

Month	Rainfall in mm		
	1992	1993	1994
January	170.5	90.0	70.5
February	67.0	90.0	115.0
March	167.5	160.0	55.0
April	40.0	35.5	147.0
May	110.0	61.0	108.0
June	38.5	141.0	81.0
July	253.0	150.5	230.0
August	236.5	108.5	251.0
September	158.5	141.0	151.5
October	-	-	15.0
November	20.5	15.0	-
December	20.0	-	36.0
Total annual rainfall	1282.0	992.5	1260.0

Table 2.7 (ii) : Rainfall recorded at Sainj

Month	Rainfall in mm		
	1992	1993	1994
January	240.0	130.3	55.6
February	39.0	97.8	187.8
March	148.0	353.0	12.6
April	11.0	25.3	136.4
May	67.0	42.8	64.7
June	52.0	38.4	116.1
July	307.3	248.1	248.1
August	173.5	80.5	294.7
September	100.9	94.4	112.6
October	-	-	10.4
November	25.6	21.6	-
December	-	-	25.6
Total annual rainfall	1164.3	1132.2	1264.6

2.9 Landuse

In the project area 2032 ha. (1.74%) area is under cultivation, 38092 ha. (32.53%) area is under forests, 45233 ha. (38.63%) area is blank, 12918 ha. (11.03%) area is rocky and 18825 ha. (16.07%) area is snow bound. A summary of landuse classification of different parts of project area is given in table 2.8 below:

Table 2.8 : Classification of area under different landuse

Sl No.	Name of area	Landuse in ha.					
		Cultivation	Forest	Blank	Rocky	Snow bound	Total
1.	GHNP	21	13018	32306	12874	18281	76500
2.	Sainj Sanctuary	7	3162	5428	44	359	9000
3.	Tirthan Sanctuary	-	2875	3140	-	85	6100
4.	Ecodevelopment area	2004	19037	4359	-	100	25500
	Total	2032	38092	45233	12918	18825	117100
	% of total area	1.74	32.53	38.63	11.03	16.07	100

2.10 Erosion intensity classification

The project area has following erosion intensity classes as given in table 2.9 below:

Table 2.9 : Classification of area by erosion intensity classes

Sl No.	Name of area	Area in ha.						
		E_1	E_2	E_3	E_4	Rocky	Snow bound	Total
1.	GHNP	3005	7381	32603	2356	12874	18281	76500
2.	Sainj Sanctuary	-	1207	7078	312	44	359	9000
3.	Tirthan Sanctuary	200	600	5135	80	-	85	6100
4.	Ecodevelopment area	671	4641	19776	312	-	100	25500
	Total	3876	13829	64592	3060	12918	18825	117100
	% of total area	3.3	11.8	55.2	2.6	11.0	16.1	100

E_1 = Slight Erosion, E_2 = Moderate Erosion
E_3 = Severe Erosion & E_4 = Destroyed

S.W.S. wise and landuse wise classification of areas by erosion intensity classes is given in Annexure 11.5.

2.11 Flora and Fauna

The project area supports a rich diversity of flora and fauna. The creation of GHNP and Tirthan and Sainj Sanctuaries by H.P. Government will go a long way to conserve this diversity for posterity.

(a) Flora

A total of 309 species of trees and other plants have been reported from the park area (Singh et. al. 1990).

The project area on the whole has 32.53% area under forests. The GHNP has 17.0% of its area, Tirthan Sanctuary has 47.1%, Sainj Sanctuary has 35.1% and Ecodevelopment area has 74.6% of their respective areas under forests. The low percentage of forest area in GHNP is due to preponderance of high altitude meadows beyond tree line and rocky and snow bound areas in the park area. The project area is covered by dense Himalayan Moist Temperate forests, characterised by both coniferous and broadleaves species between 1500-3600 m with following dominant species occurring according to different locality factors in the area:

Deodar, Blue pine, Cypress, Chilpine, Silver fir, Spruce and Taxus among conifers and Quercus incana, Q. delatata, Q. semicarpifolia, Celtis australis, Horse chestnut, Walnut, Maple, Prunus, Alder, Birch, Ash, Cedrella Serrata, Populus, Salix etc. among broad-leaved species.

Blue pine occurs below 2000m and chilpine down below in the lowest limit of the project area. Diverse broadleaved species are seen in moderate slopes. Kharsu oak occurs in pure form between 2000 to 3500 m. Small areas of Ban oak are seen between 1800 to 2400 m with Moru oak overlapping upper range of Ban oak and lower range of Kharsu oak. Generally Silver fir and spruce are seen in Northern slopes and stands of blue pine, Deodar and Kharsu oak are seen in southern slopes. Alnus, Populus and Salix species are found near water streams. Bamboo brakes of Arundinarea species are also found in moist northern slopes in Tirthan and Sainj Valleys.

Undergrowth and ground cover comprises of Indigofera, Viburnum, Sarcococca, Berberis, Iris, Polygonum, Cannabis, Balsam, Rumex, Gerardiana etc.

The last tree line is mixed with sub-alpine scrub of Rhododendron and Juniper species, usually occurring in patches interspersed with meadows and out crops of rocks. Alpine thatches

have preponderance of medicinal and aromatic plants. About 61 herbs have been identified in the park. Some of the commercial value herbs are Balchhar, Dhoop, Glaeoda, Guchhi, Hathpanja, Karoo, Mehndi, Nihanoo, Patish and Shingli mingli. List of medicinal herbs reported from GHNP is given in Annexure 11.8. Besides alpine meadows in GHNP we find grass lands in Ecodevelopment area which seem to have been created and maintained as "Ghasnies" as a result of practice of pastoralism.
Following Forest types based on Champion and Seth's classification, occur in the area:

1. Ban Oak Forest (12/C1(a)
2. Moist Deodar Forest 12/C1(c)
3. Western Mixed Coniferous Forest 12/C1(d)
4. Moist Temperate Deciduous Forest 12/C1(e)
5. Kharsu Oak Forest 12/C2(a)
6. Western Himalayan Upper Oak-Fir Forest 12/C2(b)
7. Montane Bamboo Brakes 12/DS1
8. Himalayan Temperate Parkland 12/DS2
9. Himalayan Temperate Pastures 12/DS3
10. Western Himalayan Sub-Alpine Fir Forest 14/C1(a)
11. Sub-Alpine Pastures 14/DS1
12. Birch/Rhododendron Scrub Forest 15/C1
13. Deciduous Alpine Scrub 15/C2
14. Alpine Pastures 15/C3

Legal Position

The villages, hamlets and cultivation are revenue lands under private ownership. Rest of the areas are either Reserve Forest (RF) or Protected Forest (PF). The RF are situated in remote areas and are free from rights. The Protected forests are further divided into Demarcated PF class I and class II and Undemarcated PF also called class III forests. The class I forests are situated near the habitation, the rights of users are less extensive but well defined and comprise of valuable growing stock both for people and for producing timber for market. The class II forests are situated above class I forests towards the ridge in higher elevation consisting of mainly Silver Fir and Spruce, alpine pastures and snowbound areas. Besides supplying large quantities of timber to local requirement and export, class II forests are also used as summer grazing grounds. The grazing rights are well defined in class II forests.

The undemarcated class III forests are all government lands other than notified as RF or Demarcated PF and the private land. The class III forests are important to people as its wooded areas provide timber and firewood and its grass lands are grazed. The large barren grass lands of class III forest also meet the demand of "Nautors" (land granted for fresh

cultivation). The class III forests areas have been shrinking gradually due to demand for fresh cultivation land. The barren slopes of class III forests will form the potential afforestation sites for this project.

(b) Fauna and Avifauna

The project area has wide variety of fauna and avifauna which include about 31 species of mammals and over 300 species of birds. The Reptiles, Amphibians and numerous insects also occur in the area. Some of the important species of animals and birds found in the area are Musk deer, Barking deer, Serow, Himalayan Tahr, Himalayan Ibex, Blue sheep, Black bear, Brown bear, Snow leopard, Common leopard, Wolf etc. among wild animals and Western Tragopan, Monal, Cheer, Kalij, Koklas, Snow Cock etc. among birds. But some of the animal and bird species like Musk deer, Snow leopard, Wolf, Western Tragopan, Monal and Cheer Pheasants are endangered species.

List of mammals and birds reported from the park are given in Annexure 11.6 and 11.7 respectively.

CHAPTER - 3

SOCIO ECONOMICS AND THE CROPPING PATTERN

3.1 In the project area most of the habitation is confined to the peripheral area i.e. ecodevelopment area. The number of villages in GHNP, Sainj and Tirthan Sanctuaries and Ecodevelopment area is given in table 3.1 below :

Table 3.1 : List of Villages in the Project Area

Sl No.	Name of area	No. of villages	Name of villages
1.	GHNP	2	Kundar and Manjhan
2.	Sainj Sanctuary	3	Shagor, Shakti and Maror
3.	Tirthan Sanctuary	-	-
4.	Ecodevelopment area	124	List of villages is given in Annexure 12
	Total	129	

Note - The discrepancy in number of villages if any is attributable to inclusion of hamlets in the main village.

3.2 In GHNP, there are only two villages viz., Kundar and Manjhan which are situated in Jiwanal subwatershed at an altitude of about 2400 m. In Kundar village only one family lived and it was found that recently it has abandoned the village and shifted to a village down below. However, cultivation of land continues there. Thus the biotic pressure in the park from the habitation inside the park is minimal as existence of only 2 villages in a park area of 76500 ha. can be considered negligible. However, the biotic pressure in the park is mainly from the large number of villages in the adjoining areas particularly in the Ecodevelopment area.

In Tirthan Sanctuary there are no villages inside the sanctuary. But in Sainj sanctuary there are 3 villages viz., Shagor, Shakti and Maror. These villages are situated in Sainj Khad SWS on the right bank of Sainj Khad. These villages are situated in the valley in the heart of the project area adjacent to GHNP and have geographically nucleous position for harbouring outsiders for any illegal activity harmful to the park and calls for careful watch. The presence of these villages seems to be the reason to carve out and create Sainj Sanctuary from initial park area as all efforts to shift these villages out of the park area had failed. However, considering the richness in the biodiversity in and core situation of the Sainj Sanctuary, it is suggested that Sainj Sanctuary should be included in the GHNP, irrespective of the fact that efforts to shift these villages succeed or not.

Most of the habitation in the project area is situated in the Ecodevelopment area so there is maximum biotic pressure of human and livestock population in this area. As many as 124 villages are located in the Ecodevelopment area. A map of Ecodevelopment area showing location of the villages is given in chapter V as map No....

3.3 Human Population: (Park authorities, Per.Com.)

In the project area present total human population is 9694 as detailed below:

Table 3.2 :Human Population figures

Sl No.	Name of area	Population			
		Male	Female	Children	Total
1.	GHNP	27	42	33	102
2.	Sainj Sanctuary	22	20	24	66
3.	Tirthan Sanctuary	-	-	-	-
4.	Ecodevelopment area	NA	NA	NA	9526
	Total	NA	NA	NA	9694

3.4 Number of Families: (Park authorities, Per. Com.)

In the project area the number of families is 1362 as detailed in table 3.3 below:

Table 3.3

Sl No.	Name of area	Number of families
1.	GHNP	12
2.	Sainj Sanctuary	12
3.	Tirthan Sanctuary	-
4.	Ecodevelopment area	1338
	Total	1362

3.5 Livestock Population: (Park authorities, Per. Com.)

Present population figures of livestock in the project area is given in table 3.4 below:

Table 3.4 : Livestock Population

Sl No.	Name of area	Sheep & Goat	Cow/Ox	Ponies	Total
1.	GHNP	369	153	-	522
2.	Sainj Sanctuary	360	133	-	493
3.	Tirthan Sanctuary	-	-	-	-
4.	Ecodevelopment area	19916	6757	48	26721
	Total	20645	7043	48	27736

On perusal of human and livestock population figures given in table 3.2 and 3.4 it is evident that most of these are concentrated in Ecodevelopment area and thus it is the Ecodevelopment area which bears the maximum brunt of the biotic pressure and this biotic pressure also spills over to GHNP in the form of migratory sheep and goat grazing, extraction of medicinal herbs, collection of Guchhi mushroom, fuelwood collection etc. Besides above existing sheep and goat population of about 20,000 already in the area, a large number of sheep and goats (about 15000 to 20000) from outside the project area also migrate to Park area for summer grazing.

3.6 Literacy

Literacy percentage in the project area (Park authorities, Per. Com.) is extremely low as given in table 3.5 below:

Table 3.5 : Literacy Percentage

Sl No.	Name of area	Literacy Percentage
1.	GHNP	Nil
2.	Sainj Sanctuary	Nil
3.	Tirthan Sanctuary	_
4.	Ecodevelopment area	17.9%
	Total for the project area	17.6%

3.7 Occupation

The main occupation of the villagers is agriculture alongwith horticulture. However, to a considerable extent, the villagers augment their income by rearing sheep and goats for wool and meat and by extracting medicinal herbs and collecting guchhi mushroom (*Morchella esculanta*). There are very few persons who do the service (salaried job). Extraction of medicinal herbs and collection of guchhi mushroom has been their traditional source of income since several generations and it fetches them ready cash money which goes a long way to sustain them. Villagers go to extract and collect medicinal herbs and guchhi mushroom in the interior of project area with ration and camp there for 2-3 weeks. With the dwindling of these natural resources due to over exploitation, now the villagers have to go to farther interior areas to collect them. Medicinal herbs are generally collected by digging and during their extraction camps the villagers cut saplings and shrubs etc. for fuelwood resulting in soil erosion and eco degradation. Guchhi mushroom is sold at Delhi/Shimla at a price of about Rs.5,000/- per kg. as it is considered a delicacy particularly by foreigners and so it has great demand and export value. As all efforts to reproduce Guchhi mushroom artificially world over including FRI have failed and it grows only in high altitudes in natural conditions so it commands a good price. The traders purchase from villagers medicinal herbs and Guchhi mushroom through their local agents. Every family is said to earn substantially from sale of medicinal herbs and Guchhi mushroom depending upon number of working members in the family.

Rearing sheep and goats is still practised on a fairly large scale as it has been traditional profession of villagers. There is great demand for sheep wool in Kullu for making woollen shawl etc. Kullu shawl is great name in Indian and foreign markets. A large number of handloom cottage industries have come up in and around Kullu which manufacture woollen shawls and other woollen garments. Even in remote villages, villagers are found weaving sheep wool in crude handlooms to manufacture woollen clothes and blankets etc. for themselves. The sheep and goats are taken to high altitude thatches inside the GHNP to graze during summer and rainy season. It is estimated that about 20000 local and about 15000 to 20000 migratory totalling about 35000 to 40000 sheep and goats graze in the park area, causing sever imbalance in ecosystem including soil erosion.

Animal husbandry is practised for farm yard manure and for family use of milk and milk products. Generally, we find local breed of cows but now a few improved breed of cows are also seen in the villages. The cattle are left open to graze in the forest area and stall feeding is seldom done. A few progressive farmers have started rearing Jersey and other cross bred cows and sell the milk and milk products to nearby markets. However, a redeeming feature is rearing of grass by villagers in “Ghasnies”. The grass reared in Ghasnies is cut and stored for stall feeding in winter months.

Horticulture is catching mass movement in the area and it is a matter of good achievement that people are raising orchards of apple, plum, cherry, walnut etc. It is picking up momentum in remote villages too and apple etc. are seen planted in sloping fields. Orchards can fetch good income to villagers. Young orchards will take some time to reach to fruiting stage and established orchards are few so far. However, the area has great potentiality for development of horticulture and more of sloping cultivation fields need change of landuse from agriculture to horticulture for soil and water conservation in the area.

3.8 Cropping Pattern

In agriculture villagers mostly grow maize and ogal (Kotu) during rainy season. Maize is widely grown in the area and it seems the main food crop of the villagers. After rainy season, wheat and barley etc. are also grown in lower areas but where winters are severe, only one crop that of maize is grown. Agricultural production is poor and people depend upon fair price shops to purchase wheat etc. brought from the plains.

CHAPTER - 4

THE PROBLEM AND EXTENT OF SOIL EROSION AND LANDSLIDES IN THE PROJECT AREA

4.1 Types of erosion

Following types of erosion occur in the Project area:

1) Landslides

A landslide is the downward and outward movement of slope-forming materials composed of natural rocks, soil, artificial fills or combination of these materials.

The project area, particularly the GHNP is quite prone to landslides and their occurrence in frequent years is common phenomenon. During rainy season whenever there is higher intensity of rainfall during short span of time their occurrence assumes alarming proportions causing wide-spread damage and disruption of communication paralysing normal life.

2) Sheet erosion and Rill erosion

Soil erosion starts with sheet erosion i.e. washing of surface soil from arable land. Thereafter, as the water concentrates into mini rivulets in the fields, rill erosion takes place. When the eroded channels get larger, gully erosion occurs. Finally stream bank erosion takes place when rivers or streams are cutting into banks.

The sloping cultivation fields in the project area have acute problem of sheet and rill erosion. Cultivation fields have not been properly bench terraced and in general they are alarmingly sloping and rain water washes down top soil including nutrients and micronutrients from the soil. Sheet and rill erosion are common in barren slopes too wherever vegetation has been destroyed due to biotic pressure.

3) Gully erosion and nala erosion

Gully erosion is advanced stage of rill erosion while the latter is advanced stage of sheet erosion. When the eroded channels of rills become large enough which can not be obliterated by normal agricultural operations they are called gulleys. The incessant rains during rainy season further aggravates gully to nala formation, taking soil, stones boulders and debris down hill damaging barren slopes and agricultural fields in its stride.

4) Bank erosion by streams and rivers

The high run off down the hill slopes with heavy silt loads fill up the stream beds thereby reducing their capacity to carry the run off and sediments. Consequently the fast flowing waters cut and erode banks. Bank erosion by turbulent waters of Sainj khad and Tirthan khad is acute in the project area.

5) Glacial erosion

About 18825 ha. (16%) of the project area is snow bound and in this area on both sides-southern and northern slopes are sources of big avalanches forming glaciers down below. Glacial action consists of three distinct processes of erosion, transport and deposition. The erosive action of glacier is affected by abrasion and is aided by frost action. All products of erosion are transported downhill by the glacier ice, which tend to accumulate at the terminus called moraines. At times morainal deposits impound stream course forming lakes as in the upper reaches of Parbati Nadi Valley in GHNP. These natural calamities result in destruction of habitat and at times wild animals get trapped.

4.2 Causes of erosion

4.2.1 Water is the most important single agent of erosion. Whenever water is in movement it is eroding its boundaries. Rainfall, streams and rivers all scour soil. Thus erosion is essentially a smoothing or levelling process in which soil and rock particles are carried, rolled or washed down by the force of gravity (slope) and water. The problem in the project area is aggravated when balance of “Soil-water-plant” is disturbed by overgrazing particularly by sheep and goats, faulty cultivation due to sloping fields, reduction of forest cover, shifting cultivation, careless road/path construction, high rate of growth of human and livestock population resulting in indiscriminate exploitation of natural resources for meeting ever increasing demand of food, fodder, fuelwood, medicinal plants, guchhi mushroom etc. Severe erosion by water results in continuous degradation of production base and imbalance in land-water-plant-human-animal systems leading to ecological imbalance and economic insecurity in the area.

Slope of land determines the speed and extent of run off. Greater the slope, greater the velocity of flow of the run off water. According to law of falling bodies velocity varies as square root of vertical drop i.e. if land slope is increased four times the velocity of water flowing in the slope is doubled. If velocity is doubled the erosive capacity of run off varies in direct proportion with the slope of land on which the run off occurs. Also if velocity is doubled the quantity of material that can be carried is increased about 32 times and size of particles that can be transported by pushing or rolling is increased by about 64 times. (G. Singh, Venkataraman, Shastry & Joshi - 1990, Manual of Soil and Water Conservation Practices).

The factor which most influences erosion by water is mean annual rainfall and kind of rain. An annual rainfall of more then 1000 mm can be certain cause of soil erosion when combined with one or more of aggravating factors. The intensive downpour has much more damaging effect than the gentler rain. Steeper slopes and vulnerable rocks and soils can lead to quite serious erosion.

A perusal of table 2.3 on slope-wise distribution of area shows that the project area has almost 60% area under 50-100% slope class. A perusal of table 2.7 on rain fall data shows that the project area has high annual rainfall i.e. about 1200 mm which is mainly concentrated during rainy season. Thus Project area abounds in factors which influence the soil erosion most.

4.2.2 Factors causing Landslides

Factors causing landslides can be broadly classified as geological, hydrological, seismic and landuse. Almost all landslides involve failure of earth material under shear stress.

a) Geological factors

Landslides are dependent on structure and nature of materials involved. The beds of shales, sedimentary beds, ash beds and schist varieties are all pointers to weak zone and danger of landslides if along with above, structural deformities like steep dips, folds, faults accompany.

b) Hydrological factors

Water seeping through the disturbed slopes, toe cutting by rivers and torrents and pore water pressure in soil zone are major agents responsible for landslides. Torrents because of excessive velocities of flow and turbulence carry out quick removal of debris and cutting of sides. In Sainj valley particularly between Shakti and Maror the turbulent Sainj Khad river during heavy rains in 1995 rainy season caused toe cutting at numerous places on the banks resulting in occurrence of several landslides.

The rainwater has mainly three effects - (i) it increases the effective weight of the material due to saturation (ii) lubricates any sliding places especially of shales and (iii) causes weakening of strata because of moisture intake. One or all these effects in combination brings about the landslide in rainy season.

c) Seismic factors

The intensity and frequency with which earthquakes are felt in a particular region also influence the occurrence of landslides. Blasting for slates, lime stones quarrying and road making in

Himalayan region reduces shear strength and mild seismic activity can take place to initiate land slides.

d) Landuse factors

Landslides may also be caused by single or a combination of activities such as (i) indiscriminate felling of trees, overgrazing, unscientific removal of land cover and fire (ii) adoption of improper agriculture on steep slopes (iii) blasting for mining and roadmaking (iv) undercutting of the base of existing slope by torrents or for road cutting and (v) improper alignment of roads and mule paths on weaker and unstable rock formation.

4.2.3 Causes of sheet erosion and rill erosion

Nearly all agricultural operations in hills do tend to encourage sheet and rill erosion but situation gets alarming when the cultivation fields are sloping and improperly terraced. The project area has generally sloping fields in almost all the villages. No care seems to have been taken to terrace and level the fields properly. In such fields there is more of rainfall erosion as ploughing and tilling the soil accelerates the erosion many fold in sloping fields. In barren slopes too due to the biotic pressure with livestock to trample and loosen the soil and with no trees and vegetation to absorb the energy of falling rainfall, sheet and rill erosion quickly ends up with gullys and nalas.

4.2.4 Causes of Gully erosion and Nala erosion

Causes of water erosion has already been narrated in foregoing paras and these causes start rill erosion which further aggravates into gully and nala formations. The common factor in all cases of gully erosion is the same i.e. breakdown of a state of metastable equilibrium in the water course and so the gully erosion occurs when a natural watercourse is displaced from its state of metastable equilibrium. A water course is ordinarily in balance that is the size of channel and its shape and gradient are in equilibrium. If balance is changed by an external force either due to increase in the amount of flood run off which the channel has to carry or decrease in the ability of the channel to carry that flood the water course starts gullying.

4.2.5 Causes of Bank erosion by Streams and Rivers

As already mentioned in para 4.1 (4) the incessant heavy rains in catchment area results in high run off in streams and rivers which carry heavy silt loads. This silt load reduces their capacity to carry run off smoothly. So the turbulent and fast flowing waters erode and toe cut the banks.

4.2.6 Causes of Glacial erosion

In western Himalayas the lowest line of perpetual snow is about 5200 m. Snow falls in the form of cotton but successive snow falls press lower snow and as a result air is squeezed and under pressure snow becomes compact mass of ice. In mountain slopes masses of ice begin to flow downhill under action of gravity. This movement of ice is glacier. The movement of glacier starts when the weight of mass of ice becomes more than the retarding friction along the slopes and is also dependent on temperature. It conforms to the trend of the valley in which it flows. The movement of glacier is greater in the central part than at the sides. The lowest limit of glacier movement is dependent on temperature and the glacier retreats due to melting of ice. In warmer months glacier shrinks and in moist and cold months it advances. The lowest limit of glacier in Western Himalayas is from 2500 to 3000 m. The Himalayan glacier movement varies from 2.5 cm to 1 meter per day.

4.3 Extent of Soil Erosion

An assessment of land use in the project area has been given in table 2.8. The areas under different landuses is summarised below:

Cultivation	2032 ha.
Forest	38092 ha.
Blank	45233 ha.
Rocky	12918 ha.
Snowbound	18825 ha.
Total	117100 ha.

The blank area is about 45233 ha. The blank area in GHNP and two sanctuaries is mostly in higher altitudes beyond tree line but blank area of about 4359 ha. in Ecodevelopment area being in lower altitudes and around habitation is susceptible to process of water erosion and calls for soil conservation and afforestation measures.

Erosion is dependent on slope percent of land and other factors enumerated in para 4.2. As detailed in table 2.9 and annexure 11.5 the summary of erosion class wise distribution of area is as under:

Table 4.1

Landuse	Area in ha. under				
	E_1	E_2	E_3	E_4	Total
1. Cultivation	32	1164	826	10	2032
2. Forest	832	4304	31786	1170	38092
3. Blank	3012	8361	31980	1880	45233
4. Rocky	-	-	-	-	12918
5. Snowbound	-	-	-	-	18825
Total	-	-	-	-	117100

Thus the area under E_3 and E_4 is about 57.8% of total area of the project.

4.3.1 Extent of Landslides

Occurrence of landslides is found maximum in Sainj Khad valley followed by Tirthan Khad valley mainly due to toe cutting of banks by Sainj Khad and Tirthan Khad rivers. As many as 28 landslides were found between Shakti and Maror in a stretch of 5 kms. There was heavy rainfall in the end of August and beginning of September 1995. During the short span of 10 days between 27th August and 5th September rainfall of 132.5 mm was recorded. Thus heavy rainfall in the catchment of Sainj Khad and Tirthan Khad swelled the waters of these rivers resulting in bank cutting. Abetted by seepage of water to saturation and with base already cut by turbulent rivers there were numerous land slides. The stream near Lapah also caused havoc causing landslides and washing down the bridge at Lapah. There were numerous landslides around Rolla and also from Maror to Kutla. Though occurrence of landslides is spread over large area in the project but their concentration was maximum in Sainj and Tirthan valleys. It is estimated that about 200 landslides exist in the project area and at least 50 landslides need immediate treatment for stabilization to overcome disruption of path and communication by these landslides. It was noticed that bridle path between Shakti and Maror had been completely washed down by landslides making movement of human beings and livestock impossible. Even essential commodities could not reach Maror due to landslides.

4.3.2 Extent of sheet and rill erosion

Large number of cultivation fields in almost all villages excepting paddy fields in bottom of valleys have undesirable slopes and improper terracing. Sheet and rill erosion is rampant in such cultivation fields. Out of about 2044 ha. area of cultivation fields, at least 400 ha. needs

to be properly levelled and bench terraced. The photograph of sloping cultivation fields in a village in Jiwanal valley is given in **Plate No.A** which gives a fair idea of gravity of erosion in sloping fields in the project area.

4.3.3 Extent of Gully and Nala erosion

Gully and Nala erosion is maximum in Ecodevelopment area. Gully and nala erosion is affecting cultivation fields, habitation, Ghasnies etc. and it needs to be controlled by undertaking effective measures.

4.3.4 Extent of Bankcutting by streams and rivers

Sainj Khad, Tirthan Khad, Jiwanal and Parbati rivers and about a dozen other smaller streams are cutting their banks. The toe cutting of banks by Sainj Khad and Tirthan Khad is alarming as it has resulted in numerous landslides on the banksides.

4.3.5 Extent of Glacial erosion

Glacial erosion is widespread in the snow bound region of the GHNP. But due to its inaccessibility and adverse natural conditions nothing can be done to remedy this natural phenomenon.

CHAPTER - 5

PREPARATION OF MAPS OF SOIL, WATER AND LANDUSE FEATURES

5.1 For preparation of concerned maps, existing information with various agencies e.g. Survey of India, Forest Survey of India, H.P. Agriculture University etc. were used, followed by field checks and necessary rectification.

5.2 The project area is covered in Survey of India topographical maps in the scale of 1:50,000 in the following 6 sheets:

Sheet No. 53 E/5, 53 E/6, 53 E/9, 53 E/10, 53 E/13 and 53 E/14.

These toposheets formed the “Base Map” for this project.

5.3 The boundaries of the area comprising the project area i.e. boundaries of Great Himalayan National Park, Sainj Sanctuary, Tirthan Sanctuary and Ecodevelopment area were delineated in the base map.

5.4 There are following four distinct subwatersheds (SWSs) comprising of 4 rivers in the project area which drain the water of these catchments:

1) Jiwanal SWS
2) Sainj Khad SWS
3) Tirthan Khad SWS
4) Parbati Nadi SWS

These 4 SWSs have been delineated on the base map.

5.5 The drainage pattern comprising of all rivers and streams in the project area has been shown on the map with the help of toposheets.

5.6 As regards preparation of soil map, no detailed survey and mapping of soil in the project area has been done by any agency so far. However, a general soil map of H.P. state including project area has been prepared by H.P. Agricultural University, Palampur which has been appended in the project report.

5.7 Landuse maps prepared by Forest Survey of India (Ministry of Environment & Forests) with the help of vertical Aerial photographs were also obtained.

5.8 With the help of toposheets, altitudinal, slope percentage wise and erosion class wise zonations were also depicted in the maps so prepared and area under each zonation was calculated.

5.9 The following maps were finally prepared with the help of GIS

a) Map of Great Himalayan National Park (HP) with its Ecodevelopment area, Tirthan and Sainj Sanctuaries.

b) Map of Project Area showing sub water sheds and different area categories

c) Map of Project Area showing landuse pattern.

d) Map of Project Area showing drainage pattern.

e) Map of eco-development area showing location of villages.

f) Soil map of H.P. showing soil types of project area.

Note: Please see these maps in following pages.

CHAPTER - 6

PROJECT ACTIVITIES

6.1 For soil conservation and for stabilizing the landslides in the project area, following measures are suggested

i) Indirect or Preventive measures
ii) Direct or Remedial measures

6.2 Indirect or preventive measures

It is always better to undertake preventive measures to mitigate the factors that ultimately lead to soil erosion and such preventive measures will indirectly help to conserve soil in the long run, keeping in view that it is important to integrate eco restoration strategy with socio economic needs of the local community where in both ecology and economics are developed.

Following indirect or preventive measures are suggested:

1) Change of landuse through Horticulture development
2) Livestock development
3) Farm Forestry
4) Afforestation with Fuelwood and Fodder species
5) Silvi pastoral development
6) Energy conservation and non conventional energy

6.3 Change of landuse through horticulture development:

Agriculture is being practised in the project area mostly in sloping fields. The cultivation fields have not been properly levelled or bench terraced. Such sloping fields are highly prone to soil erosion particularly to sheet, rill and gully erosion. As ploughing and tilling of these sloping fields aggravates the soil erosion hence such fields need either change of landuse from agriculture to horticulture or these should be levelled properly. Horticulture development programme will include following activities:

6.3.1 Establishment of new orchards

The project will motivate villagers to change the existing landuse and in lieu plant orchards. Villagers should be provided financial and technical help to achieve the goal. About 200 ha. of

sloping cultivation fields are proposed to be put from agriculture to horticulture. This will not only increase the income of cultivators but will also conserve the soil and put halt to soil loss due to agricultural practices. Inputs like planting stock of good varieties of fruit plants, fertiliser and pesticides and subsidy for digging pits etc. will be provided to villagers as an incentive to go for this change in landuse.

6.3.2 Rejuvenation of existing orchards

Under this programme the existing old and deteriorating orchards will be improved by pruning, using chaubatia paste, thawla making, spraying pesticides, using fertilisers and thus new life will be injected into existing orchards.

6.3.3 Distribution of improved horticultural tools

Under this programme beneficiary orchardists are provided improved horticultural tools such as grafting knife, pruning knife, secateurs, hand saw, spray machine etc. so that orchardists can themselves maintain their orchards properly.

6.4 Livestock Development

Large population of domestic animals puts heavy strain on the fragile ecosystem. Local cattle are smaller in size and their milk yield is low. People keep large number of cattle for milk production and for cow dung which is the main source of organic matter for the fields. The cattle is often let free for grazing in the project area. The project area has also to support large number of sheep and goats to the detriment of the project area. Villagers rear sheep and goats for wool and meat which fetches them cash returns. They take large flocks of sheep and goats to high altitude alpine pastures/thatches inside the GHNP during summer and rainy season for almost 5 to 6 months. A summary of live stock population in the project area is given below which gives a fair idea of their enormity:

Sheep and goats	=	20,384
Cow/oxes	=	6,935
Ponies	=	48
Total	=	27367

Thus unrestricted grazing results in denudation of hill slopes and even wastage of cow-dung. Therefore, to achieve the objective of ecological rehabilitation, a rational programme of live stock management should be taken up on a large scale which could aim at reducing number

of unproductive live stock and introduce better breeds of cows and sheep and thus reduce grazing pressure in the project area, encourage stall feeding and also enhance milk and wool production in the process.

The animal husbandry programme of the project includes following components:

6.4.1 Upgrading breed of livestock

In order to improve the breed of existing livestock Natural Breeding Centres (N.B.Cs.) should be established in the project area particularly in the villages of ecodevelopment area with one bull of Jersey-Sindhi crossbreed and four Merino rams in each centre. The facility will be provided on Darinda pattern under which bulls and rams will be given to selected villagers for their maintenance and upkeep, who will be paid wages. Necessary feed and concentrates for these animals will be provided by the project. After the elapse of the project period payment of wages can be stopped and Darinda will be allowed to charge specified fees for every service done by the animals. On the basis of experience gained in World Bank Watershed projects, no Artificial Insemination (A.I.) programme is suggested as it has been found that A.I. staff is difficult to be contacted by villagers in the hills in time so as to reach within short duration the animals are in heat and difficulty in preserving frozen semen. N.B.Cs. are considered more certain and dependable method than A.I. in hills for improving the breed of cattle. It is proposed to establish one NBC for every 4 or 5 villages. Thus in all about 20 NBCs are proposed to be established in this project.

Upgrading breed of cattle will not only increase milk or wool production but will reduce scrub animals conversely.

It will be interesting to mention at this juncture that one progressive villager in the project area has improved breed of cows and has flourishing sale of dairy products but he ensures sale of his young bulls only, after castration so that no cross breeding is available to other villagers. It is therefore of utmost importance for the Project to take upon itself to make available improved bulls and rams for upgrading breed of live stock of villagers.

6.4.2 Castration of scrub bulls

This activity is essential to stop proliferation of scrub and unwanted bulls and rams. Incentive should be given to the owners of such castrated bulls and rams.

6.4.3 Distribution of fodder minikits

Fodder seed pkts of clovers, Barseem, Chari, Barley etc. will be distributed free of cost for raising green fodder in farmers own land and thus encourage stall feeding.

6.4.4 Supply of Feed Troughs (tubs) and chaff cutters

In order to encourage proper use of fodder, feed troughs and chaff cutters will be distributed.

6.4.5 Silage making

If green fodder is stored without proper drying, it rots and oxygenation causes formation of Beuteric acid which is unpalatable to cattle. However, if green fodder is stored in air and water tight pits or other devices, then in the absence of oxygen lactic acid is formed which doesn't allow rotting of fodder and such a fodder is relished by cattle. To preserve the fodder by this method, such a fodder is used (i) which is left by cattle due to being hard though it is eatable (ii) which does not loose nutrients on slight drying and (iii) which is digestible

For making silage the green fodder is dried in light shade so that it wilts. Thereafter it is cut by chaff cutter. One quintal of this fodder is mixed with 2-3 kg. of sheera, 5-7 kg of coarse grain pieces and 400 gms of sodium metabisulphate. This mixture is pressed and stored in closed tanks. These tanks are covered with lid and made air tight with mud paste. After 2 - 3 months such a fodder inside the tank becomes "silage" which is not only delicious but can also be safely stored for 12 - 18 months. Silage is like tasteful pickles for the cattle.

One cu.m. of silo or tank contains silage which is equivalent to 4 quintal of dry fodder weight whereas same capacity silo will contain only 70 kg. dry hay.

Project will give financial and technical help to construct pucca silage tanks with removable R.C.C. lids. However, it is important that at a time at least 7 to 10 cm silage fodder is taken out so that remaining silage doesn't deteriorate soon.

6.4.6 Calf rallies and cattle shows

In order to motivate to improve breed of livestock, calf rallies and cattle shows will be held and prizes will be distributed to owners of best breeds.

6.4.7 Supply of modern handlooms

Large number of sheep in the project area yields large quantities of wool but villagers have crude handlooms for weaving. Modern handlooms will be distributed as a motivation to upgrade A.H. and allied activities.

6.5 Farm Forestry

Farm forestry is an important aspect of forestry programme provided villagers can be motivated to adopt it in right earnest. It yields higher direct individual benefit to farmers and requires low out lay than other plantation models. The project will bear only cost of raising the seedlings. With the aim of providing farmers with better access to seedlings and advice, project should provide for more decentralised network of small nurseries. Taking into consideration the problems of cultivation and suitability of site, 500 ha. of marginal farm lands, field bunds and terrace risers have been targeted for farm forestry. Twenty five plants will make one ha. of Farm Forestry plantation. The seedlings of fodder and fuelwood species will be supplied free of cost to villagers who will themselves plant them in their fields.

6.6 Afforestation

In the hills trees and vegetal cover have an important role for the conservation of soil and ecology. Due to increase in demand of fuelwood, fodder and grazing, the pressure on vegetation in the project area particularly in the Ecodevelopment area has increased many fold. Large chunks of blank area devoid of trees totalling about 4359 ha. exist in the Ecodevelopment area. The loss of vegetation has resulted in degradation of ecosystem, sedimentation of rivers, threat of siltation of dams and reservoirs under construction and reduction in availability of fuelwood and fodder.

In ecodevelopment area where most of the human and livestock population of the project area resides it is very essential to create more resources for fuelwood and fodder to check further degradation of the area. Such a step is bound to go a longway to provide vegetal cover to barren slopes to check erosion and cater increasing demand of fuelwood and fodder.

6.6.1 The project envisage afforestation work in following model of planation

Plantation in blanks - 1600 plants per ha. and vegetative hedge in contour trenches.

Fuelwood species will be planted mixed with fodder species. As there is great pressure of grazing, so instead of raising fuelwood and fodder plantations separately, for success of plantation it is essential to raise mixed plantation of fuelwood and fodder. Each plantation should have at least 20 - 30% of fodder species and 40 - 50% fuelwood species including few timber species.

The type of area proposed to be planted in Ecodevelopment area comes under the category of undemarcated Protected Forest or III class forests. This category of forests contains large

chunks of barren grassy slopes and are generally devoid of trees. These areas are honey-combed by private cultivation. The “Nautor” (land granted for fresh cultivation) has made these areas most sufferers because no policy has been followed in deciding the location of the nautors by the revenue dept. Nautors have been granted anywhere or everywhere according to convenience of the grantee.

Consent of Gram Sabha and cooperation of people shall be taken for planting these areas as cooperation of people is essential for the success of plantations.

In World Bank funded watershed projects, World Bank had been insisting on soil working and planting along contours. Contour planting conserves soil and enhances moisture regime and adverse effect of surface run off of rain water is reduced considerably. Trenches, pits and plants along contour reduce velocity of water, increase moisture and seepage of water in soil and reduce soil loss resulting in better growth of plants. Hence soil working and planting along contours should be strictly followed in the project.

In afforestation areas for digging trenches and pits along contour it is necessary to first align contour lines with the help of contour template. A contour template is a wooden frame with a spirit level fitted at the centre of the frame (fig. 1). Trenches should be dug along the contour lines aligned with the help of contour template and limestone powder (fig.1 to 4). Generally, 20 or 30m long contour trenches can be dug leaving a space of 50 cms (septa) between two consecutive trenches [fig. 5(a) and 5(b]. Upper and lower contour trenches should be staggered so that septa left to break the contour trenches should not be below upper septa. Soil is dug along contour lines marked on ground by lime-stone powder. The dug up soil is collected on lower side of the trench and after removing pebbles and weeds, the trench is half refilled with soil and remaining soil is collected to
form berm on lower side of trench (fig.6). On the berm, seed sowing of shrubs or hedges like Dodonea, Duranta etc. should be done to raise vegetative barrier. The size of trench should be 30cm x 20cm. The contour trenches can be at an interval of 5m.

For digging 1600 pits per ha. pits are dug 15 cm uphill side from the contour trenches. The spacing of pits along contour trench should not be closer than 1.25m.

In afforestation areas soil working should be started in October-November and completed by March. It is important that filling of pits and half filling of trenches should not be left to be done along with planting during rains otherwise dug soil will be washed down by rains leaving only stones and pebbles near the pit. Extreme care should be taken in transporting plants to avoid any damage. Planting should be done and completed well in time during rains and few species which get leafless in winter can be planted during winter rains.

6.6.2 Raising Vegetative barrier along contour

Seeds of hedge like Dodonea, Duranta, spirea etc. should be shown in contour trenches before onset of monsoon. With a view to conserve soil and water it is very important to raise the vegetative barrier of hedge plants. When the water of surface run off reaches the line of hedges its speed is checked and silt is stopped and only percolated water passes down slowly. In the silt left behind, hedge spreads to grow and thus making a natural terrace. The plants planted in the pits near contour trenches get more moisture and grow fast. Raising vegetative barrier of hedges have been found very useful not only for soil and water conservation but also for fuelwood production.

6.6.3 Choice of Species

Species for planting should be selected after considering altitude, aspect, biotic pressure, soil depth, moisture etc. As there is great pressure of cattle grazing hence in plantations, non-fodder fuelwood species should be planted in suitable proportion in between fodder species.

Species for planting can be divided in 3 groups:

Group 1 - Fodder species:
Kharik (*Celtis australis*)
Bhimal (*Grewia elastica*)
Robinia pseudoacacia
Subabul (*Leucena leucocephela*)
Shehtut (*Morus serrata*)
Ficus species, Bamboo, Oak, Himalayan Poplar (*Populus ciliata*)
Siras (*Albizzia stipulata*)

Group 2 - Fuelwood species:
Acacia mollissima, Jungle Jalebi (*Pithecolobium dulci*), Rhus parviflora, Alder (*Alnus nepalensis*), Robinia pseudoacacia, Silver oak, Darli (*Cedrella serrata*), Anga (*Fraxinus micrantha*), Chillu (*Prunus armeniaca*), Walnut (*Junglans regia*), Pangar (*Aesculus indica*), Willow (*Sallix* spp.)

Group 3 - Conifers:
Deodar (*Cedrus deodara*), Kail (*Pinus wallichiana*) Cedar (*Cupressus torulosa*).

(1) Species of group 1 - Fodder species should be planted 20-30% mixed with species of other groups.

(2) Species of group 2 - Fuelwood and timber species should be planted 40-50% with species of other 2 groups.

(3) Species of group 3 - About 20-30% conifers should be planted with species of other 2 groups.

6.6.4 Fencing

Stone wall of 120cms height and 45cm width or 4 strand barbed wire fencing should be erected during first year along with soil working. Cooperation of local villagers is most essential for the success of all plantations. Plantation watcher should be local and a plantation protection committee should be formed to ensure protection for long period.

6.6.5 Beating up

Due to longer spells of draught, refractory sites or adverse natural conditions, some mortality of plants is bound to occur requiring beating of dead plants during second year and third year. Normally 20% beating up in second year and 10% beating up in third year may be required but beating up should be done as actually required. In southern slopes where moisture stress is more the requirement of replacement of mortality may be more than in northern aspects.

6.6.6 Weeding and mulching

Weeding including hoeing and thawlabandi should be done during October-November. Weeding and loosening of soil by hoeing breaks the capillary action in soil and thus reduces the moisture loss. Mulching is also necessary to conserve moisture. In mulching the cut and uprooted weeds and grasses are spread in the thawla around the plant. Mulching reduces evaporation of moisture and adds humus to soil. Mulching is done alongwith weeding.

6.6.7 Plantation Chaukidar and Protection from Fire

Protection of plantation is greatest challenge in hills as villagers and their cattle damage the plantations before it is established. Hence protection of plantation is of paramount importance and chaukidar should be engaged from closest village for 2 to 3 years to protect the plantations. He should also be made to beat up damaged plants. Chowkidar should stay in plantation area during day in the hut made for him. Most of the plantations are damaged by fire during summer so great care should be taken in protecting them from fire.

6.6.8 Fuelwood Production

Habitation mainly exists in the Ecodevelopment area of the project. There are about 1338 families in this area. It is estimated (By the World Bank) that the annual fuelwood requirement is 3.6 tonnes of fuelwood per family. At this rate the requirement in the Ecodevelopment area is of the order of 4817 tonnes of fuelwood per year. As against this the annual production of fuelwood from the area is estimated to be about 20000 tonnes as shown in table 6.1 below:

Table 6.1 : Existing fuelwood production in the Ecodevelopment area

Sl No.	Type of land	Area in ha.	Production per ha. (MT)	Total Production per year (MT)
1.	Cultivation	2004	0.5 (Agricultural and Horticultural waste)	1002
2.	Waste land (Blank)	4359	-	-
3.	Forests	19037	1.0 (Fuelwood)	19037
4.	Snowbound	100	-	-
	Total	25500	-	20039

Thus this area is fairly self sufficient in fuelwood. However, the fuelwood resources (forests) are far flung whereas areas near the villages are barren. So to augment dwindling forest due to increasing population and to bring fuelwood resources nearer to villages fuelwood and fodder plantations should be raised. Also to prevent soil erosion it is direly needed.

6.6.9 Fodder Production

The Ecodevelopment area has 11808 cattle units as detailed in table 6.2 below:

Table 6.2 : Cattle units in Ecodevelopment area

S. No.	Animal	Cattle Unit factor	Population in Ecodevelopment area	Total cattle units
1.	Cow and Ox	1.0	6757	6757
2.	Sheep and Goats	0.25	19916	4979
3.	Ponies	1.5	48	72
	Total	-	26721	11808

A cattle unit needs 2.35 M.T. of dry fodder annually apart from leaf fodder which is required 50% of dry fodder (World Bank - Machhlad Project U.P.). The Ecodevelopment area has 11808 cattle units. At the above rate the Ecodevelopment area requires 27748 M.T. of dry fodder and 13874 M.T. of leaf fodder every year. The estimated fodder production from existing landuse in the Ecodevelopment area is given in table 6.3 below:

Table 6.3 : Existing Fodder Production in the Ecodevelopment Area

Sl. No.	Present landuse	Area in ha.	Annual yield per ha. (M.T.) Grass/ dry fodder	Leaf fodder	Total Annual yield Grass/ dry fodder	Leaf fodder
1.	Cultivation	2004	2.2	0.5	4408	1002
2.	Wasteland (blank)	4359	2.0	-	8718	-
3.	Forests	19037	2.0	0.5	38074	9518
4.	Snowbound	100	-	-	-	-
	Total	25500	-	-	51200	10520

Thus area (including far flung areas) is self sufficient in dry fodder but deficit in leaf fodder. For meeting the green fodder demand, fodder species will be planted in plantations and in silvi pastoral area. To enhance quality and yield of grasses and fodder, Silvi-pastoral development will be taken up near the villages.

Following areas are proposed to be planted during the project period in the Ecodevelopment area:

Table 6.4 : Area proposed for plantations in Ecodevelopment area

Type of area	Area in ha.	Area proposed for plantations in ha.	
Cultivation	2004	(i) Farm Forestry (ii) Raising Orchard	500 200
Wasteland (Blanks)	4359	(i) Plantation of fuelwood and fodder species (ii) Silvi pastoral development	700 200
Forest	19037	-	-
Snowbound	100	-	-
	25500	-	1600

Instead of prescribing fuelwood and fodder plantations separately for the success of plantations, it is advisable to raise mixed plantations of fuelwood and fodder. Each plantation should have at least 20-30% of fodder species and 40-50% of fuelwood and timber species.

6.7 Silvi Pastoral Development

It is proposed to undertake silvi pastoral development work in Ecodevelopment area.

In Silvi pastoral development programme 400 plants per ha. of fodder tree species and nutritious grasses and legumes will be raised besides fertilising these areas with chemical fertilisers. This activity will be taken up in blank slopes and "Ghasnies" near the villages in Ecodevelopment area with the aim of enhancing quality and yield of fodder. Pits 45cm x 45cm x 45cm will be dug at a spacing of 5m x 5m (400 pits per ha.). In pits nursery raised plants of leguminous fodder tree species @ 400 plants per ha. will be planted.

An ideal pasture has a mixture of legumes and grasses. Since legumes abound in protein and grasses abound in carbohydrates so such a mixture forms the most nutritious fodder for cattle. To enhance the yield of local grasses in the area; DAP and urea should be broadcast during rainy season. Fertiliser application has been found to enhance the existing grass yield many times which villagers can cut when grass ripens in October and store it for stall feeding during winter.

Seeds of nutritious grasses and legumes can also be introduced in these areas. Legumes are very important for pastures. Besides their nutritious value legumes have nitrogen fixing root nodules which fix atmospheric Nitrogen and release it to the soil and enhance its fertility. Though there is no exact data available for temperate legumes but as a piece of information it may be mentioned that subtropical legume Siratro (*Macroptilium artopurpureum*) fixes a good amount of Nitrogen about 55 to 138 kg. N/ha/year (Kretschmer - 1966) which amounts to 120 kg to 300 kg of urea (urea has 46% N). So it shows how important the role of legumes is in improving soil fertility. However, only perennial legumes and not annual legumes should be raised.

Seeds of grasses and legumes can be broadcast in the Silvi pastoral area but the problem is how seed should penetrate the soil as soil working is bound to be costly. At best it can be shown in 1/2Mx1/2M or 1Mx1M patches scattered in the area. These patches can be hoed with Kutla after seed sowing so that seed is covered with soil due to hoeing. The optimum time for sowing grass and legume seeds is early spring or late autumn. Seeds should not be put below 5 mm depth.

Hill soils are specifically deficient in phosphates and Nitrogen deficiency in general to lesser extent. It is suggested that 50 kg. per ha. of DAP for phosphate and 100 kg per ha. of Urea for

Nitrogen should be broadcast in the Sivli pastoral development areas in the Ecodevelopment area during rainy season. Urea should be broadcast twice during rainy season @ 50 kg. each time per ha. at an interval of 2 to 3 weeks.

Following are some of the important legumes and grasses:

Grasses

1. Cocks foot (*Dactyles glomerata*)
2. Perennial Rye grass (*Lolium perenne*)
3. Tall Fescue (*Festuca arundinacea*)
4. Brome grass (*Bromus inermis*)
5. Georgia selection
6. Timothy (*Phleum pratense*)
7. Poa grass

Legumes

1. White clover (*Trifolium repens*)
2. Red clover (*Trifolium pratense*)
3. Lucerene (*Medicago sativa*)
4. Vetch (*Vicia villosa*)
5. Sainfoin (*Onobrychis viciaefolia*)
6. Caucasian clover (*Trifolum ambiguum*)

6.8 Energy conservation and non conventional energy

In the villages of the project area the main source of energy is fuelwood which is the main cause of ecological degradation. Women folk have to walk several kms. to collect fuelwood for cooking. Hence energy conservation and installation of non conventional sources of energy is of paramount importance for conserving the environment. Under this programme following components have been provided:

a) Installation of Biogas plants

Biogas plant is hundred percent substitute for fuelwood. In valleys and in low altitude villages, biogas plants can work satisfactorily if not for whole year at least for 9 months excepting cold winter months. Still it is worth it. Biogas plants also help in ameliorating hygienic conditions and prevent eye ailments to village women which are generally caused by wooden smoke. Installation of “Pragati” model of Biogas plant of KVIC (Khadi and Village Industries Corporation) through KVIC trained workers have been found very successful. KVIC provides subsidy which

amounts to about one third of the cost of the plant. Facility of subsidy should be availed and balance cost will be borne by the project.

b) Distribution of wood stoves

Priyagini Agethi saves fuelwood and even small pieces of wood and stems of the agricultural crop like “Tor” can also be used in the wood stove.

c) Distribution of Kerosene oil stoves

It is good substitute for fuelwood and can be distributed amongst villagers.

d) Distribution of Pressure Cookers

It will economise energy consumption.

e) Solar Cookers

Solar cookers utilise sun rays - one of the abundant source of pollution free natural energy. Barring cloudy days in rainy season, it can be used in sunny days to cook and thereby save fuelwood.

f) Installation of smokeless chulhas

Smokeless chulhas not only economise fuelwood consumption but also help in keeping the house clean i.e. free from smoke and also help in preventing eye ailment due to smoke.

g) Biomass production

Villagers should be encouraged to raise “Tor” etc. as its stem can be used as fuelwood in wood-stoves. Besides it is a good pulse crop. Maize stems can also be used as fuelwood in wood stove.

6.9 Direct or Remedial Measures

To check soil erosion following direct or remedial measures are suggested:

(i) Gully plugging and nala control by checkdams (vegetative, stone and cratewire or wiremesh checkdams)

(ii) Diversion drains

(iii) Levelling/Bench terracing of sloping cultivation fields.

(iv) Landslide stabilization

a) Streambank protection against toe cutting.

b) Stabilization of land slipped slopes.

6.10 Gully plugging and nala control

In control of gullies and nalas the erosive velocities are reduced by flattening out the steep gradient of the gully by constructing a series of checks which transform the longitudinal gradient into a series of steps with low risers and long flat treads. This will involve construction of checkdams (vegetative, stone and cratewire or wiremesh checkdams). Spur walls and retaining walls can also be constructed for bank protection to save valuable agricultural fields from being cut up. Mechanical measures (checkdams) will be supplemented by planting in gullies behind checkdams.

As all gully or nala control work should start from the top, so this activity will cover both non-arable and arable land.

Stabilization of gullies through vegetation is difficult task as gullies have to be used for conveying run off during the time vegetative measures are undertaken and these measures get damaged by run off. So mechanical measures have to be adopted to prevent washing away of vegetative measures by large volume of run off. Vegetation once established will be able to take care of gully. Thus mechanical measures, temporary or permanent are necessary in gully control to be supplemented by vegetative measures since mechanical measures weaken and vegetative measures strengthen with passage of time.

In mechanical measures following types of checkdams are suggested:

a) Brushwood checkdams

The main requirement of temporary control structures is that they must be quick and easy to construct and use cheap readily available materials. In brushwood checkdams as shown in fig. 7 small branches preferably of coppiceable species are fixed in two parallel rows across the gully or nala and packed with brushwood between the rows of these vertical stakes. The vertical stakes can be tied down with wires or fastened with sticks across the top. The important point in erecting brushwood checkdams is to pack the brushwood as tightly as possible and to secure it firmly. Brushwood checkdams are generally meant for small gullies or at the starting stretch of gullies.

b) Stone checkdams

For constructing R.R. dry stone checkdams, the site where it is to be constructed is cleared and the sides are sloped 1:1. The bed of gully is excavated for foundation to a uniform depth of 0.45 m to 0.60 m and dry stones are packed from that level as shown in fig.8. Over the foundation, R.R. dry stone masonry super structure of check dam can be constructed. The stones can be dressed and properly set in with wedges and chips. The width of checkdam at the base should be approximately equal to maximum height and successive courses are narrower so the section is roughly a trapezium. It is common to find upstream face of checkdams vertical with all slopes on the down steam face but while there is sound engineering reason for this in case of large dams but it is not of any consequence in small gully control dams. In the Centre of the dam portion sufficient waterway is allowed to discharge the maximum run off. The dry stone work should go upto 0.30m to 0.60m in the stable portion of the gully side to prevent end-cutting. Sufficient apron should be provided to prevent scouring of the structure. The thickness of the apron packing should be about 0.45m and gully sides above the apron have to be protected with packing to a height of at least 0.30m above the anticipated maximum water level to prevent side scour being formed by the falling water.

c) Cratewire or wiremesh checkdams

When a dry stone checkdam is held down with woven wire netting, the life and strength of the structure is enhanced many fold. The mesh of wire is generally 0.15m x 0.15m and care should be taken that stones used are larger than the mesh size so that stones can not pass through the mesh. The wirenetting is spread below the stone foundation and in the sides before stone work and after completion of stone work the wirenetting is tied, covering the masonry tightly so that the whole structure becomes one piece. The stability is secured by careful masonry work, setting and wedging. Wiremesh stone checkdams have flexibility to withstand and absorb and adjust the bending moments due to water pressure. For controlling gullies and nalas in sloppy hills wiremesh stone checkdams have proved very useful and more lasting than ordinary stone checkdams.

6.11 Diversion Drains

Diversion drains intercepts the storm water which could otherwise flow down from higher ground on to the arable land which it protects. It is the first line of defence and vital for protection systems and structures low down as it effectively controls the run off from outside the arable land and conducts it safely to natural outlet. The diversion drains should be aligned on non erosive grades. It must also be protected from silting. A narrow and deep ditch does not get silted up as rapidly as a broad and shallow ditch of the same cross sectional area and is therefore, self maintaining. The soil excavated from the diversion drain shall be deposited on lower side of the drain, leaving a berm of 0.3 M and sectioned in a trapezoidal shape with side slopes not steeper than 1:1. The out let end of the diversion drain should be taken to the existing or stabilised safe natural drainage lines or out lets e.g. nala etc. so as to conduct the run off properly without causing erosion. In order to protect the bed and sides of the diversion drain from scour and erosion, suitable spreading type of grasses should be planted.

6.12 Levelling/Bench terracing of sloping cultivation fields

Bench terracing is one of the most popular mechanical soil conservation practices adopted by farmers in India and other countries. In hills intensive farming can be only adopted with bench terracing. It consists of construction of step like fields along contours by half cutting and half filling. Original slope is converted into level fields. Thus hazards of erosion are eliminated and manure and fertiliser applied are retained in the field.

However, in the project area we find most of cultivation fields sloping and improperly terraced as shown in photograph (plate No.A). These sloping fields need to be bench terraced by cutting and filling with filling supported by retaining stone wall as shown in fig. (Fig. No..9).

Having fixed depth of cutting (d) the width of terrace (w) can be computed for a given slope percent (s) by the following formula:

$$W = \frac{200d}{s}$$ (where w and d are in meters and s in percent)

This formula is derived as under:

S = slope percent

= $\tan 0^0 \times 100$

$$\frac{d}{W/2} = \frac{}{} \times 100$$

or

$$W = \frac{200d}{s}$$

For example if cutting is to be restricted to 0.8 meter and if slope percent is 40, then width of terrace = 200 x 0.8/40

= 4 m.

But determination of vertical interval depends upon the practical experience of the area and good judgement with consideration of prevalent local practices. The important factor limiting the spacing are soil and slope. Also the width of terrace should be such as to enable convenient and economic agricultural operation. As increasing the width of terrace increases the cost of excavation and fill, therefore, narrow terraces are cheaper than wide terraces. For animal draught cultivation a minimum width of 3 or 4 meters is desirable.

For carrying out work of levelling of fields it is proposed to motivate villagers to labour for this work and the project should make part payment of cost i.e. about Rs.10,000/- per ha. to the villagers for bench terracing their sloping fields. About 400 ha. of sloping fields are proposed to be thus bench terraced at an approximate cost of Rupees 40 lakh.

6.13 Stabilization of landslides

For the stabilization of land slides following measures are suggested:

1) Stream Bank Protection against toe cutting.
2) Stabilization of landslipped slopes.

6.13.1 Steam Bank Protection

One of the main reasons for the frequent occurrence of land slides in the project area is toe cutting by streams and rivers, particularly by Sainj Khad and Tirthan Khad. In order to confine the flow and protect the bank the construction of spurwalls/Retards is desirable to deflect water of torrents from toe cutting of banks particularly at the curves. As a matter of fact R.C.C. block spur walls should have been constructed but magnitude of work and cost involved desist from suggesting large scale work. However, wherever landslides have caused destruction of bridle paths which form the life line for the project area e.g. path to Maror or Rolla side it is suggested that wire mesh boulder or stone spurwalls be constructed. As there is no dearth of boulders or stones it is high time to make a beginning in this direction instead of facing wrath of landslides causing disruption of communication and paralysing normal life year after year. It is therefore, suggested that about 50 wiremesh-spurwalls be constructed to protect the banks of streams on the bank side the bridle path lies.

A method for locating the spurwalls or retards is shown in fig.10. The first major retard at A is located by the intersection of the projected centre line of flow with the concave bank. In locating the second major retard C, a line HB is drawn parallel to the above projected centre-line and through the end of retard A. The intersection of this line with the concave bank locates point B. AC is then made equal to twice AB. Additional retards are located by intersection of a line connecting end points of two previous retards with the concave bank (see D). An auxiliary retard at K is located a distance AB upstream from A and is extended into the stream about one half the length of other retards.

The retard or spurwalls should extend into the stream at an angle of 45^0 for a distance of about 30 percent of the channel width. On small streams the spacing of retards may be made equal to stream width and length 0.25 times the spacing.

In the silt setting between parallel lines of spurwalls, species which grow well near stream beds should be planted e.g. Salix, Populas ciliata, Ipomea carnea, Vitex nigundo, Alnus nepalensis and local grasses etc.

6.13.2 It has been observed that trees uprooted and drifted by the torrent cause obstruction and deflect water to bankside causing toe cutting of bank. Any such obstruction should be immediately removed to avoid further aggregation.

6.13.3 Stabilization of landslipped slopes: Following measures are suggested for stabilization of land slipped slopes:

(i) Protective measures against biotic pressure

Four strand barbed wire fencing should be erected around the affected area to prevent cattle, sheep, goats and other animals grazing in the area.

(ii) Structural measures : Stone retaining walls along contour should be constructed to with-hold and help in stabilizing the land slip.

(iii) Vegetative measures : Slip area should be planted and well covered with quick establishing species of trees and shrubs e.g. Alnus nepalensis (a coloniser), Populas ciliata, Salix, Agave, Wendlandia, Vitex, Ipomea etc.

(iv) Covering with netting : Wherever possible land slipped slopes should be provided with cover of wire netting, rope netting or sack (coarse Jute fabric) etc. including wattling and mulching. Several types of netting can be used woven with wire, Jute yarns or cannabis ropes etc. To use these nettings, slopes should be smoothened, seeded and fertilised and layer of mulch is spread and the netting unrolled over the mulch and anchored by wire staples.

(v) Diversion channel : Diversion channel well above the landslide can check rain water coming to fragile site and divert it to safe natural course nearby.

Due to constraint of funds it will not be possible to undertake treatment of all landslides. However, landslides directly damaging the bridle paths should be taken up in right earnest. It is estimated that about 50 landslides will need to be treated on priority basis in the interest of maintaining communication lines besides checking further degradation by these highly eroding sites.

6.14 Miscellaneous regulatory measures

Following regulatory measures are suggested which will help in exercising stricter control in the Park and thus help in overall protection of ecosystem in the area:

(i) There are no controlling check points to regulate the entry of visitors to the GHNP. These check points can be at the following places:

a) Kharongcha in Tirthan SWS

b) Shagor in Sainj SWS

c) Majharna in Jiwanal SWS

d) Bakar Bihar in Parbati SWS

Passes should be issued at these check points for entering the park by visitors. No firearms or fishing rods should be allowed inside the park and visitors should be made to deposit any firearms or rods at these check points.

(ii) Patrolling parties should be formed in each Range to patrol the areas of Park and Sanctuaries. A programme should be drawn in advance for the ensuing month with dates, places of night halt and patrolling routes of their itinerary. The programme should be kept confidential. The patrolling should be closely monitored with surprise checks by A.C.Fs. and Project Director. Patrol parties can comprise of B.Os., Forest Guards and Watchers (Porters) in the Range. Hitherto there is no patrolling schedule and no regulatory restrictions are noticeable inside the park.

(iii) To check poaching, informers should be engaged confidentially without making their identity public and they should be handsomely rewarded for any reliable information leading to apprehending of poachers. Retention money also be paid to them. Informers will be extremely helpful in apprehending poachers illegally hunting in the interior of the park. There should be patrolling of snow bound area during winter to apprehend musk deer poaching.

(iv) Tourism should be encouraged as visit of tourists to interior areas makes the staff active and awakens them from inertness. Illegal activities aggravate in the forlorn area. Any illegal activity whether poaching or extraction of medicinal plants etc. can be better controlled when staff has the interest to visit the area on some activity. Tourist spots with tourist huts and catering facility can be developed at Mantalai, Maror, Shangarh,

Rolla etc. Lesson can be learnt from Corbett National Park where visitors presence in the core area i.e. at Dhikala is helpful in many respects for protection.

(v) *Control of timber demand*: Villagers have rights to get trees allotted for bonafide house construction. There are always chances of misuse of rights timber being sold and illicitly exported. It is essential to control T.Ds. to save forests. T.Ds. should be sanctioned after thorough enquiry for bonafide house construction. After timber is extracted further enquiry should be held to verify its actual use. Action should be taken against defaulters who have misused the timber.

(vi) *Rotational grazing and rotational extraction of medicinal plants :* About 35000 to 40000 sheep and goats migrate to GHNP for summer grazing which is a most important irritant in eco-restoration in the Park. Rotational grazing should be exercised in the Park on alternate year basis, so that every thatch gets rest from grazing on alternate years. Similarly extraction of medicinal plants on rotational basis will give area rest and full seeding opportunity on alternate years.

6.15 Public Participation

Stimulating and getting people's participation in micro planning, implementation, benefit sharing and post project management of assets would be integral part of the project approach and policy. A sum of Rs.5.00 Lakh has been earmarked for this purpose.

Though the project specifies the activities and their physical goals but micro level planning exercise should be undertaken based on Participatory Rural Appraisal (PRA) technique and villagers should be fully involved and interacted with to select sites, locations and beneficiaries (whether for individual, groups or community) of the project activities. Village women play important role in farming systems, rearing livestock, fuelwood and fodder collection, agricultural operations etc. besides house keeping, cooking and numerous house hold chores. Public participation is incomplete without women's participation. Even one or two women motivators on monthly wages basis can be engaged in each range for motivation and awakening of villagers towards achieving project objective of conservation of ecology and environment. Established democratic institutions like Village Panchayats can be involved particularly in post project management of community assets like afforestation, pasture development, N.B.Cs. etc. and in regulating rotational grazing and rotational extraction of medicinal plants etc.

6.16 Monitoring and Evaluation

Monitoring and Evaluation will be developed as in built part of Project Management. Thus a process of self evaluation at specified intervals will ensure the field worthiness and efficiency of the project.

Annual work plan for each range could be prepared well in advance specifying physical and financial targets, sites, locations and beneficiaries of each component of the project activity. Monthwise work schedule of various items of each component for the financial year could also be prepared in advance and its timely implementation could be ensured. Monthly progress report on all activities could be submitted by Range Officers to Park Director and P.D. could submit it to his superior officer. The P.D. could monitor the progress regularly and his superiors could also monitor it from time to time. All project works could be regularly inspected by P.D. and his gazetted assistants as frequently as possible to ensure the quality and quantity of works done. The Park staff cuold also interact with villagers to know the impact on monitoring parameters such as changes in life styles and extraction pattern of natural resources such as reduction in the use of fuelwood, changes in grazing pressure, upgrading breed of livestock, stall feeding and other project activities.

For scientific monitoring, bench mark studies should be done at the start of project implementation and then compared with the measurement of parameters under study on completion of the project to know the impact. For example Silt Observation Posts (S.O.Ps.) can be installed in one or two streams in each range to know the impact of soil conservation measures. Technical guidance of Central Board of Soil and Water Conservation, Dehra Dun can be taken for installation of S.O.Ps. A sum of Rs.5.00 lakh has been provided for monitoring and Evaluation.

CHAPTER - 7

PROJECT ADMINISTRATION AND ESTABLISHMENT

7.1 Administration

The project will be implemented by the GHNP administration of Department of Forest Farming and Conservation (DFFC), Himachal Pradesh.

7.2 Staff

The project will be headed by Director, GHNP under the administrative control of Chief Conservator of Forests, Wildlife, H.P. with head quarter at Shamshi. However it is very essential that the post of Director, GHNP should be upgraded to the rank of Deputy Conservator of Forests with drawing and disbursing powers including Financial powers to issue sanctions. Without adequate financial powers the Director cannot be expected to implement project activities properly. The Director GHNP shall be the nucleous of project activities and he will be responsible for proper execution of project activities according to financial and physical norms and prevalent schedule of rates of the department. The existing strength of gazetted assistants (A.C.Fs) and Range staff seems adequate and no additional staff or administrative cost is being provided under this project. If found necessary in due course of time such addition may be made from departmental resources.

7.3 Ranges

The existing 3 ranges are adequate with their head quarter at Larjee, Sainj and Sai Ropa. The ranges should have areas strictly sub-watershed wise as under :-

Table No.7.1

	Range	H.Q.	Subwatershed (S.W.S.)	Area in ha.
1.	Jiwanal	Larjee	Jiwanal S.W.S. and Parbati Nadi S.W.S.	39,120
2.	Sainj	Sainj	Sainj Khad S.W.S.	43,623
3.	Tirthan	Sai Ropa	Tirthan Khad S.W.S.	34,357
		Total		1,17,100

7.3 Area of Park falling in Parbati nadi S.W.S is yet to be transferred to Park administration by D.F.O., Parbati Forest Division. As Jiwanal khad and Parbati nadi S.W.Ss are not inter-crossable so it is essential that one B.O. and two forest guards be posted with head quarter at Pulga to look after area of Park in Parbati nadi S.W.S. The Parbati nadi valley is important for trekking point of view, The trekking route from Manikaran to Pin-Parbati pass and Spiti pass is trekkers delight and this route is frequented by tourists (Indian and foreign). Guides and porters are available at Manikaran. The biotic pressure in Parbati valley area of park is no less as almost 10000 sheep graze in the area during summer and villagers camp in the thatches of this valley for extraction of medicinal plants. The Parbati S.W.S. also abounds in wildlife like Kath, Nata and Kastura. All to say that Park administration will have to pay immense heed to Parbati nadi valley too and its transfer to and administration by Park should be affected immediately.

7.4 Administrative map of the area is appended.

7.5 The institution or system of engaging the local villagers as porters/watchers on monthly wages basis has proved very beneficial to the park. These persons being local, help in procuring labour for park works, act as informer for any illegal activity, help in protection of flora and fauna of the project area, act as very good guides for trekking the project area and also help in creating public opinion favourable to park administration and park activities. This system should be continued.

CHAPTER - 8

PROJECT COST

8.1 The total estimated cost of the project during the project period of 5 years is Rs.514.79 lakh. The physical targets and estimated expenditure on various components have been given in respective Annexures. A summary of year wise expenditure is given in Annexure-I

8.2 An abstract of estimated expenditure is given in table 8.1 below:

Table 8.1 : Abstract of estimated expenditure

S.No	Activities	Cost 000Rs.	Percentage of total cost	Remark
I.	**Indirect or Preventive Measures:**			
1.	Change of landuse through Horticulture development	2,400.00	4.66	Annexure-2
2.	Livestock development	4,330.00	8.41	Annexure-3
3.	Farm Forestry	31.00	0.06	Annexure-4
4.	Afforestation with Fuelwood and fodder species	14,200.00	27.58	Annexure-5
5.	Silvi-pastoral development	1,965.00	3.82	Annexure-6
6.	Energy Conservation and non-conventional Energy	3,730.00	7.25	Annexure-7
7.	Public Participation	500.00	0.97	Annexure-9
8.	Monitoring and Evaluation	500.00	0.97	Annexure-10
	Subtotal(I)	27,656.00	53.72	
II	**Direct or Remedial Measures:**			
1.	Gully plugging and Nala control	6,760.00	13.13	Annexure-8
2.	Diversion drains	500.00	0.97	"
3.	Levelling/Bench terracing of slopping cultivation fields	4,000.00	7.77	"
4.	Stabilization of landslides: a) Steam Bank protection to check toe cutting b) Stabilization of landslipped slopes	 1,250.00 7,500.00	 2.43 14.57	 " "
	Sub-total (II)	20.010.00	38.87	
	Total (I & II)	47,666.00	92.59	
III	Contingencies 8%	3,813.00	7.41	
	Grand Total	51,479.00	100.00	

8.3 Price increase at the rate of 8% has been added to cover up the likely price escalation or inflation and unforseen expenditure under the head contingencies.

8.4 It is expected that during the period of 5 years, the objectives of the project will be fulfilled to the desired extent and expected benefits will be delivered. However, component like Afforestation will take some more years to grow and establish itself for delivering the direct and indirect benefits. It is expected that various project measures will not only help the ecological upliftment and conservation of soil in the area but will also awaken rural population to comprehend the significance of preserving environment and ecology of GHNP and its surrounding areas by exercising restraint in their acts of omissions and commissions endemical to fragile environment of the project area. This project is not an end in itself. Depending upon the result of the project activities fresh project could be prepared and executed. Soil and water conservation are long term programmes for ecological restoration.

8.5 In case in any year sufficient funds are not available, the project should take up priority works such as Afforestation and direct soil conservation measures etc. first. But works deferred in any year should be taken up in coming years.

8.6 Mid Term Review of project should be done in 3rd year and necessary changes can be made in the project on the basis of experience gained.

CHAPTER - 9

BENEFIT COST RATIO

9.1 Benefits

The project will provide two types of benefits viz. tangible benefits and non-tangible benefits. Tangible benefits can be quantified in terms of money or material e.g. production of fuelwood, fodder, fruits, dairy products etc. Non-tangible benefits are indirect benefits which could be felt and seen but can not be quantified e.g. soil and water conservation, reducing floods and siltation, controlling ecological degradation, amelioration of climate etc. The tangible benefits have been quantified in table 9.1 below:

Table 9.1 : Tangible benefits of the project

Product	Production expected due to the project activity				Rate Rs./ (M.T.)	Total value (lakhs Rs.)
	Activity	Area in ha.	Annual production per ha. (M.T.)	Total production (M.T.)		
1.Fuelwood	1.Afforestation (Plantation in blanks) 2.Farm Forestry	700 500	25 0.5	17500 250		
	Sub Total	-	-	17750	1000	177.50
2.Fodder (tree leaf)	1.Afforestation (Plantation in blanks) 2. Farm Forestry 3.Silvi pastoral development	700 500 200	5 0.1 3	3500 50 600		
	Sub Total	-	-	4150	100	4.15
3.Fodder (Grasses and Legumes)	1.Afforestation (Plantation in blanks) 2.Farm Forestry 3.Silvi pastoral development	700 500 200	0.50 - 10	350 - 2000		
	Sub Total	-	-	2350	100	2.35

4.Orchard Fruits	1.New orchard 2.Old orchard	200 200	10 5	2000 1000	6000/- 5000/-	120.00 50.00
	Sub Total	-	-	3000	-	170.00
5.Dairy Products	1.Milk 2.Ghee 3.Wool	2000 No. 2000 No. 10000 No.	0.5MT/cow 0.02/MT/cow 0.006/MT/sheep	1000 40 60	7500 75000 100000/-	75.00 30.00 60.00
	Sub Total	-	-	-	-	165.00
6.Energy Conservation	1.Biogas 2.Other Energy Saving devices	100 Nos. 4800 Nos.	Eq.to 3.6MT of fuelwood Eq.to 0.72 MT of fuelwood	360 3456	1000 1000	3.60 34.56
	Sub Total	-	-	-	-	38.16
	Total (I)					557.16

Note: Fuelwood and fodder production figures are based on EEC report on S. Bhagirathi in U.P. Phase II Watershed Project and appropriate adjustment have been made in view of the mixed plantations suggested in the project.

9.2 Though no exact quantification of Intangible benefits can be made however, an approximate estimation of value of intangible benefits can be made by taking the basis given by Ministry of Environment and Forests in its circular on forest land transfer according to which the environmental value (as regards soil conservation, Hydrological, Wild life habitat, micro climate and ecological upliftment) of one ha. fully stocked (1.0 density) forest can be taken as equivalent to Rs.2.535 lakh annually or for 0.7 density it will be Rs.1.77 lakh annually assuming success of afforestation work to be 70%. On this basis approximate value of intangible benefits can be roughly estimated as under:

Table 9.2

Activity	Effective Area in ha.	Approximate Environmental value Rs. Lakh/ha./year	Total value in lakh Rs.
1. Afforestation	700	1.77	1239.00
2. Silvi pastoral development	200	1/4th or 0.44	88.00
3. Soil Conservation Works	1200 (approx)	1/2 or 0.88	1056.00
Total (II)			2383.00
Grand Total (I & II)			2940.16

9.3 Benefit cost Ratio

$$\text{The Benefit Cost Ratio} = \frac{2940.16}{514.79}$$

$$= 5.7$$

The benefit cost ratio comes to 5.7 (more than one). Thus direct and indirect benefits of the project will go a longway to conserve soil and environment and in the process also uplift the economic condition of the rural people. Besides, the project is labour intensive and will generate employment opportunities to the local people. Thus the project is beneficial, viable and justified.

ANNEXURE - 1

Summary of project cost (000 Rs.)

Sl.No.	Project Component	Cost in 000Rs.					Total (000Rs.)
		1st Year	2nd Year	3rd Year	4th Year	5th Year	
	I.INDIRECT OR PREVENTIVE MEASURES						
1.	Horticulture development	370	480	480	535	535	2400
2.	Livestock development	671	798	878	979	1004	4330
3.	Farm Forestry	4	7	8	8	4	31
4.	Afforestation	1200	3000	3830	4210	1960	14200
5.	Silvi Pastoral development	255	415	480	535	280	1965
6.	Energy Conservation and non conventional energy	442	822	822	822	822	3730
7.	Public Participation	100	100	100	100	100	500
8.	Monitoring and Evaluation	150	200	50	50	50	500
	Sub Total (I)	3192	5822	6648	7239	4755	27656
	II DIRECT OR REMEDIAL MEASURES:						
1.	Gully Plugging and Nala control	1300	1365	1365	1365	1365	6760
2.	Diversion drains	100	100	100	100	100	500
3.	Levelling/Bench terracing of sloping cultivation fields	800	800	800	800	800	4000
4.	Stabilisation of Landslides: (a) Stream Bank Protection (Construction of spur walls to check toe cutting)	250	250	250	250	250	1250
	(b) Stabilisation of land slipped slopes	1500	1500	1500	1500	1500	7500
	Sub Total (II)	3950	4015	4015	4015	4015	20010
	Total (I & II)	7142	9837	10663	11254	8770	47666
	III Contingencies 8%	571	787	854	900	701	3813
	Grand Total	7713	10624	11517	12154	9471	51479

ANNEXURE - 2

Cost of Horticulture Development

P - Physical
F - Financial (000 Rs.)

S. No.	Activities	Unit	Unit Cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Raising of private orchards	Ha.	5000/	30	150	40	200	40	200	45	225	45	225	200	1000
2.	Rejuvenation of old orchards	Ha.	6000/-	30	180	40	240	40	240	45	270	45	270	200	1200
3.	Distribution of improved horticultural tools	Set	1000/-	40	40	40	40	40	40	40	40	40	40	200	200
	Total	-	-	-	370	-	480	-	480	-	535	-	535	-	2400

ANNEXURE - 3

Cost of Livestock Development

P - Physical
F - Financial (000 Rs.)

S. No	Activities	Unit	Unit Cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Establishment of N.B.Cs. on Darinda Pattern (one Jersey x Sindhi bull and 4 Merino rams for each centre	Centre	15000/-	5	75	5	75	5	75	5	75	-	-	20	300
2.	Maintenance of N.B.Cs. on Darinda Pattern (Attendant and feed)	Centre	20000/-	-	-	5	100	10	200	15	300	20	400	20	1000
3.	Distribution of fodder minikits	No.	80/-	200	16	200	16	200	16	200	16	200	16	1000	80
4.(a)	Castration of Scrub bulls	No.	250/-	-	-	50	12.5	50	12.5	50	12.5	50	12.5	200	50
(b)	Purchase of Burdizzo castrators	No.	2000/-	10	20	10	20	-	-	-	-	-	-	20	40
5.	Supply of chaff cutters	No.	1500/-	80	120	80	120	80	120	80	120	80	120	400	600
6.	Supply of feed troughs (tubs)	No.	400/-	100	40	100	40	100	40	100	40	100	40	500	200
7.	Supply of modern handlooms for weaving	No.	12000/-	20	240	20	240	20	240	20	240	20	240	100	1200
8.	Construction of silage tanks	No.	2000/-	80	160	80	160	80	160	80	160	80	160	400	800
9.	Farmers Motivation-calf rallies and cattle shows	LS	LS	-	-	LS	15	LS	15	LS	15	LS	15	LS	60
	Total	-	-	-	671	-	798.5	-	878.5	-	978.5	-	1003.5	-	4330
	Or say	-	-	-	671	-	798	-	878	-	979	-	1004	-	4330

ANNEXURE - 4
Cost of Farm Forestry Activity

P - Physical
F - Financial (000 Rs.)

S. No.	Activity	Unit	Unit cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Farm Forestry:														
	a) Pre-planting year	Ha.	28.00	125	3.5	125	3.5	125	3.5	125	3.5	-	-	500	14
	b) Planting year	Ha.	34.00	-	-	125	4.25	125	4.25	125	4.25	125	4.25	500	17
	Total	-	-	-	3.5	-	7.75	-	7.75	-	7.75	-	4.25	500	31
	or say				4.0	-	7.0	-	8.0	-	8.0	-	4.0	500	31

(Details of cost per ha. given in Annexure - 4.1)

ANNEXURE - 4.1

Per ha. Cost of Farm Forestry
(25 Plants per ha.)

Sl. No.	Item of Works	Unit	Unit Cost (Rs.)	Cost per ha. (Rs.) P.P.Y. I Year	P.Y. II Year	Total (Rs.)
1.	Raising of Plants	No.	1.50	28.00	9.50	37.50
2.	Transportation of Plants	No.	1.00	-	25.00	25.00
	Total	-	-	28.00	34.50	62.50
	or say	-	-	28.00	34.00	62.00

P.Y. - Planting Year
P.P.Y.- Pre Planting Year

ANNEXURE - 5
Cost of Afforestation Work)

P - Physical
F - Financial (000 Rs.)

Sl No	Activities	Unit	Unit Cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Plantation in Blanks in Ecodevelopment area –			100	1200	200	2400								
				-	-	100	600			200	2400	-	-	700	8400
	(a) Pre-Planting year	Ha	12000/-	-	-	-	-	200	2400	200	1200	200	1200	700	4200
	(b) Planting year	Ha	6000/-	-	-	-	-	200	1200	200	460	200	460	500	1150
	(c) Maintenance 3rd year	Ha	2300/-					100	230	100	150	200	300	300	450
	(d) Maintenance 4th year	Ha	1500/-					-	-						
	Total	Ha	21800/-	-	1200	-	3000	-	3830	-	4210	-	1960	700	14200

(Details of Per ha cost given in Annexure - 5.1)

ANNEXURE - 5.1

Per ha. cost of raising plantation (1600 plants per ha.) alongwith contour hedges

S.No.	Item of works	Unit	Unit Cost Rs.	Year-wise expenditure(Rs./ha.) PPY 1st Year	PY 2nd Year	Maintenance 3rd Year	4th Year	Total Rs.
1.	Survey and demarcation	Ha	35.00	35.00	-	-	-	35.00
2.	Site Clearance	Ha	35.00	35.00	-	-	-	35.00
3.	Fencing	Ha	3400.00	3400.00	-	-	-	3400.00
4.	Digging Pits (45cm cube)	No.	2.80	4480.00	-	-	-	4480.00
5.	alignment and digging of contour trenches (30cm x 20cm)	Mt.	2.00	2000.00	-	-	-	2000.00
6.	Cost of raising plants	No.	1.50	1800.00	960.00	300.00	60.00	3120.00
7.	Filling of Pits and Planting	No.	1.35	-	2160.00	-	-	2160.00
8.	Filling of Contour Trenches	Mt.	0.20	200.00	-	-	-	200.00
9.	Carriage of Plants	No.	1.00	-	1600.00	320.00	160.00	2080.00
10.	Beating up (digging pit, filling and planting)	No.	2.40	-	-	768.00	384.00	1152.00
11.	Cost of sowing seed of hedges in trenches and spacing of seedlings and weeding	Ha	300.00LS	-	300.00	-	-	300.00
12.	Weeding and hoeing of plants and mulching	No.	0.30	-	480.00	96.00	48.00	624.00
13.	Watcher (one per 15 ha.)	-	1050/-PM	-	490.00 (7 months)	840.00	840.00	2170.00
14.	Equipment (trey, pipe, drum) tools etc.	LS	150.00	100.00	50.00	-	-	150.00
	Total	-	-	12050.00	6040.00	2324.00	1492.00	21906.00
		Say		12000.00	6000.00	2300.00	1500.00	21800.00

P.P.Y. - Pre Planting Year
P.Y. - Planting Year

ANNEXURE - 6

Cost of Silvi-Pastoral Development

S. No.	Activities	Unit	Unit Cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Silvi-pastoral development in Ecodevelopment area														
	a) Pre-planting year	Ha	5100/-	50.00	255	50	255	50	255	50	255	-	-	200	1020
	b) Planting year	Ha	3200/-	-	-	50	160	50	160	50	160	50	160	200	640
	C) Maintenance 3rd year	Ha	1300/-	-	-	-	-	50	65	50	65	50	65	150	195
	d) Maintenance 4th year	Ha	1100/-	-	-	-	-	-	-	50	55	50	55	100	110
	Total	Ha	10700/-	-	255	-	415	-	480	-	535	-	280	200	1965

(Details of per ha. cost given in Annexure - 6.1)

ANNEXURE - 6.1

Per Ha Cost of Silvi-Pastoral Development (400 plants/ha and Legumes and grasses)

S. No.	Item of works	Unit	Unit Cost Rs.	Year-wise expenditure(Rs./ha.) PPY Ist Year	PY 2nd Year	Maintenance 3rd Year	4th Year	Total Rs.
1.	Survey and demarcation	Ha	35.00	35.00	-	-	-	35.00
2.	Site Clearance/Removal of unwanted weeds)	Ha	100.00	100.00	-	-	-	100.00
3.	Fencing	Ha	3400.00	3400.00	-	-	-	3400.00
4.	Digging Pits (45cm cube)	No.	2.80	1120.00	-	-	-	1120.00
5.	Cost of raising plants	No.	1.50	450.00	240.00	75.00	15.00	780.00
6.	Filling Pits and Planting	No.	1.35	-	540.00	108.00	54.00	702.00
7.	Carriage of plants	Nos.	1.00	-	400.00	80.00	40.00	520.00
8.	Cost of D.A.P.	50Kg/ ha	10.00 Kg	-	500.00	-	-	500.00
9.	Cost of Urea	100 Kg/ha	5.00 Kg	-	500.00	-	-	500.00
10.	Carriage and cost of broad casting D.A.P. and Urea	Ha	200.00	-	200.00	-	-	200.00
11.	Cost of Legumes and grass seeds, carriage sowing in patches and hoeing patches to cover the seeds	Ha	250.00LS	-	250.00	-	-	250.00
12.	Beating up (digging pit, filling and planting)	No.	2.40	-	-	192.00	96.00	288.00
13.	Weeding and hoeing of plants and mulching	No.	0.30	-	120.00	24.00	12.00	156.00
14.	Watcher (one for 15 ha.)	-	1050.00PM	-	490.00(7 months)	840.00	840.00	2170.00
	Total	-		5105.00	3240.00	1319.00	1075.00	10721.00
		or say		5100.00	3200.00	1300.00	1100.00	10700.00

P.P.Y. - Pre Planting Year
P.Y. - Planting Year

ANNEXURE - 7

Cost of Energy Conservation

P = Physical
F = Financial (000 Rs.)

S. No.	Activities	Unit	Unit Cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Installation of Biogas plants	No.	12000/-	-	-	25	300	25	300	25	300	25	300	100	1200
2.	Solar Cookers	No.	1400/-	200	280	200	280	200	280	200	280	200	280	1000	1400
3.	Wood Stoves	No.	60/-	200	12	200	12	200	12	200	12	200	12	1000	60
4.	Kerosene Stoves	No.	250/-	200	50	200	50	200	50	200	50	200	50	1000	250
5.	Pressure Cookers	No.	500/-	200	100	200	100	200	100	200	100	200	100	1000	500
6.	Installation of smokeless chulhas	No.	400/-	-	-	200	80	200	80	200	80	200	80	800	320
	Total	-	-	-	442	-	822	-	822	-	822	-	822	-	3730

ANNEXURE - 8

Cost of Soil Conservation Activities (Remedial Measures)

P = Physical
F = Financial (000 Rs.)

S. No.	Activities	Unit	Unit Cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Levelling/Bench terracing of sloping cultivation fields	Ha.	10000/-	80	800	80	800	80	800	80	800	80	800	400	4000
2.	Gully Plugging and Nala Control														
	a) Brushwood checkdams	No.	500/-	200	100	200	100	200	100	200	100	200	100	1000	500
	b) Stone checkdams	No.	1000/-	200	200	200	200	200	200	200	200	200	200	1000	1000
	c) Cratewire/wiremesh checkdams	No.	5000/-	200	1000	200	1000	200	1000	200	1000	200	1000	1000	5000
	d) Maintenance (5% of (a) (b) & (c)	-	-	-	-	-	65	-	65	-	65	-	65	-	260
3.	Diversion drains	Km.	50000/-	2	100	2	100	2	100	2	100	2	100	10	500
4.	Stabilization of landslides:														
	a) Stream Bank Protection (Construction of wiremesh spur walls etc.)	No.	25000/-	10	250	10	250	10	250	10	250	10	250	50	1250
	b) Stabilization of landslipped slopes	No.	150000/-	10	1500	10	1500	10	1500	10	1500	10	1500	50	7500
	Total	-	-	-	3950	-	4015	-	4015	-	4015	-	4015	-	20010

ANNEXURE - 9

Cost of Public Participation

P = Physical
F = Financial (000 Rs.)

S. No.	Project Activities	Unit	Unit Cost Rs.	I		II		III		IV		V		Total	
				P	F	P	F	P	F	P	F	P	F	P	F
1.	Public Participation	LS	LS	-	100	-	100	-	100	-	100	-	100	-	500
	Total			-	100	-	100	-	100	-	100	-	100	-	500

ANNEXURE - 10

Cost of Monitoring and Evaluation

P = Physical
F = Financial (000 Rs.)

S.No.	Project Activities	Unit	Unit Cost	I		II		III		IV		V		Total	
			Rs.	P	F	P	F	P	F	P	F	P	F	P	F
1.	Monitoring and Evaluation	LS	LS	-	150	-	200	-	50	-	50	-	50	-	500
	Total				150	-	200	-	50	-	50	-	50	-	500

ANNEXURE - 11.1

GEOGRAPHICAL SITUATION (SWS wise and Area wise)

S.No.	Name of S.W.S.	Name of Area	Latitude		Longitude		Total Area (ha.)
			From	To	From	To	
1.	Jiwanal	(1) Ecodevelopment area	31°47 19"	31°50 30"	77°17 15"	77°22 4"	2350
		(2) GHNP	31°48 25"	31°54 58"	77°20 7"	77°34 45"	13270
2.	Sainj Khad	(1) Ecodevelopment area	31°43 28"	31°50 34"	77°19 49"	77°28 8"	10623
		(2) Sainj Sanctuary	31°47 5"	31°51 46"	77°26 5"	77°37 4"	9000
		(3) GHNP	31°42 15"	31°52 22"	77°25 52"	77°45 53"	2400
3.	Tirthan Khad	(1) Ecodevelopment area	31°33'0"	31°43'28"	77°24'56"	77°31'56"	12527
		(2) Tirthan Sanctuary	31°34'7"	31°39'52"	77°27'30"	77°37'22"	6100
		(3) GHNP	31°38'6"	31°44'26"	77°26'47"	77°40'42"	15730
4.	Parvati Nadi	(1) GHNP	31°45'8"	31°56'56"	77°37'53"	77°52'5"	23500
	Grand Total		31°33'00"	31°56'56"	77°17'15"	77°52'5"	117100

ANNEXURE - 11.2

Altitudinal Zones (SWS wise and Area wise) (Area in ha.)

Sl. No.	Name of S.W.S.	Name of Area	<1600 M	1600-2000M	2000-2400M	2400-2800M	2800-3200M	3200-3600M	3600-4000M	4000-4400M	4400-4800M	4800-5200M	5200-5600M	5600-6400M	Total Area in ha.
1.	Jiwanal	(1) Ecodevelopment Area (2) GHNP	120 -	455 -	667 344	692 781	361 1325	55 1375	- 2151	- 3844	- 2650	- 800	- -	- -	2350 13270
		Total	120	455	1011	1473	1686	1430	2151	3844	2650	800	-	-	15620
2.	Sainj Khad	(1) Ecodevelopment Area (2) Sainj Sanctuary (3) GHNP	200 - -	1188 - 40	2200 235 415	2900 620 930	2716 2103 997	1075 1387 2388	300 1681 3419	44 1525 4375	- 993 5717	- 456 4619	- - 1100	- - -	10623 9000 24000
		Total	200	1228	2850	4450	5816	4850	5400	5944	6710	5075	1100	-	43623
3.	Tirthan Khad	(1) Ecodevelopment Area (2) Tirthan Sanctuary (3) GHNP	185 - -	1242 - -	2642 80 350	3773 600 1221	3032 1535 3109	1554 1900 2341	99 1000 1069	- 520 2202	- 465 2298	- - 2440	- - 700	- - -	12527 6100 15730
		Total	185	1242	3072	5594	7676	5795	2168	2722	2763	2440	700	-	34357
4.	Parvati Nadi	(1) GHNP	-	-	-	-	-	-	-	3393	5168	9162	5313	464	23500
		Grand Total	505	2925	6933	11517	15178	12075	9719	15903	17291	17477	7113	464	117100

ANNEXURE - 11.3

Slope wise Area (SWS wise & Area wise) (Area in ha.)

S.No.	Name of S.W.S.	Name of Area	Slope percent				
			<33%	33 - 50%	51-100%	>100%	Total
1.	Jiwanal	(1) Ecodevelopment Area (2) GHNP	8 2139	350 3075	1942 7737	50 319	2350 13270
		Total	2147	3425	9679	369	15620
2.	Sainj Khad	(1) Sainj Sanctuary (2) Ecodevelopment Area (3) GHNP	112 1087 5772	1197 2341 4353	7372 7033 10199	319 162 3676	9000 10623 24000
		Total	6971	7891	24604	4157	43623
3.	Tirthan Khad	(1) Ecodevelopment Area (2) GHNP (3) Tirthan Sanctuary	32 550 232	1833 3078 713	10577 11380 5060	85 722 95	12527 15730 6100
		Total	814	5624	27017	902	34357
4.	Parvati Nadi	GHNP	15008	1719	5936	837	23500
		Grand Total	24940	18659	67236	6265	117100

ANNEXURE - 11.4

Drainage Pattern (SWS wise and Area wise)

S.No.	Name of S.W.S.	Name of Area	I Order		II Order		III Order		IV Order		V Order		VI Order		Total	
			No.	Km	No.	Km.	No.	Km.	No.	Km.	No.	Km.	No.	Km.	No.	Km.
1.	Jiwanal	(1) Ecodevelopment Area	43	29.5	11	12.5	2	4.5	1	1.5	-	-	-	-	57	48.00
		(2) GHNP	249	167.5	53	42.5	10	21.0	2	6.0	1	12.0	-	-	315	249.00
		Total	292	197.0	64	55.0	12	25.5	3	7.5	1	12.0	-	-	372	297.00
2.	Sainj Khad	(1) Ecodevelopment Area	274	173.5	66	38.75	16	19.75	3	21.25	1	8.25	-	-	307	261.50
		(2) Sainj Sanctuary	218	87.5	47	36.5	13	16.5	4	20.5	-	-	-	-	282	161.00
		(3) GHNP	331	262.75	76	76.0	16	31.5	4	13.0	1	22.5	-	-	428	405.75
		Total	823	523.75	189	151.25	45	67.75	11	54.75	2	30.75	-	-	1070	828.25
3.	Tirthan Khad	(1) Ecodevelopment Area	330	145.5	66	38.0	15	24.5	5	16.2	1	16.0	-	-	417	240.20
		(2) Tirthan Sanctuary	204	106.0	41	27.7	9	16.3	1	5.0	-	-	-	-	255	155.00
		(3) GHNP	433	337.5	100	66.5	27	37.5	5	19.8	2	4.1	1	4.8	568	470.2
		Total	967	589.0	207	132.2	51	78.3	11	41.0	3	20.10	1	4.8	1240	865.40
4.	Parvati Nadi	(1) GHNP	87	50.5	17	13.5	1	19.5	-	-	-	-	-	-	105	83.5
		Grand Total	2169	1360.25	477	351.95	109	91.05	25	103.25	6	62.85	1	4.8	2787	2074.15

ANNEXURE - 11.5

Classification of Areas for Erosion Intensity Classes - SWS Wise and Landuse Wise (Ha)

S. No.	Name of SWS	Name of Area	Cultivation					Forest					Blank					Rocky	Snow	Total (ha.)
			E_1	E_2	E_3	E_4	Total	E_1	E_2	E_3	E_4	Total	E_1	E_2	E_3	E_4	Total			
1.	Jiwanal	a) GHNP b) Ecodevelopment area	- -	- 108	18 92	- -	18 200	188 9	50 210	2712 1600	- 24	2950 1843	868 -	2175 16	5109 275	163 16	8315 307	312 -	1675 -	13270 2350
Total Jiwanal SWS			-	108	110	-	218	197	260	4312	24	4793	868	2191	5384	179	8622	312	1675	15620
2.	Sainj Khad	a) GHNP b) Sainj Sanct. c) Ecodevelopment area	- - 12	- - 506	3 7 106	- - -	3 7 624	- - 625	394 188 1756	3631 2724 5161	112 250 70	4137 3162 7612	1587 - -	2537 1019 275	10012 4347 2000	1006 62 112	15142 5428 2387	218 44 -	4500 359 -	24000 9000 10623
Total Sainj Khad SWS			12	506	116	-	634	625	2338	11516	432	14911	1587	3831	16359	1180	22957	262	4859	43623
3.	Tirthan Khad	a) GHNP b) Tirthan Sanc. c) Ecodevelopment area	- - 20	- - 550	- - 600	- - 10	- - 1180	- 10 -	306 400 1000	4981 2435 8542	644 30 40	5931 2875 9582	362 190 5	1919 200 220	6137 2700 1400	431 50 40	8849 3140 1665	- - -	950 85 100	15730 6100 12527
Total Tirthan Khad			20	550	600	10	1180	10	1706	15958	714	18388	557	2339	10237	521	13654	-	1135	34357
4.	Parbati Nadi	a) GHNP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12344	11156	23500
Total Parbati nadi SWS			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12344	11156	23500
GRAND TOTAL			32	1164	826	10	2032	832	4304	31786	1170	38092	3012	8361	31980	1880	45233	12918	18825	117100

ANNEXURE - 11.6

List of mammals reported from Great Himalayan National Park

Common Name	Scientific Name	Local Name
Bear, Brown	*Ursus arctos*	Lal Bhalloo, Seta Bhalloo, Shain
Bear, Himalayan Black	*Selenarctos thibetanus*	Reech, Kala Bhaloo
Cat, Jungle	*Felis chaus*	
Civet, Himalayan Palm	*Paguma larvata*	
Deer, Barking or Muntjac	*Muntiacus muntjak*	Kakkar
Deer, Musk	*Moschus moschiferus*	Kastura Bira
Fox, Red	*Vulpes vulpes*	Lomri
Goral	*Nemorhaedus goral*	Ghorar
Ibex	*Capra ibex*	
Jackal	*Canis aureus*	Gidder
Langur, common	*Presbytis entellus*	Langur, Guni
Leopard, snow or Ounce	*Panthera uncia*	
Leopard or panther	*Panthera pardus*	Bagh
Leopard cat	*Felis bengalensis*	
Macaque, Rhesus	*Macaca mulatta*	Bander
Marten, Himalayan Yellow throated	*Martes flavicula*	Gotu
Mouse, House	*Mus ausculus*	
Mouse-Hare, Himalayan	*Ochotona roylei*	
Porcupine, Hodgson's	*Hystrix hodgsoni*	
Porcupine, Indian	*Hystrix indica*	
Serow	*Capricornis sumatraensis*	Emu
Sheep, Blue or Bharal	*Pseudois nayaur*	Hiatu, Bharal
Shrew, Grey Musk or House Shrew	*Suncus murinus*	
Shrew, Himalayan	*Soriculus migrescens*	
Shrew, Himalayan Water		
Squirrel, common Giant Flying	*Petaurista petaurista*	
Squirrel, Kashmir Flying	*Hylopetes fimbriatus*	
Tahr, Himalayan	*Hemitragus jemlahicus*	Karth, Bakri
Vole, Royle's	*Alticola roylei*	
Weasel, Himalayan	*Mustela sibirica*	
Wolf	*Canis lupus*	Bherija

(Source : Ap. Park Authories/Q.A2/FV2)

ANNEXURE - 11.7

List of birds reported from Great Himalayan National Park

S.NO.	COMMON NAME	LATIN NAME
1.	Accentor, Alpine	*Prunella collaris*
2.	Accentor, Altai	*Prunella himalayana*
3.	Accentor, Rufous-breasted	*Prunella strophiata*
4.	Babbler, Black-throated	*Stachyris nigriceps**
5.	Babbler, Gold-headed	*Stachyris chrysaea**
6.	Babbler, Redbilled	*Stachyris pyrrhops*
7.	Babbler, Red-headed	*Stachyris ruficeps*
7.	Babbler, Rufous-necked Scimitar	*Pomatorhenus ruficollis**
8.	Babbler, Rusty-cheeked scimitar	*Pomatorhinus erythrogenys*
9.	Babbler, Slaty-headed Scimitar	*Pomatorhinus horesfieldic*
10.	Babbler, Slenderbilled Scimitar	*Xlphirhynchus superciliaris**
11.	Babbler, Spotted	*Pellorneum ruficeps*
12.	Barbet, Golden-throated	*Megalaima franklinii**
13.	Barbet, Great Hill	*Megalaima virens*
14.	Barwing, Hoary	*Actinodura nipalensis**
15.	Barwing, Spectacled	*Actinodura egertoni**
16.	Blackbird	*Turdus merula*
17.	Blackbird, Grey-winged	*Turdus boulbuol*
18.	Black Redstart	*Phoenicurus caevuleocephalus*
19.	Blackbird, White-collared	*Turdus albocinctus*
20.	Bluebird, Fairy	*Irena puella**
21.	Bulbul, Black	*Hypsipetes madagascariensis*
22.	Bulbul, Black-headed Yellow	*Pyononotus melanicterus*
23.	Bulbul, Redvented	*Pycnonotus cafer*
24.	Bulbul, Rufous-bellied	*Hypsipetes mcclellandi**
25.	Bulbul, Striated Green	*Pycnonotus striatus**
26.	Bulbul, White-cheeked	*Pycnonotus leucogenys*
27.	Bullfinch, Brown	*Pyrrhula nipalensis*
28.	Bullfinch, Red-headed	*Pyrrhula erythrocephala*
29.	Bunting, Crested	*Melophus lathami*
30.	Bunting, Rock	*Emberiza cia*
31.	Buzzard	*Buteo buteo*
32.	Buzzard, Long-legged	*Buteo rufinus*
33.	Buzzard, Upland	*Buteo hemilasius*

S.No.	COMMON NAME	LATIN NAME
34.	Chat, Blue	*Erithacus brunneus*
35.	Chat, Collared Bush	*Saxicola torquata*
36.	Chat, Dark-grey Bush	*Saxicola ferrea*
37.	Chloropsis, Gold-fronted	*Chloropsis aurifrons*
38.	Chloropsis, Orange-bellied	*Chloropsis hardwickii*
39.	Chough, Red-billed	*Pyrrhocorax pyrrhocorax*
40.	Chough, Yellow-billed	*Pyrrhocorax graculus*
1.	Common Rosefinch	*Carpodacus erythrinus*
42.	Creeper, Himalayan Tree	*Certhia himalayana*
43.	Creeper, Tree	*Certhia familiaris*
44.	Creeper, Wall	*Tichodroma muraria*
45.	Crossbill	*Loxia curvirostra*
46.	Crow, House	*Corvus splendens*
47.	Crow, Jungle	*Corvus macrorhynchos*
48.	Crow-pheasant	*Centropust sinensis*
49.	Cuckoo, Himalayan	*Cuculus saturatus*
50.	Cuckoo, Indian	*Cuculus micropterus*
51.	Cuckoo, Indian Plaintive	*Cacomantis passerinus*
52.	Cuckoo, Pied Crested	*Clamator jacobinus*
53.	Cuckoo, Sirkeer	*Taccocua leschenaultii*
54.	Cuckoo, Small	*Cuculus poliocephalus*
55.	Cuckoo, The	*Cuculus canorus*
56.	Curlew	*Numenius arquata**
57.	Curlew, Stone	*Burhinus oedicnemus*
58.	Darter	*Anhinga rufa*
59.	Dipper, Brown	*Cinclus pallasii*
60.	Dove, Indian Ring	*Streptopelia decaocto*
61.	Dove, Little Brown	*Streptopelia senegalensis*
62.	Dove, Red Turtle	*Streptopelia tranquebarica*
63.	Dove, Rufous Turtle	*Streptopelia orientalis*
64.	Dove, Spotted	*Streptopelia turtur*
65.	Dove, Turtle	*Streptopelia turtur*
66.	Drongo, Ashy	*Dicrurus leucophaeus*
67.	Drongo, Black	*Dicrurus adsimilis*
68.	Drongo, Bronzed	*Dicrurus aeneus*
69.	Drongo, Hair-crested	*Dicrurus hottentottus*
70.	Eagle, Black	*Ictinaetus malayensis*
71.	Eagle, Crested Serpent	*Spilornis cheela*

S.No.	COMMON NAME	LATIN NAME
72.	Eagle, Golden	*Aquila chrysaetos*
73.	Eagle, Grey-headed Fishing	*Ichthyophaga ichthyaetus*
74.	Eagle, Imperial	*Aquila heliaca*
75.	Eagle, Short-toed	*Circaetus gallicus*
76.	Eagle, Tawny	*Aquila rapax**
77.	Egret, Little	*Egetta garzetta*
78.	Falcon, Redlegged	*Falco vespertinus**
79.	Finch, Red-browed	*Callacanthis burtoni*
80.	Finch, Tibet Snow	*Montifringilla adamsi*
81.	Flowerpecker, Firebreasted	*Dicaeum ignipectus*
82.	Flowerpecker, Tickell's	*Dicaeum erythrorhynchos*
83.	Flycatcher, Blue-throated	*Muscicapa rubeculoides*
84.	Flycatcher, Brown	*Muscicapa latirostris*
85.	Flycatcher, Feruginous	*Muscicapa ferruginea**
86.	Flycatcher, Grey-headed	*Culicicapa ceylonensis*
87.	Flycatcher, Kashmir Redbreasted	*Muscicapa subrubra*
88.	Flycatcher, Largebilled Blue	*Muscicapa banyumas**
89.	Flycatcher, Little Pied	*Muscicapa westermanni**
90.	Flycatcher, Orangegorgeted	*Muscicapa strophiata*
91.	Flycatcher, Pale Blue	*Muscicapa unicolor*
92.	Flycatcher, Paradise	*Terpsiphone paradisi*
93.	Flycatcher, Pigmy Blue	*Muscicapella hodgsoni**
94.	Flycatcher, Red-breasted	*Muscicapa parva*
95.	Flycatcher, Rufous-tailed	*Muscicapa ruficauda*
96.	Flycatcher, Slaty Blue	*Muscicapa leucomelanura*
97.	Flycatcher, Sooty	*Muscicapa sibirica*
98.	Flcycatcher, Verditer	*Muscicapa thalassina*
99.	Flycatcher, White-browed Blue	*Muscicapa supercilaris*
100.	Flycatcher, White-browed Faintail	*Rhipidura aureola*
101.	Flycatcher, Whitegorgeted	*Muscicapa monileger**
102.	Flycatcher, White-throated Fantail	*Rhipidura albicollis*
103.	Flycatcher, Yellow-bellied Fantail	*Rhipidura hypoxantha*
104.	Flycatcher-shrike, Pied	*Hemipus picatus*
105.	Flycatcher-warbler, Blackbrowed	*Seicercus burkii*
106.	Flycatcher-warbler, Blackfaced	*Abroscopus schisticeps**
107.	Flycatcher-warbler, Chestnut-headed	*Seicercus castaniceps**
108.	Flycatcher-warbler, Grey-cheeked	*Seicercus poliogenys**
109.	Flycatcher-warbler, Grey-headed	*Seicercus xanthoschistos*
110.	Flycatcher-warberl, Yellow-bellied	*Abroscopus superciliaris**

S.No.	COMMON NAME	LATIN NAME
111.	Forktail, Little	*Enicurus scouleri*
112.	Forktail, Spotted	*Enicurus maculatus*
113.	Goldcrest	*Regulus regulus*
114.	Goldfinch	*Carduelis carduelis*
115.	Goshawk	*Accipiter gemtilis*
116.	Grandala, Hodgson's	*Grandala coelicolor*
117.	Greenfinch, Himalayan	*Carduelis spinoides*
118.	Griffon, Hiamalayan	*Gyps himalayensis*
119.	Grosbeak, Allied	*Coccothraustes affinis*
120.	Grosbeak, Black-and-Yellow	*Coccothraustes icterioides*
121.	Grosbeak, Spotted-winged	*Coccothraustes melanozanthos*
122.	Grosbeak, White-winged	*Coccothraustes carnipes*
123.	Hawk-cuckoo, Large	*Cuculus sparverioides*
124.	Hawk-eagle, Booted	*Hieraaetus pennatus*
125.	Hawk-eagle, Hodgson's	*Spizaetus nipalensis*
126.	Howk, Sparrow	*Accipiter nisus*
127.	Hen-harrier	*Circus cyaneus*
128.	Hobby	*Falco subbuteo*
129.	Hoopoe	*Upupa epops*
130.	Jay	*Garrulus glandarius*
131.	Jay, Black-throated	*Garrulus lanceolatus*
132.	Kestrel	*Falco tinnunculus*
133.	Kestrel, Lesser	*Falco naumanni**
134.	Kingfisher, White-breasted	*Halcyon smyrnesis*
135.	Kite, Pariah	*Milvus migrans*
136.	Magpie, Red-billed Blue	*Cissa erythrorhyncha*
137.	Magpie, Yellow-billied Blue	*Cissa flavirostris*
138.	Martin, Crag	*Hirundo rupestris*
139.	Martin, House	*Delichon urbica*
140.	Minivet, Longtailed	*Pericrocotus ethologus*
141.	Minivet, Scarlet	*Pericrocotus flammeus*
142.	Minivet, Shortbilled	*Pericrocotus brevirostris**
143.	Minivet, Yellow-throated	*Pericrocotus solaris**
144.	Minla, Red-tailed	*Minla ignotincta**
145.	Myna, Common	*Acridotheres tristis*
146.	Myna, Jungle	*Acridotheres fuscus*
147.	Nightjar, Indian Jungle	*Caprimulgus indicus*
148.	Niltava, Large	*Muscicapa grandis*

S.No.	COMMON NAME	LATIN NAME
149.	Niltava, Rufousbellied	*Muscicapa sundara*
150.	Niltava, Small	*Muscicapa macgrigoriae*
151.	Nutcracker	*Nucifraga caryocatactes*
152.	Nuthatch, White-cheeked	*Sitta leucopsis*
153.	Nuthatch, White-tailed	*Sitta himalayensis*
154.	Oriole, Blacknaped	*Oriolus chinesis**
155.	Owl, Brown Wood	*Strix leptogrammica*
156.	Owl, Great Horned or Eagle-owl	*Bubo bubo*
157.	Owl, Short-eared	*Asio flammeus*
158.	Owl, Spotted Scops	*Otus spilocephalus*
159.	Owl, Tawny Wood	*Strix aluco*
160.	Owlet, Barred	*Glaucidium cuculoides*
161.	Owlet, Collared Pigmy	*Glaucidium brodiei*
162.	Parakeet, Blossom-headed	*Psittacula cyanocephala*
163.	Parakeet, Rose-ringed	*Psittacula krameri*
164.	Parakeet, Slatyheaded	*Psittacula himalayana*
165.	Partridge, Black	*Francolinus francolinus*
166.	Partridge, Chukor	*Alectoris chukar*
167.	Partridge, Common Hill	*Arborophila torqueola*
168.	Partridge, Snow	*Lerwa lerwa*
169.	Peafowl, Common	*Pavo cristatus*
170.	Pheasant, Chir	*Catreus wallichii*
171.	Pheasant, Kalij	*Lophura leucomelana*
172.	Pheasant, Koklas	*Pucrasia macrolopha*
173.	Pheasant, Monal	*Lophophorus impejanus*
174.	Piculet, Speckled	*Picumnus innominatus*
175.	Pigeon, Ashy Wood	*Columba pulchricollis*
176.	Piegon, Blue Rock	*Columba livia*
177.	Pigeon, Hill	*Columba rupestris**
178.	Pigeon, Snow	*Columba leuconota*
179.	Pigeon, Speckled Wood	*Columba hodgsonii*
180.	Pigeon, Wedgetailed Green	*Treron sphenura*
181.	Pipit, Indian Tree	*Anthus hodgsoni*
182.	Pipit, Tree	*Anthus trivialis*
183.	Pipit, Upland	*Anthus sylvanus*
184.	Plaincoloured mountain Finch	*Leocosticte nemoricola*
185.	Plover, Eastern Golden	*Pluvialis dominica**
186.	Raven	*Corvus corax*
187.	Restart, Bluefronted	*Phoenicurus frontalis*

S.No.	COMMON NAME	LATIN NAME
188.	Redstart, Blueheaded	*Phoenicurus caeruleocephalus*
189.	Redstart, Eversmann's	*Phoenicurus erythronotus*
190.	Redstart, Plumbeous	*Rhyacornis fuliginosus*
191.	Redstart, Whitecapped	*Chaimarrornis leucocephalus*
192.	Redstart, White-throated	*Phoenicurus schisticeps**
193.	Robin, Golden Bush	*Erithacus chrysaeus*
194.	Robin, Orangeflanked Bush	*Erithacus cyanurus*
195.	Robin, Rufousbellied Bush	*Erithacus hyperythrus**
196.	Robin, White-tailed Blue	*Cinclidium leucurum**
197.	Rosefinch, Pinkbrowed	*Carpodacus rhodochrous*
198.	Rubythroat	*Erithacus calliope*
199.	Shikra	*Accipiter badius*
200.	Shortwing, Gould's	*Brachypteryx stellata*
201.	Shortwing, Lesser	*Brachypteryx leucophrys*
202.	Shortwing, Whitebrowed	*Brachypteryx montana*
203.	Shrike, Grey bakced	*Lanius tephronotus*
204.	Shrike, Rufousbacked	*Lanius schach*
205.	Shrike-babbler, Chestnut-throated	*Pteruthius melanotis**
206.	Shrike-babbler, Green	*Pteruthius xanthochlorus*
207.	Shrike-babbler, Red-winged	*Pteruthius flaviscapis*
208.	Shrike-babbler, Rufousbellied	*Pteruthius rufiventer**
209.	Sibia, Black-capped	*Heterophasia capistrata*
210.	Siva, Bar-throated	*Minla strigula*
211.	Siva, Blue-winged	*Minla cyanouroptera**
212.	Snipe, solitary	*Gallinago solitaria*
213.	Snowcock, Himalayan	*Tetraogallus himalayensis*
214.	Sparrow, Cinnamon Tree	*Passer rutilans*
215.	Sparrow, House	*Passer domesticus*
216.	Sparrow, Tree	*Passer montanus**
217.	Sunbird, Yellow-backed	*Aethopyga siparaja*
218.	Swift, Alpine	*Apus melba*
219.	Swift, Large White-rumped	*Apus pacificus*
220.	Swiftlet, Himalayan	*Collocalia brevirostris*
221.	Swiftlet, Indian Edible-nest	*Collocalia unicolor*
222.	Thrush, Blackfaced Laughing	*Garrulax affinis**
223.	Thrush, Blue Rock	*Monticola solitarius*
224.	Thrush, Blue Whistling	*Myiophonus caeruleus*
225.	Thrush, Blue-headed Rock	*Monticola cinclorhynchus*
226.	Thrush, Blue-winged Laughing	*Garrulax squamatus**
227.	Thrush, Chestnut-bellied Rock	*Monticola rufiventris*
228.	Thrush, Greyheaded	*Turdus rubrocanus*
229.	Thrush, Greysided Laughing	*Garrulax caerulatus**
230.	Thrush, Large Brown	*Zoothera monticola*
231.	Thrush, Long-tailed Mountain	*Zoothera dixoni*

S.No.	COMMON NAME	LATIN NAME
232.	Thrush, Mistle	*Turdus viscivorus*
233.	Thrush, Plainbacked Mountain	*Zoothera mollissima*
234.	Thrush, Plaincoloured Laughing	*Garrulax subunicolor**
235.	Thrush, Red-headed Laughing	*Garrulax erythrocephalus*
236.	Thrush, Rufouschinned Laughing	*Garrulax rufogularis*
237.	Thrush, Scaly	*Zoothera dauma*
238.	Thrush, Streaked Laughing	*Garrulax lineatus*
239.	Thrush, Striated Laughing	*Garrulax striatus*
240.	Thrush, Variegated Laughing	*Garrulax variegatus*
241.	Thrush, White-crested Laughing	*Garrulax leucolophus*
242.	Thrush, White-spotted Laughing	*Garrulax ocellatus*
243.	Thrush, White-throated Laughing	*Garrulax albogularis*
244.	Tit, Brown Crested	*Parus dichrous*
245.	Tit, Crested Black	*Parus melanolophus*
246.	Tit, Firecapped	*Cephalopyrus flammiceps*
247.	Tit, Greenbacked	*Parus monticolus*
248.	Tit, Grey	*Parus major*
249.	Tit, Red-headed	*Aegithalos concinnus*
250.	Tit, Rufousbelied Crested	*Parus rubidiventris*
251.	Tit, Simla Black	*Parus rufonuchalis*
252.	Tit, White-throated	*Aegithalos niveogularis*
253.	Tit, Yellow-browed	*Sylviparus modestus*
254.	Tit, Yellow-cheeked	*Parus xanthogenys*
255.	Tit-babbler, Chestnut-headed	*Alcippe castaneceps**
256.	Tit-babbler, Golden-breasted	*Alcippe chrysotis**
257.	Tit-babbler, Whitebrowed	*Alcippe vinipectus*
258.	Tit-warbler, Stoliczka's	*Leptopoecile shophiae*
259.	Tragopan, Western	*Tragopan melanocephalus*
260.	Tree Pie, Himalayan	*Dendrocitta formosae*
261.	Tree Pie, Indian	*Dendrocitta vagabunda*
262.	Vulture, Bearded	*Gypaetus barbatus*
263.	Vulture, Black	*Aegypius monachus*
264.	Vulture, Egyptian	*Neophron percnopterus*
265.	Vulture, Griffon	*Gyps fulvus**
266.	Vulture, Indian Black	*Sarcogyps calvus*
267.	Vulture, Indian Long billed	*Gyps indicus*
268.	Vulture, Indian Whitebacked	*Gyps bengalensis*
269.	Wagtail, Grey	*Motacilla cinerea*
270.	Wagtail, Large Pied	*Motacilla maderaspatensis*
271.	Wagtail, White	*Motacilla alba*
272.	Wagtail, Yellow-headed	*Motacilla citreola*
273	Warbler Aberrant Bush	*Cettia flavolcvacea*
274.	Warbler, Black-throated Hill	*Prinia atrogularis**
275.	Warbler, Blyth's Leaf	*Phylloscopus reguloides*

S.No.	COMMON NAME	LATIN NAME
276.	Warbler, Blyth's Reed	*Acrocephalus dumetorum*
277.	Warbler, Brown Hill	*Prinia criniger*
278.	Warbler, Brown Leaf	*Phylloscopus collybita*
279.	Warbler, Chestnut-headed Ground	*Tesia castaneocoronata*
280.	Warbler, Dull Green Leaf	*Phylloscopus trochiloides*
281.	Warbler, Grey-faced Leaf	*Phylloscopus maculipennis*
282.	Warbler, Large Bush	*Cettia major*
283.	Warbler, Large Crowned Leaf	*Phylloscopus occipitalis*
284.	Warbler, Largebilled Leaf	*Phylloscopus magnirostris*
285.	Warbler, Orangebarred Leaf	*Phylloscopus pulcher*
286.	Warbler, Pallas's Leaf	*Phylloscopus proregulus*
287.	Warbler, Plain Leaf	*Phylloscopus neglectus*
288.	Warbler, Rufous-capped Bush	*Cettia brunnifrons*
289.	Warbler, Slatybellied Ground	*Tesia olivea**
290.	Warbler, Smoky Willow	*Phylloscopus fuligiventer**
291.	Warbler, Strongfooted Bush	*Cettia montana*
292.	Warbler, Tickell's	*Phylloscopus affinis*
293.	Warbler, Tytler's Leaf	*Phylloscopus tytleri*
294.	Warbler, Yellowbrowed Leaf	*Phylloscopus inornatus*
295.	White-eye	*Zosterops palpebrosa*
296.	Woodcock	*Scolopax rusticola*
297.	Woodpecker, Brownfronted Pied	*Picoides auriceps*
298.	Woodpecker, Crimson-breasted Pied	*Picoides cathpharius**
299.	Woodpecker, Fulvousbreasted Pied	*Picoides macei*
300.	Woodpecker, Himalayan Pied	*Picoides himalayensis*
301.	Woodpecker, Large Yellow-naped	*Picus flavinucha*
302.	Woodpecker, Rufous	*Micropternus brachyurus*
303.	Woodpecker, Scalybellied Green	*Picus squamatus*
304.	Woodpecker, Small Yellownaped	*Picus chlorolophus*
305.	Wren	*Troglodytes troglodytes*
306.	Wren-babbler, Scalybreasted	*Pnoepyga albiventer*
307.	Wren-babbler, Tailed	*Spelaeornis caudatus*
308.	Yuhina, Rufousvented	*Yuhina occipitalis**
309	Yuhina Stripe-throated	*Yuhina gularis**
310.	Yuhina, Whitebellied	*Yuhina xantholeuca*
311.	Yuhina, Yellownaped	*Yuhina flavicollis*

*The occurrance of these species inside the park is at variance with their known distribution in Salim Ali, et. al.

Source: Garson P.J., & Gaston A.J. Himalayan Wildlife Project III A Re-appraisal of the GHNP, July 1992.

Directory, Park Authorities, Q.A2

ANNEXURE - 11.8

List of Medicinal Herbs Reported from Great Himalayan National Park

Latin Name	Local Name	English Name	Uses	
Aconitum heterophyllum	Ateas, Atis, Patis	Atis root	Root-to treat fever, stomach-ache	Root-febrifuge
Acorus calamus (PA/FVI)	Bach			Rhizome-mental ailments, dysentery
Ainsliaea aptera (PA/FVI)	Karaibuti Sathjalari	Aerons Rod		Root-diuretic, stomach aches
Angelica glauca	Chora		Root-to treat stomach aches and wind	Root-condiment and spcie, carminative diaphoretic, expectorant
Artemisia maritima (PA/FVI)	Seski, Kirmala	Worm seed		Whole plant-laxative, floral tops - vermifuge
Atropa acuminata (PA/FVI)	Jharka	Belladonna		Root and leaf-narcotic, sedative, diuretic, sydriatic
Berberis lyciua (PA/FVI)	Kasual, Kirmora			Root-various uses
Corydalis govaniana	Bhutakishi		Medicinal	
Cuainua cyainua/Carua carvi? (PA/FVI)	Kala Jeera			Seed-flavouring
Dactylorhiza hatagirea	Hathpanja, Salam panja, Hathjari		Root-to treat warts, boils (FVI)	
Dioscorea deltoidea	Shinglimingli		Root-use for soap	Tuber-soap for washing wool, Silk, hair, fish poison, lice killer

Girardiana heterophylla	Bichhu Chikri booti	Himalayan Nettle	Leaf-saag/chutney	
Juniperus squanata	Bittal		Incense	
Jurinea doloniaea	Dhupe		Incense	
Jurinae sacrocephala	Dhoop, Gugal		Root-Incense, impt. in religious functions	-Do-
Kaeaferia galanga (PA/FVI)	Kapoor, Kachri, Chandra moola			Rhizome-carminative, expectorant
Leptadenia reticulata (PA/FVI)	Dori			Whole plant stimulant, restorative
Morchella esculenta	Gushhi	Morell mushroom	Whole mushroom eaten	
Mardostachys Jatamansi (PA/FVI)	Jatamansi, Balchora			Rhizome-various uses
Physcochilaina praealata (PA/FVI)	Bajar Bang. Laltang			Leaf-narcotic sydriatic, Seed-vermifuge to treat round worm
Picrorhiza kurroa	Karoo, Kutki		Medicinal	Root and rhizome-adulterant of Indian gentian, cholagogue, laxative
Pistacia integerrina	Kakra, Kakri, Kakkar, singi	Fruit- to treat cough: ash of fruit used		Wood-decoration leaf galls-dyeing, tanning, carminative
Podophyllum hexandrua (PA/FVI)	Ban Kakri, Bakra chinaka, Bhavanbakua, Papra, papri	Indian Podophylum		Various parts for various ailments

Polygonatum vertiallatum (PA/FVI)	Salam Misri			
Rheus emodi (PA/FVI)	Reward chini, Dolu			Root & rhizome- Purgative, astringent, tooth powder
Salvia moorcroftiana	Thooth, Thunt		Root - Soap (commercial)	Various parts - vermifuge, Poultice, emetic
Saussurea lappa/ costus? (PA/FVI)	Kuth, Kur Pachak	Costus	Medicinal	Root - incense, other uses
Sida acuta (PA/FVI)	Bariala, Bariara			
Thalictrum foliolosum (PA/FVI)	Gurbiani, pilazari Mamiri			Root - diuretic, purgative
Thymus serpyllus (PA/FVI)	Banajwain	Wild thyme	Medicinal & flavouring	Shoots - flavouring Leaf - beverage seed - vermifuge leaf & floral tops- aromatic oil
Valeriana Jatamansi	Mushkbala, Nihani	Indian Valerian	Leaf & root - added to dhoop cosmetic	Root & rhizome- incense and perfume to treat hysteria and hypochondria
Viola odorata/ serapens	Banafsha		Flower & leaf- to treat wounds fever, headaches	Flower - emollient, demulcent, leaf - painkiller, perfume Root- emetic
Zanthoxylum armatum (PA/FVI)	Timru, tezbal Nepali dhania			All parts - various uses

	Maora Kala		Root - to treat maggot infected wounds	
	Losar		Leaf - to treat throat aches, generates heat	
	Banajaan		Leaf - crushed & used to treat stomach ache	
	Tardi		Root - to make sabzi, acchaar	
	Mungo		Tuber - to make sabzi	
	Baria		Flower - to treat diahorrea	
	Talash/Sharbul		Talash- leaf & flower- for itching sharbul-tuber-grated & used to treat boils	
	Shabla		Root - chewed: used to clean eyes of livestock	
	Kaodakat		To clean eyes of livestock	
	Masangur		Root-outer covering used to make tea	
	Berthad		Leaf - used as incense like dhoop	
	Balcharr		Root	
	Lalchuri		Root - to clean and treat wounds	
	Mehendi		Whole plant- dye, used like henna for decoration of hands & feet.	

Source: Biodiversity Conservation through Ecodevelopment - A preliminary indicative plan for GHNP by Indian Institute of Public Administration.

Annexure - 12

List of Villages

Name of Area	Sl.No.	Name of Village
GHNP	1 2	Kundar Majhan
Sainj Sanctuary	1 2 3	Shagor Shakti Maror
Ecodevelopment Area	1	Bupan
	2	Bajahra
	3	Bhagi-Kashari
	4	Baretha-Saryer
	5	Banaugi
	6	Bah
	7	Chinari
	8	Dhatidhar
	9	Dalhiyar
	10	Darmera
	11	Dhartha
	12	Damiari
	13	Ghatseri
	14	Ghat
	15	Goransari
	16	Guhri
	17	Jalahra
	18	Jangla
	19	Kharangcha
	20	Khanyari
	21	Kothiyari
	22	Karehla
	23	Khainth

	24	Khain
	25	Majharna
	26	Majhgran
	27	Manahra
	28	Mail
	29	Manjhan
	30	Nadahra
	31	Neoli
	32	Niharni
	33	Pashi
	34	Patahra
	35	Pachari
	36	Riari
	37	Sharan
	38	Shaindhar
	39	Sharoh
	40	Sharan
	41	Setitol
	42	Sambha
	43	Shikari
	44	Sin
	45	Sohan
	46	Sambha
	47	Tiali
	48	Telehra
	49	Tung
	50	Gaul
	51	Nunuribahli

	52	Satesh
	53	Sambha
	54	Bhaludwar
	55	Compton
	56	Jiwa
	57	Chenga
	58	Bhathar
	59	Birashangar
	60	Chamarda
	61	Dharali
	62	Dagahra
	63	Dhara
	64	Goshti
	65	Kutwali
	66	Kahna
	67	Lapah
	68	Nawwali
	69	Pubna
	70	Ropa
	71	Suchen
	72	Shigaira
	73	Thachan
	74	Madana
	75	Barshangar
	76	Titri
	77	Kotlu
	78	Shengcha
	79	Dhara
	80	Kot

	81	Sundarnagar
	82	Banagi
	83	Bathad
	84	Chipni
	85	Daran
	86	Dingcha
	87	Farari
	88	Gushaini
	89	Ghat
	90	Galingcha
	91	Guruli
	92	Huri
	93	Kanon
	94	Khatkeri
	95	Kulthi
	96	Kharongcha
	97	Kamera
	98	Loharda
	99	Lagcha
	100	Malwani
	101	Manjaili
	102	Mashiyar
	103	Nadahar
	104	Nah
	105	Nadahra
	106	Nahin
	107	Pekhri
	108	Parwari

	109	Rogut
	110	Shirachi
	111	Shanar
	112	Shungcha
	113	Shalinga
	114	Shil
	115	Sharangar
	116	Thanach
	117	Tindar
	118	Talinga
	119	Thari
	120	Thanegad
	121	Tung
	122	Ropa
	123	Bhaliyar
	124	Gadingcha
Grand Total	129	

ANNEXURE - 13

Basis for

(A) Drainage Pattern and Drainage Density
(B) Erosion Intensity Classification
(C) Altitudinal Zonation and
(D) Slope Percent

(A) Drainage Pattern and Density

A smaller stream flows down into another stream and these two smaller streams after meeting flow into another stream to form a bigger stream. This pattern of flow depicts the drainage pattern of a micro-watershed or a sub-watershed. Thus the streams are classified into different orders as follows:

(i) Stream of First Order - a single smallest stream originating in a micro watershed.
(ii) Stream of Second Order - After two smaller streams of first order have met.
(iii) Stream of Third Order - After two streams of second order have met.
(iv) Stream of Fourth Order - After two streams of third order have met.

Similarly, when two streams of fourth order meet a stream of fifth order comes up; and when two streams of fifth order meet a stream of sixth order is created.

Drainage pattern data of a micro-watershed is thus determined by measuring lengths of the streams of different orders and computing the data so obtained in the following proforma:

First Order		Second Order		Third Order		Fourth Order		Fifth Order	
No.	Length	No.	Length	No.	Length	No.	Length	No.	Length

Drainage Density = Length of streams divided by Area of micro watershed

(B) Erosion Intensity classification

The areas under different landuses are further classified into four erosion intensity classes, as per the guidelines given in Annexure - 13.1

(C) Altitudinal Zonation

Classification of an area by altitudinal zones is done by calculating the area between contour lines on maps for the following contour zones:

(i) Less than 400 m
(ii) Between 400 to 800 m
(iii) Between 800 to 1200 m
(iv) Between 1200 to 1600 m
(v) Between 1600 to 2000 m
(vi) Between 2000 to 2400 m
(vii) Between 2400 to 2800 m
(viii) Between 2800 to 3200 m
(ix) and so on

(D) Slope Percent

Slope of an area is worked out by measuring distances between contour lines at the required places as per the following slope classes:

Less than 33%
33 to 50%
50 to 100%
over 100%

ANNEXURE - 13.1

Basis for Erosion Intensity Classification

Slight (E1)	Moderate (E2)	Severe (E3)	Destroyed (E4)
1. Arable land: (i) Natural slope upt 25% (14^0), field slope below 5% (3^0), arrangement for the disposal of excess water provided; terraced.	(i) Natural slope upto 25%(14^0), defective terracing, either field slope exceeds 5%(3^0) or water disposal arrangement absent. (ii) Slope between 25%(14^0) to 60% (31^0) with proper terracing.	(i) All unterraced fields with no defined gullies. (ii) Natural slope between 25%(14^0) and 60%(31^0) defective terracing. (iii) Slope over 60% (31^0) with proper terracing.	(i) All unterraced fields with gullies, cut up and heavy silt discharge. (ii) All defective terraced fields beyond 60% (31^0) slope.
2. Grass land: (i) Natural slope upto 60%(31^0) and density of grass or bush cover exceeding 0.7, no rills.	(i) All slopes, density of grass or bush cover between 0.3 and 0.7 (ii) Natural slope exceeding 60%, vegetation density exceeding 0.7 (iii) Gullies less than 0.3 metre in depth and upto 60 metre in length per ha.	(i) All slope with density of vegetation less than 0.3 (ii) Gullies deeper than 0.3 m and length upto 60m per ha. or gullies upto 0.3 m deep and length more than 60m per ha.	(i) Badly gullied or ravined, soil exposed, heavy silt discharge.

(3) Wood land: (i) Natural slope upto 60% and density of top canopy of tree species exceeding 0.7, no gullies or rills.	(i) All slope, density of vegetation between 0.5 and 0.7. (ii) Natural slope exceeding 60%(31^0) vegetation density exceeding 0.7. (iii) Gullies less than 0.2m deep and covering less than 60m per ha.	(i) All slope with density of vegetation less than 0.5 (ii) Gullies deeper than 0.2m and length upto 60m per ha. or gullies upto 0.2m deep and length more than 60m per ha.	(i) Badly gullied or ravined, heavy silt discharge.
(4) Roads: (i) All roads with arrangements for the disposal of run off, banks upto 5m of centre of road protected through stable rocks or vegetation cover.	(i) All roads with defective arrangement for the disposal of excess water, gullies upto 0.1m deep and or slope upto 1m high along 25% length of berms	(i) All roads with defective arrangement of excess water, gullies more than 0.1m deep and or slope exceeding 1m high along more than 25% length of berms.	(i) Badly gullied or ravined, soil exposed, heavy silt discharge.
(5) Streams: (i) Banks low, vegetated, otherwise stabilized, upto 75% of the length of bed clear, practically no silt contribution.	(i) Banks upto 50% of length vegetated or otherwise stabilized banks, liable to undercutting, bed rising with no clear land formation.	(i) Banks upto 25% length vegetated or otherwise stabilised, banks being undercut, bed with clear land formation, channel meandering.	(i) Channel branched, serious under cutting of banks heavy silt discharge.

ANNEXURE - 14

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