CATCHMENT AREA TREATMENT PLAN

FOR

KUTEHR HYDRO ELECTRIC PROJECT (240 MW)

IN

CHAMBA DISTRICT OF HIMACHAL PRADESH

Prepared by:

ENVIRONMENT IMPACT ASSESSMENT DIVISION
Directorate of Extension
INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION
(An Autonomous Council of the Ministry of Environment and Forests, Govt. of India)
P.O.-NEW FOREST, DEHRADUN-248 006 (UK).

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CHAPTER-1: INTRODUCTION

1.1 INTRODUCTION

The Indian power sector is going through an exciting growth phase leading to capacity addition in generation, transmission, and distribution, and a stable regulatory environment coupled with a focus on rural electrification, nuclear, and renewable sources of energy. India's demand for power is expected to soar to 800 GW by 2032, which implies a six fold growth of the current capacities in about next 25 years. The Government of India has taken various steps to enable the growth in capacity. The Planning Commission has set a target to add 78 GW of capacity in the XI-Five Year Plan for 2007–2012. As of March 2009, 12,467 MW has already been commissioned. Given various constraints the Government of India has envisaged in its Mission 'Power to All' by 2012, achievement of this target requires development of large capacity projects. The energy policy also facilitates an environment conducive to sustainable private sector involvement. Accordingly, the natural resources rich states like Himachal Pradesh, Uttrakhand, Chhattisgarh and North Eastern states are tapping the hydro power potential to meet the power demand involving private sector.

1.2 HYDROPOWER POTENTIAL IN HIMACHAL PRADESH

Himachal Pradesh has identified more than 20,000 MW of hydropower potential. Out of which less than 7,000 MW has been developed. It has five perennial rivers of Indus water system:-Chenab, Yamuna, Ravi, Sutlej and Beas-with significant potential for hydro power development. The basin wise hydropower potential identified in the state is given in **Table 1.1**.

Table-1.1: Basin-Wise Hydropower Potential in Himachal Pradesh

Basin	Hydro Power Potential (MW)
Beas Basin	4,564
Ravi Basin	2,305
Sutlej Basin	9,211
Yamuna Basin	1,011
Chenab Basin	3,287
Mini Micro Projects	530
Total	20,908

(Source: HPSEB Website)

1.3 HYDROPOWER POTENTIAL OF RAVI RIVER

The total potential of the Ravi basin as identified by the state is given in **Table 1.2.**

Table-1.2: Hydropower Projects in Ravi basin

Sl. No.	River / Nallah	Project	Capacity MW
1	Gharola Nallah	Gharola	0.05
2	Sal Nallah	Sal Stage-II	2
3	Sal Nallah	Bhuri Singh P/H	0.45
4	Baira Suil	Baira-Suil	198
5	Ravi River	Chamera Stage-I	540
6	Ravi River	Chamera Stage-II	300
7	Holi Nallah	Holi	3
8	Ravi River	Bajoli Holi	180
9	Ravi River	Chamba	126
10	Ravi River	Bara Bhangal	200
11	Budhil Nallah	Harsar	60
12	Budhil Nallah	Bharmour	45
13	Budhil Nallah	Budhil	70
14	Ravi River	Sai-Kothi	17
15	Sal Nallah	Sal Stage-I	6.5
16	Ravi River	Chamera Stage-III	231
17	Siul Nallah	Siul	13
18	Ravi River	Kutehr	240
19	Chanju	Chanju-I	36
20	Chanju	Chanju-II	17
		Total	**2305**

1.4 LOCATION AND APPROACH

Kutehr Hydro-electric Project has been contemplated as R-o-R scheme (barrage) across the Ravi. It envisages utilization of water through a max/min gross head of 307.35/297.2 m respectively for generation of 984 MU of power in 90% dependable year.

The project is located in Tehsil Bharmour of district Chamba of Himachal Pradesh. The diversion barrage on river Ravi shall be located 4 km down stream of village Holi at longitude 76°31'58" E and latitude 32°20'52" N and is accessible through existing Chamba-Holi road. The underground power house shall be located on the left bank of the river Ravi near village Suhaga at 1 km up stream of Kharamukh village. The nearest rail head is Pathankot, which is about 184 km from the project site. The general layout plan and L-section of the barrage are shown in **Figure-1.1** and **Figure-1.2**. The barrage location is shown in **Figure-1.3**.

1.5 SALIENT FEATURES OF THE PROJECT

Project Location	
State	Himachal Pradesh
District	Chamba
River	Ravi
Vicinity	Holi Village
Hydrology	
Catchment Area	1155 km²
Area under snow	305 km² (26.41%)
Rain fed area	850 km²
Elevation of snow line	Et. 4500 masl
Standard project flood	8328 m³/s
One day standard project storm	30.2 cm
Design flood (1 in 100 yr)	6681 m³/s
Design flood for diversion	302 m³/s
Reservoir	
Full Reservoir Level (FRL)	El 1706.75 masl
Minimum Draw-Down Level (M.D.D.L)	El 1700.00 masl
Live storage	0.65 MCM
Barrage Spillway	
Latitude	32°20'52"
Longitude	76°31'58"
Top of Barrage	El 1708.0 masl
Stream Bed Level	El 1681 masl
Barrage height from foundation level	27 m
Barrage Foundation Level (Lowest)	El 1681.0 masl
Barrage Height from Foundation Level	30 m.
Barrage Length	193.5 m
Barrage Crest Elevation	El 1685.0 masl
Gate Type and Size (W x H)	5 Nos. Radial; 11 m x 12.5 m
Hoist type and capacity	Twin hydraulic cylinder (2 No., 125 T)
Stop log type and size (W x H)	Vertical lift slide type, 11m x 12.5 m (1 No)
Hoist type and capacity	Gantry crane, 40 MT
Intake (On Left Abutment)	
Intake well	15.45 m x 14.0 m x 17.0 m
Crest elevation of intake well	El 1689 masl
Nominal discharge	116.20 m³/s
Trash rack size	4 Nos. 3.5 m x 10.0 m
Clear opening between trash bars	100 mm
Gate type	Vertical lift fixed wheel type
Gate size (W x H)	2 No., 3.5 m x 4.75 m
Hoist type and capacity	Rope drum hoist, 20MT
Cut & Cover Section	
No. & size and shape	2 Nos., 3.5 m (W) x 4.75 m (H) Rectangular
Invert level	El 1689.0 masl
Length of each limb	15 m

Feeder Tunnels	
Nos. and size (W x H) (d/s part) Length	2 Nos. modified D-shaped 3.5 m x 5.0 m 644 m/585 m

De-sanding Chambers	
No. & size (L x H x W)	2 Nos., 290 m x 15 m x 15.9 m
Size of particle to be removed	> 0.2 mm
Average discharge for each chamber	53.24 m³/s
Flushing discharge	19.36 m³/s
Link Tunnels	
Nos. and size (W x H)	2 Nos. modified D-shaped 3.5 m x 5.0 m
Gate type	Vertical lift fixed wheel type
Gate size (W x H)	2 Nos. 3.3 m x 5.0 m
Hoist type and capacity	Rope drum hoist, 10 MT
Headrace Tunnel	
Excavated shape	6.8 m diameter circular
Finished size	6.2 m diameter circular
Lining type	Concrete lined
Lining thickness	300 mm
Length / slope	14602 m; 1:345 (excluding length of aqueduct)
Design discharge and velocity	96.8 m³/s; 3.21 m/s
Aqueduct	
Location	On Solun nalla
Size	4.0 m diameter circular
Lining type	Steel lined
Design discharge and velocity	96.8m³/s; 7.70 m/s
Surge Shaft	
Type	Open to sky Restricted Orifice Vertical Shaft
Diameter	15 m
Orifice Area	5.3 m² (Rectangular)
Orifice top	El 1649.55 masl
Surge Shaft Top	El 1737.00 masl
Total height	87.45 m
Upsurge	El 1735.7 masl
Downsurge	El 1668.5 masl
Gate Type	Vertical lift fixed wheel type
Gate size (W x H)	1 No., 3.4 m x 4.35 m
Hoist Type and Capacity	Rope Drum Hoist, 75 MT
Pressure Shaft	
Number and diameter	1 No. 4.35 m
Thickness of Liner	22-36 mm
Type of steel	ASTM A517 GR-F & A537 GR-II
Total length of pressure shaft	317.425 m
Design discharge through each pressure shaft	96.8 m³/s
Unit Penstock	
No. & Dia	3 Nos., 2.5 m
Combined Length	113.4 m
Underground Powerhouse	
Latitude	32°27'36"N
Longitude	76°27'36"E
Dimensions (W x H x L)	19 m x 440 m x 90 m
Turbine Type	Vertical Axis Francis Turbine
Number of units	3
Unit Tailrace Tunnel	
Length / slope	71 m; 1:11.08
Shape	Rectangular shaped, 6.25 m (W) x

	3.0 n (H)
Tailrace Tunnel	
Length / slope	275 m; 1:42.3
Shape	Circular, 6.2 m dia
Tailrace outfall gate type	Stop log
Tailrace outfall gate size (W x H)	1 No. 5 m x 6.2 m
Outlet invert elevation	El 1397 masl
Estimated Cost	
Civil works	808.83 Cr
E & M works (excluding transmission line cost	281.81 Cr
Total basic cost	1090.64 Cr
Escalated cost for Civil and E & M works	346.81Cr
Interested during construction & financing charges	360.68 Cr
Total (generation works)	1798.13 Cr
Cost per MW installed	7.49 Cr
Power Benefits	
90% dep. Energy/Design energy	984/969 MU
Financial Aspects	
Levellised Tariff / Kwh (with free power to the state)	Rs. 3.86
Construction period	**5 years**

1.6 PROJECT SPECIFIC

Kutehr Hydro-Electric Project (240 MW) has been allotted to M/S JSW Energy Ltd. for implementation. The implementation agreement has been signed on March 1, 2008 with H.P government. Environmental clearance has been granted to the project, vide letter No. J-12011/67/2007-IA-I, dated July 5, 2011 by Ministry of Forest & Environments, New Delhi, copy enclosed as **Annexure-I**. The Central Electricity Authority, New Delhi, has granted the **TEC Clearance** vide their letter No. 2/HP/25/CEA/98-PAC/3698-3727 dated August 31, 2010, copy enclosed as **Annexure-II**. The total estimated completed cost granted under TEC clearance is Rs. 1798.16 Crore and shown in **Table-1.3**.

Table-1.3: Abstract of Cost

S. No	Description	Amount (in Crores)
i)	Civil works	1005.41
ii)	E & M works	386.65
iii)	Interest during construction	353.94
iv)	Financing Charges	06.74
	Total Project Cost	**1798.16**
v)	Local Area Development @ 1.5% of the Project Cost	26.97
	Grand Total	**1825.13**
vi)	CAT Plan Charges @ 2.5% of the project cost, already included under sl. No. 1 – Civil Works	45.00
	Grand Total	**1870.13**

1.7 MANDATORY REQUIREMENT FOR SUBMISSION OF CAT PLAN

The project involves diversion of 61.4083 ha of forest land lying in Tretha range, within jurisdiction of Forest Division, Bharmour under administrative control of Conservator, Chamba Forest Circle. Therefore, as per para 4.8 A added to Forest (Conservation) Act, 1980 vide MoEF circular No. 11-14/94-FC dated 1.11.2001, it has been made mandatory for project proponent to formulate and accompany CAT Plan for hydro-electric/river valley projects, while submitting proposal for diversion of forest land for non-forestry purpose and provide funds for its implementation. In the wake of this provision, the project proponent have allotted the work of preparation of CAT Plan to ICFRE, Dehradun, who after having carried out detailed field survey/Remote sensing have come up with an elaborate CAT Plan costing Rs. 4500 lac. The abstract of cost of components of CAT plan are shown in **Table-1.4**. With increase in Project Cost, Outlay of CAT Plan will be revised proportionately and review will be done after every Two years.

Table-1.4: Abstract of Cost of CAT Plan of Kutehr HEP (240 MW)

Sr. No.	Items	Out Lay(in Lacs)
1.	Afforestation measures (25%)	1125.00
2.	Soil & Water Conservation measures (25%)	1125.00
3.	Payment for Environmental services including Eco-Tourism (10%)	450.00
4.	Research, Training & Capacity Build-up (5%)	225.00
5.	Infrastructure build-up & Forest Protection (15%)	675.00
6.	Improvements & Development wildlife & wildlife habitate (5%)	225.00
7.	Monitoring & Evalution (7%)	315.00
8.	Support for Preparing Site Specific plan (3%)	135.00
9.	Contingency (5%)	225.00
	TOTAL OUTLAY(in Lacs)	**4500.00**
	Rupees Four Thousand Five Hundred Lac Only	

Catchment Area Treatment Plan has been prepared based on the Site specific requirements and the guidelines laid down by Forest department H.P. The Toposheet of the Catchment Area for Kutehr HEP is attached at **Annexure- III.**

CHAPTER-2: PHYSICAL AND WATER ENVIRONMENT

2.1 TOPOGRAPHY

Lying mostly astride the main Himalayas and touching the Shivaliks on the southern fringe, the catchment area of the river Ravi is rugged and covered with the spurs of the high ranges. The Dhauladhar range separating the basin of river Beas from that of the river Ravi, the Pangi or Pir Panjal range dividing the water shed between the river Ravi and the river Chenab and Zaskar range bifurcating the basins of Chenab and Indus are three well defined snowy ranges, constituting the main topographical features of the area.

The Dhauladhar range running in North-West direction forms the boundary between Mandi and Kullu Districts, at the point where it gives off Bara-Bangahal branch to join the mid Himalayas. It makes a sudden bend westward and for the first time touches the boundaries of District Chamba, on the southern border. From this point, it continues for about 50 kms. forming the boundary between District Kangra and District Chamba.

The Zanskar range is the most direct continuation of the main Himalayan axis. It runs in North-West direction, dividing Ladakh from Lahaul-Spiti and then touches District Chamba, for a short distance along its northern border, separating Chamba and Lahaul-Spiti from Zanskar.

The Pir Panjal range known as the Pangi range within District Chamba after separating District Kullu from District Lahaul-Spiti, enters District Chamba on the western border of the Bara-Bangahal and traverses the district from South-East to North-West for more than 100 km. On the North-Western border, where the Pangi range leaves the territory, it gives off a branch to the South-West called the Daganidhar which forms the boundary between Chamba and Bhadrawah of Jammu and Kashmir. At its western extremity, this branch is connected by a short ridge, in which are the Padri and the Chatardhar passes. Topographically, the Dagnidhar and the Chatardhar are different sections of one continuous offshoot, forming with the Pangi Range, the water shed between the Ravi and the Chander-Bhaga (Chenab).

2.2 RIVER RAVI AND ITS TRIBUTARIES

River Ravi originates from Bara-Bangahal at an elevation of 4229 m above mean sea level, approximately 150 km North-East of historical Chamba town. It flows in steep gradient with series of loops and bends. In between, main tributaries like Kalihan, Budhil, Tundah, and Suil & Sewa contribute lot of run-off to the Ravi. Bara-Bangahal comprises of snow covered slopes at heights ranging from 3050 m to 5800 m, above mean sea level. The total length of the course of the river Ravi is about 720 Kms.

The basin represents some remarkable physical features. The river flows in a North-West direction for most of its course, rises in Baira-Balsio and continues through Traila and Chanota to Ulans, where it is joined by two of its major

tributaries in the head reaches viz. Budhil and Tundah. Beyond this, upto Chhatrari, river flows through a narrow gorge whereafter it opens out. After passing through Churi, Bagga, Mehla, Chamba and Udaipur, the river approaches Rajnagar, and then flows in narrow gorge to Sherpur. The Sull river, its largest tributary, joins the river Ravi upstream of Chamera Stage-I dam site. The Sewa river flowing from the north joins the river Ravi near Khairi. It then bends to the South-West and striking the terminal spurs of the Dhauladhar range, separates Chamba from Jammu and Kashmir and finally leaves the territory of Himachal Pradesh up stream of Ranjit Sagar Dam (Punjab).

Budhil nallah has its origin on the slopes of the mid Himalays near Kugti pass. At Harsar, it receives on its left bank the small stream from sacred lake of Mani-Mahesh, situated beneath the peak called the Mani-Mahesh, Kailash at an El. 3952 m. It passes village Bharmour downstream and soon afterwards meets the Ravi near village Kharamukh.

Tundah nallah rises at Kalichtop pass, flows through Tundah valley and joins the Ravi near Kharamukh. The right bank tributaries are bigger and have more discharge as compared to the left bank tributaries except Kalihan, which originates in Dhauladhar range on the left bank and contributes a good discharge. Both Budhil & Tundah are about 54 km in length.

2.3 CATCHMENT

The Ravi, is one of the important glacier-fed river systems of western Himalayas originating from Bara Bhangal, flows in east-westerly direction up to the proposed diversion site of Kutehr HEP (240 MW), located at about 4 km downstream of village Holi, at Longitude 76°31'58" E and Latitude 32°20'52" N. The Ravi has its genesis in the confluence of right bank stream, i.e., Bhadal Nala originating from Bhadal glacier at El 4400-4600 masl and Ravi and Tantogri nala originating from Tantogri glacier at El 4000-4400 masl. From Bara Bhangal the river flows for about 3 km and is joined by Paed Nala. Thereafter at RD 5.2 km it is joined by Pher Nala. Up to the proposed barrage site it has right bank tributaries in torrents like Pher ka Nala, Raula ka Nala and Kunkali Nala, Dug ka Nala, Gwari ka Nala, Kala Nala and Oi Nala, besides left bank tributaries like Dera Nala, Luain, Kuthed, Holi and Tulang Nala. The total catchment area of the Ravi up to the proposed barrage site is 1155 sq km., out of which the free draining catchment area extending to next upstream Bajoli-Holi HEP (180 MW) is 246.38 sq km.

2.4 CLIMATE

The climate of Ravi basin is affected by the tropical weather systems during summer and the cold weather systems known as 'Western Disturbances' during winter and pre-monsoon months. The project basin broadly experiences summer, monsoon, autumn and winter seasons.

2.5 METEOROLOGICAL CHARACTERISTICS

The month wise climatological data for the period 1951-1980, as observed at IMD station, Dalhousie, nearest to the project site, is presented in following table.

Climatic Data of IMD Dalhousie for the Period of 30 Years (1951-1980)

Month	Average Air Temperature		Relative Humidity		Mean wind Speed	Prevailing Wind Direction
	Highest in the month	Lowest in the month	Average (at 8:30)	Average (at 17:30)	Average	
	°C	°C	%	%	Kmph	
JAN	17.2	-2.6	62	73	3.4	NE
FEB	19.2	-2.2	61	69	3.7	NE
MAR	24.0	0.8	57	64	4.6	NE
APR	27.1	4.5	56	56	4.8	NE
MAY	30.5	7.3	52	50	5.5	NE
JUN	31.3	10.7	60	55	3.7	NE
JUL	27.9	12.8	84	81	1.9	NE
AUG	26.0	13.2	88	85	1.4	NE
SEP	25.8	10.6	81	82	1.9	NE
OCT	25.2	6.2	62	70	2.6	NE
NOV	21.9	2.9	54	68	2.5	NE
DEC	19.6	-0.7	56	68	2.8	NE

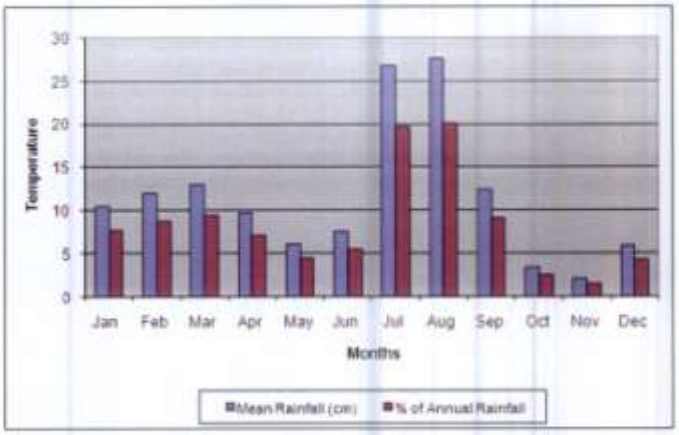
2.5.1 Rainfall

Bharmour is the only rain gauge station near the project basin where long term rainfall records are available. At this station, average annual rainfall has been computed as 1326 mm. The detail of mean monthly rainfall for the Ravi basin is given below.

Mean Monthly Rainfall of Ravi Basin

Month	Mean Rainfall (cm)	% of Annual Rainfall
Jan	10.5	7.7
Feb	11.9	8.7
Mar	13.0	9.5
Apr	9.7	7.1
May	6.1	4.5
Jun	7.6	5.5
Jul	26.8	19.6
Aug	27.6	20.1
Sep	12.4	9.1
Oct	3.4	2.5
Nov	2.1	1.5
Dec	5.9	4.3
Total	**137**	

Source: [Generalized PMP Atlas of Indus Basin in India, CWC, 2007]



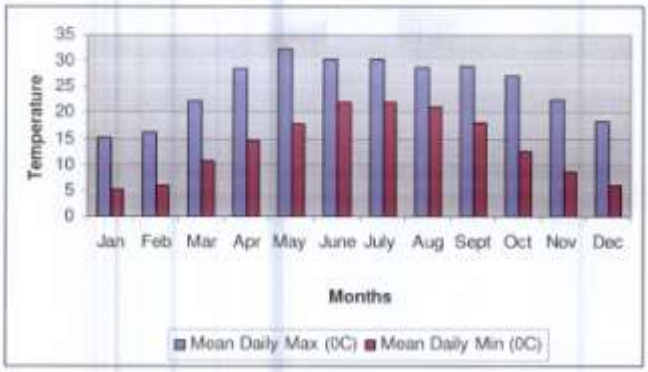
Mean Monthly Rainfall for the Ravi Basin

2.5.2 Temperature

Temperature record nearest to the project basin is available at Chamba, which is located 75 km downstream of the project. Details of mean daily maximum and minimum temperature during different months are given below.

Mean Daily Maximum and Minimum Temperature at Chamba

Sl. No.	Month	Mean Daily Max Temp (°C)	Mean Daily Min Temp (°C)
1.	January	15.2	5.2
2.	February	16.1	5.9
3.	March	22.3	10.6
4.	April	28.6	14.6
5.	May	32.5	17.8
6.	June	30.4	22.0
7.	July	30.4	22.0
8.	August	28.8	21.2
9.	September	29.1	18.1
10.	October	27.1	12.6
11.	November	22.5	8.5
12.	December	18.3	5.9



Mean Daily Maximum and Minimum Temperature at Chamba

2.5.3 Relative Humidity

The monthly mean relative humidity data (0830 hrs and 1730 hrs.) observed at IMD station in Dalhousie that is very near to the study area have already been depicted in **Table-2.1**. The data show that relative humidity varies from 50 % to 88 %. The month of May is observed to have the lowest humidity, whereas maximum humidity is observed during the month of August.

2.6 GEOLOGY OF THE PROJECT

The proposed Kutehr Hydroelectric Project is envisaged in Ravi Basin in Chamba district in western part of Himachal Pradesh, located between Pir Panjal and Dhauladhar mountain ranges. According to Srikantia and Bhargava (1998), the Chamba Basin is located in Tethys Himalayan Tectogen in which a thick sequence of Proterozoic and Upper Paleozoic–Mesozoic rocks is exposed. These formations are co-related with similar rock types of Bhaderwah in Jammu & Kashmir in the northwest and the Proterozoic rocks are considered extension of similar rocks exposed in Lahaul in southeast. Based on the works of Geological Survey of India and several others, Srikantia and Bhargava (1998) have established the stratigraphic sequence of the area, as given below.

Geological Succession in Chamba Area

Formation	Age	Lithology
Khalei	Triassic	Grayish blue, gray and yellow limestone and dolomite with inter-bedded gray orthoquartzite in the upper part and gray calcareous shale with inter beds of limestone in basal part
Salooni	Permian	Dark gray or black carbonaceous & pyritous slates with this lenticles of limestone. Thin discontinuous

Formation	Age	Lithology
		bands of amygdaloidal and massive lava flows of basaltic to andesitic composition are observed at places
Batal or Katarigali	Terminal Proterozoic	Black carbonaceous phyllite with inter beds of quartzite. Local limestone bed at the base with magnesite and gypsum
Manjir	Neoproterozoic	Polymictic diamictite – poorly sorted, lithologically heterogeneous, laminated or banded
Chamba	Neoproterozoic	Mainly laminated chloritic slate with greywacke and intercalated carbonaceous slate
		Mainly greenish grey or dark grey meta greywacke with slate and subordinate quartzite

2.7 SOIL

The soil in the area in general is quite shallow gravelly and impregnated with weathered fragments of parent rocks. The soils have developed under unique environment of natural forest vegetation. The surface layer upto 15 cm is of dark brown to black colour, sandy with loose and un-decomposed organic matter and rich in humus at depths ranging from 15-50 cm. The slope soils compose of silt and are good for vegetation. Rocks are weathering due to heavy rainfall. The texture varies from sandy loam to loamy sand.

The EIA report of the HEP conducted by the ICFRE, Dehradun, reveals that the soil is slightly basic at all the locations having pH varying from 6.80 to 8.50 in pre-monsoon, 6.59 to 8.40 in monsoon and 6.70 to 8.20 in post-monsoon. The texture of the soil varies from sandy loam to loamy sand having predominantly sand. The moisture content of the soil varies from 5.50 to 7.20% in pre-monsoon, 6.94 to 11.08 in monsoon, and 4.80 to 10.20% in post monsoon. Sodium absorption ratio varies from 1.45 to 1.80 in pre-monsoon, 1.40 to 1.60 in monsoon and 1.45 to 1.60 in post-monsoon. The micronutrients are found in all the samples.

2.8 WATER QUALITY

On the basis of the physicochemical and biological characteristics of the samples collected during the pre-monsoon (May 2008), monsoon (August 2008) and post-monsoon seasons (November 2008), it is revealed that the quality of surface water is generally good. Its pH varies from 7.05 to 7.88. Dissolved oxygen varies from 8.0 to 9.6 in surface water samples. The other parameters are meeting the requirements of drinking water quality standard except the bacteriological parameters in surface water samples.

2.9 DISCHARGE DATA

The 10 daily flow of Ravi at project site in 50% and 90% dependable year is enumerated below.

Year	10-Daily	Average 10-Daily	50% Dep. Year Flow	90% Dep. Year Flow
Jun	I	112.5	104.2	42.6
	II	128.2	130.8	31.7
	III	145.6	142.4	59.7
July	I	154.6	116.9	121.7
	II	153.0	140.0	137.6
	III	143.7	149.4	173.2
August	I	146.1	133.1	189.4
	II	128.8	116.9	114.0
	III	112.4	101.0	97.5
September	I	98.7	99.5	78.2
	II	86.4	85.6	35.1
	III	65.4	63.7	17.3
October	I	42.2	40.5	18.7
	II	36.9	34.7	16.8
	III	29.2	31.6	15.7
November	I	25.5	26.6	14.3
	II	22.7	25.5	12.8
	III	20.2	23.1	12.1
December	I	18.6	20.8	11.9
	II	17.4	18.5	11.4
	III	16.2	17.9	11.1
January	I	15.6	18.5	11.0
	II	14.7	18.5	10.6
	III	14.5	16.8	10.6
February	I	14.7	16.2	10.8
	II	15.6	19.7	11.5
	III	17.4	20.3	12.8
March	I	19.8	18.5	16.5
	II	23.4	24.3	24.9
	III	28.7	30.5	29.6
April	I	35.1	28.9	28.2
	II	43.6	41.7	33.0
	III	58.9	69.4	50.7
May	I	78.1	82.2	76.0
	II	89.5	70.6	111.3
	III	97.8	91.5	104.4

CHAPTER-3: SOCIO-ECONOMIC PROFILE

3.1 INTRODUCTION

Since time immemorial mankind has a great affinity to forests. The forest has been haven for primitive man and continues to be so even today for nomadic tribes. Forest plays a pivotal role in the social, economic and rural development of a country in general and in mountainous area in particular, aside its role in maintaining ecological stability, particularly, in the context of a developing country. Forests constitute a traditional resource of multitude of produce with regard to fuel wood, fodder, small and constructional timber and have always sustained large masses of population surrounding these. Of late, forests have been subjected to tremendous pressure due to indiscriminate and un-inhibitive removal of timber, fuel wood, fodder, resin, NTFP and other forest produce. In fact, anthropogenic activities are responsible for none-to-good situation frequently witnessed in the forests. In the wake of all these factors, the assessment of socio-economic set-up of the dwelling areas in the catchment is all the more important as on its basis reasons contributing for deterioration of forests can be ascribed. The understanding of social milieu is a pre-requisite before embarking upon the formulation of watershed management plan.

3.2 DEMOGRAPHIC PROFILE OF VILLAGES IN THE FREE DRAINING CATCHMENT

The free draining catchment has its bounds within the jurisdiction of Tretha range of Bharmour Forest Division, Himachal Pradesh. The area is encompassed within three beats i.e. Tiyari, Sutkar and Deol of Holi Forest Block; Bajol and Naya Gaon beats of Barabanchu Forest Block. The actual resident population, as enumerated (Census Data: 2001) is 5871, out of which, 3103 are male (52.85%) and 2768 are female (47.15%). The sex ratio of the resident population is 892 female to 1000 male. Demographic profile of the free draining catchment is given in **Table-3.1**.

Table-3.1: Demographic Profile of the Free Draining Catchment

Sl. No.	Name of village	No. of Household	Total Population	Male	Female
1	Kutehr	70	323	177	146
2	Sutkar	94	523	276	247
3	Andaria Graon	47	226	111	115
4	Banun	54	256	133	123
5	Holi	262	1028	552	476
6	Gowhla	66	339	174	165
7	Kuleth	101	451	241	210
8	Gwari	96	446	238	208
9	Deol	108	615	316	299
10	Kiur J	8	63	30	33
11	Gharau	62	290	160	130
12	R.F Sawin	1	1	1	0
13	Navei	6	21	12	9

Sl. No.	Name of village	No. of Household	Total Population	Male	Female
14	Chuned	27	118	68	50
15	Naya Graon	31	110	60	50
16	Garaunda	41	222	114	108
17	Bajol	53	175	84	91
18	Gowari	19	89	48	41
19	Kaiah	22	114	65	49
20	Jhiki Tiari	54	242	129	113
21	Uperli Tiari	48	219	114	105
	Total	**1270**	**5871**	**3103**	**2768**
	%			**52.85**	**47.15**

3.2.1 Profile of the Villages of Free Draining Catchment

In total, twenty-one villages are covered under the free draining catchment of the proposed project. These villages fall under the Hali Sub - Tahsil of Chamba district of Himachal Pradesh. The region is notified as tribal area of Himachal Pradesh and is dominated by the Hindu community, consisting of both general and scheduled castes. The general group further consists of mainly Brahmins and Rajputs. Gaddi tribe is also dominant in the area. The main occupation of the Gaddi tribals is shepherding. There are farmers, weavers and tinkers (a mender of metal household utensil) also in the area. In earlier times, many people indulged in crushing of millets and carrying of loads to make a living for themselves. Gaddis have strict moral values and stick to them in even worst of circumstances. The social structure is given in **Table-3.2**.

Table-3.2: Social Structure of the Villages

Sl. No.	Village	SC population	Male	Female	ST population	Male	Female
1	Kutehr	140	73	67	182	103	79
2	Sutkar	96	52	44	426	223	203
3	Andaria Graon	27	13	14	198	97	101
4	Banun	54	29	25	202	104	98
5	Hali	170	87	83	532	277	255
6	Gowhia	0	0	0	338	173	165
7	Kuleth	58	31	27	368	194	174
8	Gwari	38	18	20	396	212	184
9	Deol	124	62	62	455	234	221
10	Kiur)	0	0	0	63	30	33
11	Gharau	0	0	0	225	119	106
12	R.F sawin	0	0	0	0	0	0
13	Navei	0	0	0	14	7	7
14	Chuned	0	0	0	118	68	50
15	Naya Graon	0	0	0	96	49	47

Sl. No.	Village	SC population	Male	Female	ST population	Male	Female
16	Garaunda	1	1	0	221	113	108
17	Bajol	17	10	7	155	71	84
18	Gowari	0	0	0	89	48	41
19	Kaiah	0	0	0	114	65	49
20	Jhiki Tiari	0	0	0	238	125	113
21	Upreli Tiari	0	0	0	238	125	113
Total		**725**	**376**	**349**	**4668**	**2437**	**2231**
%		**12.34**	**51.86**	**48.14**	**79.50**	**52.20**	**47.80**

3.2.2 Education Status

In the free draining catchment area, the literacy rate of the population is 51.93%. The percentage of male and female literate is 59.45% and 43.49% respectively. The educational status is presented in **Table-3.3**.

Table-3.3: Educational Status of the Area

Sl. No.	Village	Population Literate	Male	Female	Population Illiterate	Male	Female
1	Kutehr	159	103	56	164	74	90
2	Sutkar	274	166	108	249	110	139
3	Andaria Graon	99	58	41	127	53	74
4	Banun	111	67	44	145	66	79
5	Holi	614	367	247	414	185	229
6	Gowhla	193	115	78	146	59	87
7	Kuleth	244	154	90	207	87	120
8	Gwari	250	159	91	196	79	117
9	Deol	307	184	123	308	132	176
10	Kiur	36	18	18	27	12	15
11	Gharau	122	77	45	168	83	85
12	R.F Sawin	0	0	0	1	1	0
13	Navei	4	2	2	17	10	7
14	Chuned	49	33	16	69	35	34
15	Naya Graon	59	36	23	51	24	27
16	Garaunda	118	66	52	104	48	56
17	Bajol	91	53	38	84	31	53
18	Gowari	46	26	20	43	22	21
19	Kaiah	53	35	18	61	30	31
20	Jhiki Tiari	126	73	53	116	56	60
21	Upreli Tiari	94	53	41	125	61	64
Total		**3049**	**1845**	**1204**	**2822**	**1258**	**1564**
%		**51.93**	**59.45**	**43.49**	**48.07**	**40.54**	**56.50**

3.2.3 Occupational Status

The population of the upper Ravi belt is mostly dependent on horticulture and agriculture, which is also applicable to all the population of villages falling under free draining catchment area. Very few persons are having government or private jobs and business. As the area is hilly and there is no industry in the area, people are dependent on agriculture for their livelihood. So the main occupation of villagers in all the twenty-one villages is agriculture. Some people are in jobs, business and some work as shopkeepers, as well. The total workers are 3464 (57.73%) and non-workers are 2406 (42.27%). The male and female workers are 1894 (54.80%) and 1570 (43.20%) respectively as shown in **Table-3.4**. The break-up of main workers and marginal workers, sex-wise, is depicted in **Table-3.5**. The various categories of main workers are shown in **Table-3.6**.

Table-3.4: Statistics of Male and Female Workers

Sl. No.	Village	Total worker	Male	Female	Non worker	Male	Female
1	Kutehr	210	104	106	113	73	40
2	Sulkar	342	170	172	181	106	75
3	Andaria Graon	133	69	64	93	42	51
4	Banjun	169	82	87	87	51	36
5	Hali	565	357	208	463	195	268
6	Gawhia	194	100	94	145	74	71
7	Kuleth	237	130	107	214	111	103
8	Gwari	280	150	130	166	88	78
9	Deal	340	192	148	275	124	151
10	Kiur	38	19	19	25	11	14
11	Gharau	142	93	49	148	67	81
12	R.F Sawin	0	0	0	0	0	0
13	Navei	14	8	6	7	4	3
14	Chuned	80	48	32	38	20	18
15	Naya Graon	72	46	26	38	14	24
16	Garaunda	111	56	55	111	58	53
17	Bajal	125	61	64	50	23	27
18	Gowari	52	26	26	37	22	15
19	Kaiath	75	39	36	39	26	13
20	Jhiki Tiari	152	78	74	90	51	39
21	Upreli Tiari	133	66	67	86	48	38
	Total	**3464**	**1894**	**1570**	**2406**	**1208**	**1198**
	%	**57.73 %**	**54.80 %**	**43.20 %**	**42.27 %**	**49.93 %**	**50.07 %**

Table-3.5: Break-up of Main Workers and Marginal Workers

Sl. No.	Village	Main worker	Male	Female	Marginal worker	Male	Female
1	Kutehr	163	95	68	47	9	38
2	Sutkar	265	152	113	78	18	60
3	Andaria Graon	10	10	0	123	59	64
4	Banun	6	6	0	163	76	87
5	Holi	509	341	168	56	16	40
6	Gawhia	179	97	82	15	3	12
7	Kuleth	182	129	53	55	1	54
8	Gwari	270	148	122	10	2	8
9	Deol	262	191	71	78	1	77
10	Kiur	30	19	11	8	0	8
11	Gharau	94	77	17	48	16	32
12	R.F.Sawin	0	0	0	0	0	0
13	Navoi	8	7	1	6	1	5
14	Chuned	50	48	2	30	0	30
15	Naya Graon	50	44	6	22	2	20
16	Garaunda	89	53	36	22	3	19
17	Bajol	101	56	45	24	5	19
18	Gowari	43	24	19	9	2	7
19	Kalah	71	35	36	4	4	0
20	Jhiki Tiari	132	68	64	20	10	10
21	Upreli Tiari	130	65	65	3	2	1
	Total	2644	1665	979	**821**	**230**	**591**
	%	**76.21%**	**61.81%**	**38.19%**	**23.78%**	**32%**	**68%**

Table-3.6: The Details of Various Categories of Main Workers

Sl. No.	Village	Main worker	Cultivator	Agricultural Labour	House hold Worker	Other Worker
1	Kutehr	163	133	0	0	30
2	Sutkar	265	243	0	3	19
3	Andaria Graon	10	0	0	0	10
4	Banun	6	0	0	0	6
5	Holi	509	252	0	4	253
6	Gawhia	179	165	0	0	14
7	Kuleth	182	119	0	0	63
8	Gwari	270	243	0	0	27
9	Deol	262	198	0	0	64
10	Kiur	30	26	0	0	4
11	Gharau	94	29	0	0	65
12	R.F.Sawin	0	0	0	0	0

Sl. No.	Village	Main worker	Cultivator	Agricultural Labour	House hold Worker	Other Worker
13	Navel	8	1	0	0	7
14	Chuned	50	41	0	0	9
15	Naya Gaon	50	29	0	0	21
16	Garaunda	89	52	0	0	37
17	Bajol	101	91	0	0	10
18	Gowat	43	43	0	0	0
19	Kalah	71	69	0	0	2
20	Jhiki Tiari	132	123	0	0	9
21	Upreil Tiari	130	122	0	0	8
	Total	**2644**	**1979**	**0**	**7**	**658**
	%age	**100%**	**74.85%**	**0%**	**0.26%**	**24.89%**

3.3 LAND USE OF THE FREE DRAINING CATCHMENT

The whole study area falls in the hilly terrain. Therefore, availability of agricultural land is comparatively less than forest land. Pasture land is also a part of the area to support the livestock in the project affected area. The total area under land-use classification agriculture and settlement as per satellite imagery is 2522.59 ha which constitutes 10.24% of total geographical area of free draining catchment i.e. 24638.29 ha. The area covered under other land use classes i.e. dense forest, open forest, degraded forest, open scrubs, reservoir and water body and snow is 6816.40 ha (27.67%), 5373.93 ha (21.81%), 3017.85 ha (12.25%), 3402.24 ha (13.81%), 1138.53 ha (4.62%) and 2366.74 ha (9.60%), respectively. In 29 muhals within the forest beats agriculture land also exists, the details of which are enumerated in **Table-3.7**. The details of area under Demarcated Protected Forest (DPF), Reserve Forests (RF) and Dhar area in various beats is shown in **Table-3.8**.

Table-3.7: Details of Agriculture Land within the Forest Area

Name of Beat	No. of Muhal	Private Land (ha)	Agriculture land (ha)	Horticulture land (ha)	Samlat Land (ha)	Total land (ha)
Deol	6	59.36	347.54	48.64	0.0	455.54
Sutkar	8	34.00	302.42	212.40	0.0	548.82
Tiyari	3	13.46	90.11	3.06	0.0	106.63
Naya goan	5	00.00	77.20	00.00	0.0	77.20
Bajol	6	28.40	73.20	26.00	0.0	127.60
Total	**28**	**135.22**	**890.47**	**290.1**	**0.0**	**1315.79**

Table-3.8: Details of Area under Demarcated Protected Forest (DPF), Reserve Forests (RF) and Dhar

Sl. No.	Name of Range	Name of Block	Name of Beat	Total area in Beat (ha)	Total DPF area in Beat (Ha)	Total RF area in Beat (ha)	Total Dhar Area in Beat (ha)
1	Trehta	Holi	Deol	6533.08	1871.43	104.40	4557.25
2	..	Holi	Sutkar	3983.39	641.50	175.23	3166.66
3	..	Holi	Tiyari	8353.97	1502.22	000.00	6851.75
4	..	Bara Banchho	Naya goan	9452.09	1840.67	598.12	7013.30
5	..	Bara Banchho	Bajol	6819.97	2269.51	000.00	4550.46
Total				**35142.50**	**8125.33**	**877.75**	**26139.42**

3.4 LIVESTOCK

The livestock is the most important movable asset of the people living in the villages especially in the mountain regions. The villagers depend on livestock for milk, meat, wool, transportation and ploughing. Livestock provide them with very rich nutrient manure.

The livestock such as cows, bulls, sheep, goats, etc. are the movable assets with the PAFs. **Table-3.9** shows that sheep and goats constitute major livestock population, as per survey conducted.

Table-3.9: Details of Livestock Population

Name of Beat	Buffalo	Cow	Calf	Ox	Mule	Horse	Sheep	Goats	Kids	Lamb	Total
Deol	0	296	0	263	0	54	2427	752	653	772	5217
Sutkar	0	489	0	385	0	41	1925	2178	330	387	5735
Tiyari	0	162	0	151	0	59	1136	995	289	291	3083
Naya goan	48	27	7	22	2	8	2206	1689	368	437	4814
Bajol	0	190	0	43	0	19	1153	1174	142	144	2835
Total	**48**	**1164**	**7**	**864**	**2**	**181**	**8847**	**6788**	**1782**	**2031**	**21684**

3.5 HEALTH AND NUTRITIONAL STATUS

The health status determines the nature and state of human resource development. Several economic variables like income, employment, purchasing power and poverty determine the health status of the people.

Health status of the people, in general, determine: the average expectation of life, number of persons in the productive age group, production, productivity, earning capacity, employment and family welfare. The determinant factors of health status include food, nutrition, hygiene, medical facilities, and socio-cultural implications of health, environmental aspects, education, psychology and worldview of the people. The health status is manifested in general in the form of prevalent infant mortality rate, life expectancy, morbidity, maternal mortality, level of fertility and mortality etc. Besides this, the health status is connected to the hygienic conditions and nutritional status of the person concerned. The hygienic condition can be understood in terms of personal hygiene, domestic hygiene, environmental hygiene and the community hygiene. The nutritional status denotes the quality and quantity of the staple food, pulses, oil seeds, milk products, vegetable, flesh food and drinks.

During the survey, the general appearance of the locals, their hygienic conditions and the dietary pattern showed that the populace is living in a hygienic and healthy condition. However, people suffer from minor problems like eye and skin ailments, common cold and fever. Proper medical aid facilities do not exist in the village and the people depend on their age-old health care practices.

The staple food is chapatti made from wheat and maize flour and rice. Pulses and different vegetables are other major food items. Availability of milk and milk products to the villagers is very good due to large number of livestock in the area.

3.5.1 Source of income

Agriculture is the main occupation of the people of the project affected area for the source of income. Due to steep terrain, mostly terrace farming is carried out. Most of the area in the project affected villages is good for horticultural crops such as apple and walnut. Wheat and Maize are the major cereal crops of the region with *rajmah, kala mah, masoor* being the main pulses of the region. Amongst the fruiting trees, apple and walnut are common.

3.5.2 Dependency on Natural Resources

In rural India, especially in hills rich in natural resources, the people are dependent on natural resources for their daily life. Water from river and springs play major role in the lives of the people. They depend on forests for fuel, fodder and medicinal plants. Almost every family takes 1-2 head loads of fuel wood on daily basis. The locals also catch fish from the river for self consumption.

3.6 EXISTING RIGHTS OF PEOPLE

Grazing:
In almost all the forests, rights for grazing exist for each demarcated and un-demarcated forests. The field studies conducted indicated that the bulk requirement of the fodder is met from the forest area. The Forest Settlement, 1921 provides for free grazing to all animals of the right holders in their own chaks and no ceiling has been fixed on the number of cattle that might be grazed. Grazers availing summer grazing facilities in the alpine pastures are not allowed to graze their animals outside chaks unless allowed as special concessions or through payment of a certain grazing fee. A large number of cattle graze in these forests leading to great damages to the vegetation as well as to the plantations. This right of grazing comes into the teeth of periodical closure for raising plantations of different species as the consent of the local people is to be obtained before plantation work can be undertaken.

Collection of fuel wood:
People have the right to collect dry and fallen wood for their domestic use as per the forest settlement record. In the project area people depend entirely upon fuel wood for their day to day use. Annual consumption of fuel wood per house hold has been assessed to be 7.00 tones, @ 20 kg/day, during the field survey.

Timber:
People have the right to get timber at nominal rates for construction/repair/maintenance of their houses. The concession rates were fixed at the time of forest settlement. No limit on the number of trees to be sanctioned was placed.

Cutting of Grass and lopping of trees:
People have the right to cut grass and lop trees for fodder purpose. Cutting of grass is being done as of present in the forests without paying any fees to the Forest Department.

CHAPTER-4: CATCHMENT AREA TREATMENT PLAN

4.1 NEED FOR CATCHMENT AREA TREATMENT

It is a well-established fact that reservoirs formed by dams on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity, and thus affecting the water availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment adversely affects the agricultural production. Thus, a well-designed **Catchment Area Treatment (CAT)** Plan is essential to ameliorate the above-mentioned adverse process of soil erosion.

Soil erosion may be defined as the detachment and transportation of soil. Water is the major agent responsible for this erosion. In many locations, winds, glaciers, etc. also cause soil erosion. In a hilly catchment area, as in the present case, erosion due to water is a common phenomenon and the same has been studied as a part of the CAT Plan. Soil erosion leads to:

- loss in production potential
- reduction in infiltration rates
- reduction in water-holding capacity
- loss of nutrients
- increase in tillage operation costs
- reduction in water supply

The CAT plan highlights the management techniques to control erosion in the catchment area of a water resource project. The life span of a reservoir is greatly reduced due to erosion in the catchment area. Adequate preventive measures are thus needed for the treatment of catchment for its stabilization against future erosion.

CAT Plan has been formulated for free draining catchment i.e. up to the proposed upstream Bajoli-Holi HEP (180 MW) on Ravi River. Free draining catchment area for this CAT Plan is 246.38 sq km. The total catchment area at proposed Bajoli-Holi HEP site is 902 sq km while at proposed Kutehr HEP is 1102 sq km. The catchment area considered for the present study is given in **Figure-4.1** as raw satellite imagery and the topographic map of free draining catchment area is shown in **Figure-4.2**.

The catchment area treatment involves

- Understanding of the erosion characteristics of the terrain and,
- Suggesting remedial measures to reduce the erosion rate.

In the present study '**Silt Yield Index**' **(SYI)**, method has been used. In this method, the terrain is subdivided into various watersheds and the erodibility is determined on relative basis. SYI provides a comparative erodibility criteria of catchment (low, moderate, high, etc.) and do not provide the absolute silt yield. SYI method is widely used mainly because of the fact that it is easy to use and has lesser data requirement. Moreover, it can be applied to larger areas like micro-watersheds, etc.

4.2 APPROACH FOR THE STUDY

A detailed database on natural resources, terrain conditions, soil type of the catchment area, socio-economic status, etc. is a pre-requisite to prepare treatment plan keeping in view the concept of sustainable development. Various thematic maps have been used in preparation of the CAT plan. Geographic Information System (**GIS**) is a computerized resource data base system, which is referenced to some geographic coordinate system. In the present study, real coordinate system has been used. The GIS is a tool to store, analyze and display various spatial data. In addition, GIS, because of its special hardware and software characteristics, has a capacity to perform numerous functions and operations on the various spatial data layers residing in the database. GIS provides the capability to analyze large amounts of data in relation to a set of established criteria. In order to ensure that latest and accurate data is used for the analysis, satellite data has been used for deriving land use data. Ground truth studies, too, have been conducted.

The various steps, covered in the study, are as follows:

- Definition of the problem
- Data acquisition and preparation
- Output presentation

The above mentioned steps are briefly described in the following paragraphs:

4.2.1 Definition of the Problem

The requirements of the study were defined and the expected outputs were finalized. The various data layers of the catchment area to be used for the study are as follows:

- Slope Map
- Soil Map
- Land use Classification Map
- Current Management Practices
- Catchment Area Map.

4.2.2 Data Acquisition and Preparation

The data available from various sources has been collected. The ground maps, contour information, etc. were scanned, digitized and registered as per

the requirement. Data was prepared depending on the level of accuracy required and any corrections required were made. All the layers were geo-referenced and brought to a common scale (real co-ordinates), so that overlay could be performed. A computer program using standard modeling techniques was used to estimate the soil loss. The formats of outputs from each layer were fimed up to match the formats of inputs in the program. The grid size to be used was also decided to match the level of accuracy required, the data availability and the software and time limitations. Ground truthing and data collection was also included in the procedure.

For the present study, IRS LISS III Gen:12.11.07, path 94, Row-48 digital satellite data was used for interpretation & classification. The data has been procured in raw digital format and has been geo-referenced using Survey of India topographical sheets with the help of standard data preparation techniques in standard image processing software. The interpretation of geo-referenced satellite data has been done using standard enhancement techniques, ground checks and experiences of qualified professionals. A detailed ground truth verification exercise has been undertaken as a part of field survey to enrich the image interpretation process. The classified land use map of the free draining catchment area, considered for the study, is shown as **Figure-4.3**. The land use pattern of the catchment area is summarized in **Table 4.1**.

Derived contours from topographical maps were used for preparation of Digital Elevation Model (DEM) of the free draining catchment area and to prepare a slope map. The first step in generation of slope map is to create surface using the elevation values stored in the form of contours or points. After marking the catchment area, all the contours on the topographical maps were derived. The output of the digitisation procedure was the contours as well as points contours in form of x, y & z points. (x, y - location and z - their elevation). All this information was in real world co-ordinates (latitude, longitude and height in meters above sea level).

Table-4.1: Land use classification for free draining catchment at diversion site

Land use/Land cover	Area (ha)	Area (%)
River/Water Bodies	1138.53	4.62
Agricultural / Settlement Areas	2522.59	10.24
Dense Forest	6816.40	27.67
Open Forest	5373.93	21.81
Degraded Forest	3017.85	12.25
Shrubs/Bushes/Grasses	3402.24	13.81
Snow Covered Areas	2366.74	9.60
Total	**24638.28**	**100.0**

A Digital Terrain Model (DTM) of the area was then prepared, which was used to derive a slope map. The slope was divided in classes of slope percentages.

The areas falling under various standard slope categories have been tabulated below in **Table-4.2**. The slope map is enclosed as **Figure-4.4**.

Table-4.2: Area falling under different slope categories

Slope category	Area (ha)	Area (%)
0-20°	3285.53	13.34
20°-35°	10884.13	44.36
35°-50°	8746.40	35.50
50°-80°	1627.62	6.60
> 80°	294.60	1.20
Total	**24638.38**	**100.00**

The soil resource map of Himachal Pradesh (NBSS Publication No 58) has been used in the present study. The soil is predominantly sandy loam. The soil map presented in **Figure-4.5** reveals that the soil of the area belongs to greater Himalayas having map units, 7 and 11 being soil of side and reposed slopes, and also lesser Himalayas in soil of map units 53, whose characteristics are described hereunder.

Soil belonging to map Unit-7
Soils on side/reposed slopes rocks out crops associated with shallow excessively drained loamy skeletal and having severe erosion. Taxonomically these soils belong to great group/subgroup typic cryorthents.

Soil belonging to map Unit-11
These are shallow, well-drained, mesic sandy loam, soils on very steep slopes with loamy surface and severe erosion associated with Shallow, well drained, Loamy Skeletal with loamy Surface, server erosion and strong stoniness. Taxonomically these soils belong to great group/subgroup Typic Udorthents/Lithic Udorthents. Soil belongs to map unit 53.

Soil belonging to map Unit-53
These are soils of Lesser Himalayas and are shallow well drained, thermic loamy soils on very steep slopes with loamy surface and very severe erosion associated with medium deep, well drained, sandy loam soil with loamy surface and severe erosion. Taxonomically the soils belong to great group/subgroup Lithic Udorthents and Typic Udorthents.

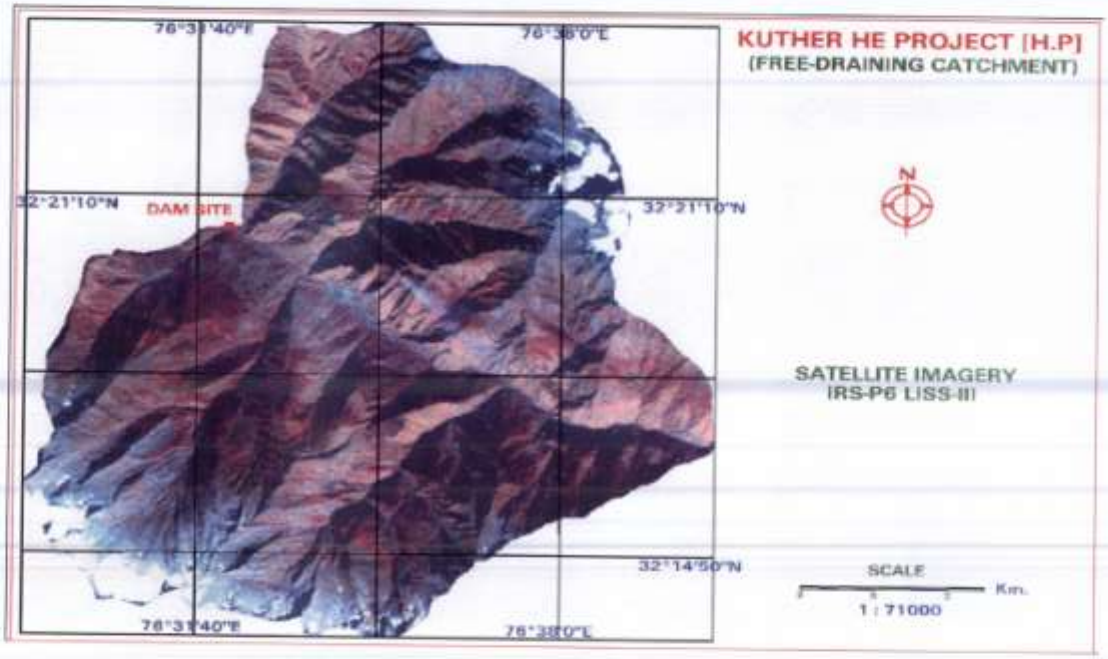


Figure-4.1: Satellite Imagery of Free Draining Catchment

4.3 ESTIMATION INTENSITY

Determination of erosion intensity unit is primarily based upon the integrated information on soil characters, physiography, slope, land-use/land-cover, lithology and structure. This is achieved through super-imposition of different thematic map overlays. Based upon the field data collected during the field survey and published data, weightage value and delivery ration were assigned to each erosion intensity unit. The composite map for delineating different erosion intensity units was prepared through superimposition of the maps showing soil types, slope, and land-use/land-cover. This thematic mapping of erosion intensity for entire catchment was done using the overlay and union techniques. Based on ground truth verification conducted during fieldwork and published data, weightage and delivery ratio was assigned to each erosion intensity units. The composite erosion intensity map was then superimposed on the drainage map with micro-watershed boundaries to evolve CEIU for individual micro-watershed.

Each element of erosion intensity unit is assigned a weightage value. The cumulative weightage values of the erosion intensity units represent approximately the relative comparative erosion intensity within the watersheds. A basic factor of K=10 was used in determining the cumulative weightage values. The value of 10 indicated an equilibrium condition between erosion and deposition. Any value of K (10+X) is suggestive of erosion intensity in an ascending order whereas the value of K (10-X) is suggestive of deposition intensity in descending order.

The sum of weightages was reclassified as per the **Table-4.3** below to further sub-divide the area as per the erosion intensity classes. The Weightages for Landuse, Slope and Soil are summed to get the Erosion Intensity Classes.

Table-4.3: Erosion Intensity and Weightages

Erosion Intensity Class	Sum of weightages
Very severe (E5)	12 to 14
Severe (E3)	9 to 11
Moderate (E3)	6 to 8
Low (E2)	4 to 5
Negligible (E1)	0 to 3

The Erosion Intensity Map of the free draining catchment is presented in **Figure-4.6**.

4.4 SOIL LOSS USING SILT YIELD INDEX (SYI) METHOD

The Silt Yield Index Model (SYI), considering sedimentation as product of erosivity, and erodibility was conceptualized in the All India Soil and Land Use Survey (AISLUS) as early as 1963 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units within river valley project catchment areas.

Methodology for the calculation of silt yield index developed by All India Soil & Land Use Survey (Department of Agriculture, Govt. of India) was followed in this study.

The delivery ratio is generally governed by the type of material, soil erosion, relief length ratio, soil cover conditions, distance from the nearest stream, etc. However, in the present study the delivery ratio to the erosion intensity units were assigned upon their distance from the nearest stream (being the most important factor responsible for delivery of the sediments) according to the following scheme as presented in **Table-4.4**.

Table-4.4: Delivery Ratio (DR) Criteria Adopted for the Project

Nearest Stream	Delivery Ratio (DR)
0-0.9 km	1.00
1.0-2.0 km	0.90
2.1-5.0 km	0.80
5.1-15.0 km	0.70
15.1-30.0 km	0.50

Sediment Yield Index and Prioritization of Micro-watersheds

- The erosivity determinates are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the units of the detached soil material. The relationship can be expressed as:

Soil erosivity = f (Climate, physiography, slope, soil parameters land use/land cover, soil management)

- The Silt Yield Index (SYI) is defined as the Yield per unit area and SYI value for hydrologic unit is obtained by taking weightage arithmetic mean over the entire area of the hydrologic unit by using suitable empirical equation.
- Prioritization of Watersheds/Micro-watershed within the vast catchments is based on the SYI of smaller units. Studying frequency distribution of SYI values and locating suitable breaking points arrive at the boundary values or range of SYI values for different priority categories. The watersheds/micro-watersheds is subsequently rated into various categories corresponding to their respective SYI values.

- The application of SYI model for prioritization of micro-watersheds in the catchment areas involves evaluation of:
  - Climatic factors comprising total precipitation, its frequency and intensity
  - Geomorphic factors comprising land forms, physiography, slope and drainage characteristics
  - Surface cover factors governing flow hydraulics
  - Management factors

- The data on climatic factors can be obtained for different locations in the catchment area from the meteorological stations whereas field investigations are required for estimating other attributes. The various steps involved in the application of model are:

  - Preparation of a framework of micro-watershed through systematic delineation
  - Rapid reconnaissance surveys on 1:50,000 scale leading to generation of a map indicating erosion-intensity mapping units.
  - Assignment of weightage values to various mapping units based on relative silt-yield potential.
  - Computing Silt Yield Index for individual watersheds/sub watersheds.
  - Grading of watersheds/micro-watersheds into very high, high medium, low and very low priority categories.

  The area of each of the mapping units is computed and silt yield indices of individual micro-watersheds are calculated using the following equation:

Silt Yield Index
SYI = (Ai x Wi x Di) x 100/Aw;
where i = 1 to n

Where

Ai	=	Area of ith (EIMU)
Wi	=	Weightage value of ith mapping unit
Di	=	Delivery ratio
n	=	No. of mapping units
Aw	=	Total area of micro-watershed

The SYI values for classification of various categories of erosion intensity rates were taken for the present study as:

Priority Category		SYI Values
1.	Very High	>1300
2.	High	1200-1299
3.	Medium	1100-1199
4.	Low	1000-1099

5. Very low <1000

Accordingly after excluding the area under permanent snow/glaciers from the total geographical area of micro-watershed, the Sediment Yield Index was calculated for 16 micro-watersheds and they were prioritized.

4.5 WATERSHED MANAGEMENT – AVAILABLE TECHNIQUES

Watershed management is the optimal use of soil and water resources within a given geographical area so as to enable sustainable production. It implies changes in land use, vegetative cover, and other structural and non-structural action that are taken in a watershed to achieve specific watershed management objectives. The overall objectives of watershed management programme are to:

- increase infiltration into soil;
- control excessive runoff;
- manage & utilize runoff for useful purpose.

Following Engineering and Biological measures shall be suggested for the catchment area treatment depending upon the requirement and suitability:

a. Engineering measures
- Step drain
- Angle iron barbed wire fencing
- Stone masonry
- Check dams

b. Biological measures
- Development of nurseries
- Plantation/afforestation
- Pasture development
- Social forestry

4.6 BASIS FOR TREATMENT

In the present report, CAT Plan as per the slope, land use pattern, soil characteristics has been suggested based on the prioritization of sub watersheds using SYI method **(Table-4.5)**. The CAT plan has been suggested for micro-watersheds with very high and high erosion categories as the cost for treatment for such watersheds is to be borne by the project proponents. The objective of the SYI method is to prioritize micro-watershed in a catchment area for treatment. The basis of site selection for different biological and engineering treatment measures under CAT are given in **Table-4.6**. The micro-watershed maps of Chamba Forest Circle, Bharmour Forest Division and the micor-watersheds in free draining catchment of Kutehr HEP are shown in **Figure-4.7, Figure-4.8 and Figure-4.9** respectively.

Table-4.5: Erosion intensity categorization as per SYI classification

Micro-watershed	Area (ha)	SYI	Priority Category
Tm1d	2450.00	1104	Medium
Tm1g	1825.00	1118	Medium
Tm1f	1725.00	1131	Medium
Tm2a	1525.00	1155	Medium
Tm2b	1550.00	1160	Medium
Tm2c	1100.00	1108	Medium
Tk3d	1475.00	1138	Medium
Tk3a	950.00	1170	Medium
Tk3b	1175.00	1176	Medium
Tk3c	2328.00	1198	Medium
Tk2f	1050.00	1135	Medium
Tk2a	2550.00	1244	High
Tk2b	1300.00	1204	High
Tk2c	1125.00	1217	High
Tk2d	2510.00	1145	Medium
Total	**24638.00**		

Table-4.6: Basis for selection of catchment area treatment measures

Treatment measure	Basis for selection
Social forestry, fuel wood and fodder grass development	Near settlements to control tree felling
Contour Bunding	Control of soil erosion from agricultural fields.
Pasture Development	Open canopy, barren land, degraded surface
Afforestation	Open canopy, degraded surface, high soil erosion, gentle to moderate slope
Barbed wire fencing	In the vicinity of afforestation work to protect it from grazing etc.
Step drain	To check soil erosion in small streams, steps with concrete base are prepared in sloppy area where silt erosion in the stream and bank erosion is high due to turbidity of current.
Nursery	Centrally located points for better supervision of proposed afforestation minimize cost of transportation of seedling and ensure better survival.

4.7 CATCHMENT AREA TREATMENT PLAN

There are mainly five categories of land uses for which a proper treatment plan should be developed. First is the agricultural land as this activity can never be eliminated. And, agriculture activities, if faulty, result in heavy loss of fertile soil. Second, is open forest land for conservation reasons. Third is scrub or degraded land, which contributes heavily to silt load. Possibilities exist to bring this area under pastures and plantation to meet local demand of fuel and fodder and thus decreasing the biotic pressure on the forests leading to environment friendly approach of sustainable development. The fourth and most important category is barren land because with practically no vegetal cover the area produces huge amount of silt load. The fifth is dense forest land where at few places soil conservation measures are required.

Areas falling under very severe and severe erosion intensity category would be taken up for conservation treatment measures after excluding the percentage of area above 50° slope from the area coming under very severe and severe erosion intensity class falling under rocks and inaccessible terrain where no treatment is feasible, the rest of area of very severe and severe categories is to be treated with biological, bio-engineering and engineering measures under CAT Plan.

Considering the topographic factors, soil type, climate, land-use/land-cover in the catchment area following measures have been proposed to be undertaken with aim to check soil erosion, prevent/check siltation of reservoir and to maintain its storage capacity in the long run. The activities under the following broad heads have been considered for the formulation of catchment area treatment plan.

1. Afforestation measures.
2. Soil & water conservation measures.
3. Payment for Enviornmental services including Eco-tourism.
4. Research,Training & Capacity build-up.
5. Infrastructural build-up & forest protection.
6. Wildlife measures.
7. Monitoring & Evaluation.
8. Support for preparing Site specific work plan.
9. Contingencies.

4.7.1 Activities to be Undertaken

4.7.1.1 Normal Afforestation

In critically degraded areas, plantation of locally useful diverse and indigenous plant species such as timber plantation species, fodder species, fuel wood species, grasses, shrubs and legumes, medicinal and aromatic plants would be undertaken. The forestation will include rising of multi-tier mixed vegetation of suitable local species in the steep and sensitive catchment areas of rivers/streams with the objective of keeping such areas under permanent vegetative cover. Furthermore, degraded areas would also

be brought under vegetation cover. Suitable trees of economic value to local people shall be raised in the degraded forest areas near to villages with the objective of supplementing income of the villagers.

With a view to conserve and augment the state's rich medicinal plant resources in its natural habitat through adaptive and participatory management of the local people, cultivation of high priority medicinal plant species shall be undertaken. Thrust shall be given to organic cultivation of medicinal plants.

Effective fencing would also be provided for protection of saplings. Before any new area is taken up, eradication of weeds and unpalatable grass species is important. It is, therefore, recommended that some parts of the pasture should be closed for seeding purpose only.

The following local/indigenous trees/shrubs species are required to be planted/preferred for afforestation of the area:

Alnus nitida, Aesculus indica, Berberis lycium Cedrus deodara, Celtis australis, Debraegesia hypoleuca, Juglans regia, Morus serrata, Myrsine Africana, Olea cuspidata, Prinsepia utilis, Prunus armeniaca, Punica granatum, Populus ciliata, Quercus ilex, Rhamnus virgatus and Rhododendron arboreum.

4.7.1.2 Enrichment Plantation

There are a few locations within forest in the catchment area where the crown density is poor and plantation can be done to increase the patch density of crop. In such areas, plantation of 800 seedlings per hectare is likely to create dense forest.

4.7.1.3 High Density Energy Plantation

In order to reduce the biotic pressure on the forest areas near the villages, high density energy plantation in forest areas and barren areas under the village can help in long way to solve the ever increasing problem of scarcity of fodder and fuel wood in hilly areas. To overcome the problem of scarce availability of fodder and fuel it is proposed to bring substantial area by planting 5000 trees/ha with suitable fast growing species. Species to be planted include Robinia pseudoacacia, Populus ciliata, Salix spp. etc.

4.7.1.4 Treatment of Alpine Pasture

These are high altitude areas situated in alpine / sub-alpine zones. The flora is herbaceous and the pastures have the potential to support regulated grazing. These areas continuously remain under snow from late October to late March. Therefore, they are in supine state for about six months. The restoration and management of degraded alpine pasture is a vital objective, both to provide sufficient habitat for spatial movement of the spill over species outside and within catchment area and to provide biological resources to the local populace. The alpine pastures have their own unique significance in the geophysical, environmental and socio-economic set-up of the region. They are the prime and continual source of herbage for the wild

herbivores which are prey base for carnivores, cattle, sheep and goats. These pastures are extensively grazed by the live stocks of the local people during summers for 3-4 months and also frequented by large herds of goats and sheep which are brought-in and encamped by the migratory grazers (Gadi) from plains. The large scale and indiscriminate grazing of these pasture over a prolong time has left these pastures ominously degraded. The palatable grasses are no more than a few inches tall and the other related pasture species have also started showing signs of stress. As a result of continuous and heavy pressure of grazing, barren patches have developed over vast areas and soil erosion is rampant in these alpine pastures. There is an imperative need to address this abysmal and alarming situation immediately before these pastures are brought to such a condition, where, their rejuvenation becomes impossible. Owning to traditional rights of the grazers, it is difficult to restrict the number of animals grazing there. Thus the only alternative left is to increase the productivity of these pastures to cope with the grazing pressures. The situation warrants for a realistic survey and allied research in context of entire grazing issues and formulation of an action plan for corrective measures within the gambit of the state policy on the subject matter. Till such time the following recommendations are made for the management of pastures.

- Assessment of the carrying capacity of the pastures through surveys so as to ascertain allowable size of live stocks.
- Periodical field checking of the size of the herds mentioned in the permits so as to avoid mis-utilization by some permit holders.
- Public awareness.
- Periodical closure of areas in pastures for the proliferation of seeds of desirable grass species.
- Implementation of rotational deferred grazing system to derive the advantage of early nutritive growth and rest period during the growing season.
- Interaction with the local people and the migrating grazers so that a sort of social fencing could be achieved.
- Assessment of the carrying capacity of alpine pasture and grazing land in forests. Role of different categories of live stock and their grazing requirement needs to be investigated.

4.7.1.5 Nursery Support

In order to meet the huge requirement of saplings required under biological / bio-engineering measures and reservoir rim treatment new nursery has to be developed along with support to the existing nurseries which shall also augment the supply of saplings for the works proposed.

4.7.1.6 Soil Bioengineering

Soil bio-engineering is state-of-the-art using the living vegetation, either alone or in conjunction with non-living plant material and civil engineering structures, to stabilize slopes and/or reduce erosion. Such measures utilize live plants and plant parts, either alone or in conduction with non-living plant material and hand measures usually referred to as civil engineering structures, where they provide additional mechanical support to soil, present barriers to earth movement, function as hydraulic drains, and act as hydraulic pumps. Soil bio-engineering system use live plant cuttings, rooted plants, and plant stems that are placed in the ground, or in earthen or other structures that commonly incorporate inert materials such as rock, wood, geo-synthetics, geo-composites or other products.

Control of severe landslide or gully erosion usually requires engineering structures to avoid slope failure and gully cutting. However, such measures involve exorbitant investment and a high degree of technology. It has been experienced that lack of timely and adequate maintenance has resulted in spectacular failure of measure under taken and the resultant erosion is more serious than before the treatment.

The exclusive use of vegetative measures for control of major land slide and severe gully erosion often results in failure. However, when vegetative measures are combined with engineering measures, i.e. bio-engineering, the end result can be effective stabilization of the area from mass movement and gully cutting, and dramatic reduction of surface erosion, at relatively low cost and high sustainability and with added benefit of fodder and fuel wood production for local people.

The successful results of bio-engineering techniques have been observed in gully control, waste land reclamation and slope stabilization. By for these have been observed to be economically desirable and most-effective for erosion control in degraded area.

Soil bio-engineering measures shall be adopted in landslide zones and area degraded due to road excavation. The work shall involve fixing of brush wood check dams, spraying of grass and legume seeds, plantation of trees @ 1100 trees/ha, fencing of the area and maintenance for three years. The most common method of hill and slope stabilization is the seeding of grass and herb mixture.

Dry Seeding is an easy method where seed (5 g/sq.m.) and organic fertilizer (100 g/sq.m.) are scattered by hand or machine. It can be applied on flat slopes with rough surfaces. It is also possible to use hay-flowers instead of common seeds.

On steeper slopes where it is necessary to cover the soil quality, a cover crop seeding is used. Special types of rye (in fall) and barley (in spring) are spread in a mixture of 5 gm/sq.m. and covered with soil. On the surface normal seed (5 g/sq.m.) are spread.

On less steep slope with rough surface and no erosion problems tree and shrub seeding can be spread. Seeds of trees and shrubs are mixed with sand in a ratio of 1:3 and spread as broadcast, pit oar row seeding.

Indigenous woody perennials (Trees/Shrubs) to be planted will include, Asparagus spp, Berberis spp. Cedrus deodara, Celtis australis, Debraegesia hypoleuca, Desmodium microphyllum, Ficus palmata, Lonicera quinqueloculans, Morus serrata, Olea cuspidate, Pistacia intergerrima, Prinsepia utilis, Prunus armeniaca, Punica granatum, Rhus spp, Robinia pseudoacacia, Rumex hastatus, Yucca aloifolia.

The grasses suitable for the area include Arundo donax, Eulaliopsis binata, Cymbopogon citrates, Poa sp, Sachharum spp, Thysanolaena maxima, etc. The species for live – hedge fencing include Berberis spp., Agave sp. and Yucca aloifolia.

4.7.1.7 Civil Structures

- **Brush wood Check Dams and Retaining Walls**

Brushes wood check dams are useful in arresting further erosion of depressions, channels, and gullies on the denuded landslides. In addition, retaining walls of stone masonry and RCC would be constructed to provide support at the base of threatened slopes.

- **Slope Modification by Stepping or Terracing**

The slope stability increases considerably by grading it. The construction of steps or terraces to reduce the slope gradient is one of the measures.

- **Bench Terracing**

The area under moderately steep slope i.e. between 10°-15° slope would be subjected to bench terracing. The local people would be convinced to follow this type of terracing for comparatively better yield and with minimum threat to erosion. Moreover, in a number of habitations in the catchment such practices are already visible. While making bench terraces, care will have to be taken not to disturb the topsoil by spreading earth from the lower terraces to higher terraces. The vertical intervals between terraces will not be more than 1.5m and cutting depth may be kept at 50 cm. The minimum average width of the terrace would be kept from 4 to 5 m in order to enable usage of prolong hinge. The shoulder bunds of 30 x 15 cm would also be provided. Staggered channels will drain off the excess water from the terraces.

- **Gully Control-Check Dams**

Gullies are mainly formed on account of physiography, soil type, and heavy biotic interference in an area. The scouring of streams at their peak flows and sediment-laden run-off cause gullies. The gullies would be required to be treated with engineering/mechanical as well as vegetative methods. Check dams would be constructed in some of the areas to promote growth of vegetation that will consequently lead to the stabilization of slopes/area and prevention of further deepening of gullies and erosion. Different types of check dams would be required for different conditions comprising of different

materials depending upon the site conditions and the easy availability of material (stones) at local level and transport accessibility. Generally brush wood check dams are recommended to control the erosion in the first order basin/streams in upper reaches and dry random stone masonry check dam shall be provided in the lower reaches where discharge is higher. In such stream where discharge and velocity of flow are still higher gabion structure shall be provided. Lower down the micro-watershed, i.e., in the third order drainage silt retention dams in the form of gabion structure shall be provided.

- **Stream bank Protection**
  Stream bank erosion is caused by variety of reasons such as destruction of vegetative cover, mass movement on unstable bank slopes, undermining of top portion of lower bank by turbulent flow and sliding of slopes when saturated with water. The Stream bank Protection would include wire crate boulder spurs in two to three tiers depending upon the high flood level of the streams.

- **Contour Staggered Trenches**
  Contour staggered trenches are mainly provided to trap the silt and runoff. This is also done to prepare a fertile base for plantation, in moderately steep to very, very steep slopes.

- **Landslide Control**
  Rainfall pattern of the area and water seepage coupled with geological formation results in landslides. Water plays an important role in triggering of landslides and mass wasting processes along with other factors such as slope and nature of soil/land-cover/land-use. However, most of the landslides are caused by human negligence. Road construction, overgrazing of hill slopes, felling of trees for timber, fuel, and fodder and upslope extension of cultivation are some of main causes of landslides. Gabion structures shall be provided at the base of the land slide zones to control the toe erosion by water.

- **Catch-water Drains**
  Among the most effective, practical and least expensive measures of landslide hazard management is construction of catch-water drains for run-off and surface waters in the identified hazard-prone zone so that little or no water is able to infiltrate into the ground. All the streams and minor water courses would be diverted around the crown of the slide or the potentially hazardous area through catch water drains with an adequate gradient. The catch water drain when provided avoids runoff to pass over such vulnerable areas and water is guided through these drains provided on foothill or along the katcha/pucca roads. The ground surface of threatened area is leveled out to eliminate all depressions where water can accumulate.

4.8 AFFORESTATION MEASURES

Since this is mountainous tract with moderate to steep slopes, gully formation due to water/snow flows in the depressions are bound to occur. Therefore, all the afforestation works will have to be supported by anti-erosion measures like gully plugging, check dams etc. in varying extent. The total amount of **Rs. 1125.00 lac** has been kept for afforestation measures. The following types of areas are proposed for afforestation aided by varying types and degrees of soil conservation measure and check dams:

(i) Evergreen forest blank detected through Remote Sensing.
(ii) Heavily grazed areas around habitations.
(iii) Blank area fit for bringing in vegetation and draining directly in the vicinity of diversion dam storage.

In the background of above criteria, limitation of extent of area which can be closed with the consent of local people (right holders) and in consultation with local field forest officers, it is proposed to do afforestation of **1450 ha** over a period of 5 years, starting from the 2nd year of CAT Plan implementation. The details of various categories of plantation under the afforestation measures are given in **Table-4.7**. The cost norms for normal afforestation, energy plantation and enrichment planation have been furnished at **Annexure-IV**.

Table-4.7: Cost of Activities under Afforestation Measures

Sr. No.	Activities	Area (ha)	Amount (in lacs)
I	Afforestation & Maintenance	500.00	260.125
Ii	Energy plantation	470.00	408.19
Iii	Enrichment plantation	480.00	114.00
Iv	Nurseries development / support	-	256.58
V	Siviculuture	574.00	86.10
	Total		**1124.995**
		Say Rs.	**1125.00**

4.8.1 Choice of Species

The choice of species depends on the various factors, such as climatic, edaphic, topographic and biotic but the surviving indigenous species give a clear indication of the most suitable species. Since most of areas included in this component, are situated at lower elevations, therefore, preference should be given to indigenous, fast growing, hardy, species which can survive under the adverse condition of the locality. Sincere and strenuous efforts should be made to bring the blank areas under forest cover as early as possible. In order to cover up the blank areas expeditiously, at the earliest, the maximum area has been suggested to be taken up during the 1st & 2nd years. Soil conservation works have also been prescribed along with afforestation measures where ever necessary.

4.8.2 Plantation Technique

4.8.2.1 Site Selection

Specific sites have been suggested and location of plantation is also indicated in the above statement. However, if the deviation is absolute necessary, some changes can be done by the Divisional Forest Officer after spot inspection.

4.8.2.2 Closure Notification

Each plantation area will be notified for closure and supervision of rights, one year in advance of plantation work. According to provision made in Forest Settlement, one third of total area of forest can be closed for thirty years, but it is normally not practicable. The area should remain closed effectively till the regenerated crop reaches the stage beyond any damage due to frost, drought, and weeds and needs no longer protection from animals. Hence the period of closure may be kept 10-20 years depending upon growth of species planted.

4.8.2.3 Fencing

Where necessary plantation areas will be effectively closed with 3-5 strands barbed wire fencing. Fence posts should be of durable species. These should be affixed in ground along the periphery of area to be closed at suitable spacing, deep enough to withstand weight and tension in barbed wire. It should be borne in mind that loose, zigzag and haphazardly aligned barbed wire fencing would provide least resistance to animals of vicinity and efforts so made in raising plantation will, surely, be unproductive and invite unnecessary criticism of local people. It would be better if some branches of fast growing species are reinforced in fencing to provide adequate tension in the strand of barbed wire. Non-palatable fast growing shrub species like Adhetoda, Vitex, Agave, Debregeasia, etc. shall be planted along the barbed wire fence at a close spacing of 50 cm to form a live hedge.

4.8.2.4 Preparation of Site

Pits on standard size 30 cm diameter for Deodar, Kail, Fir/Spruce and 45cm is diameter for broadleaved well in advance so as to provide an interval of 2-3 months between pit digging and planting for weathering of soil.

4.8.2.5 Spacing

Planting for coniferous at space of 2.5m X 2.5m and that of broad leaved 3m X 3m is general practice and it should be continued however while treating eroded portions suitable broad leaved may be planted at the space of 1.5m X 1.5m.

4.8.2.6 Sowing and Planting

Planting should be preferred to sowing, though the later operation may be cheaper. Success is more certain and initial growth more rapid, in case sturdy nursery raised plants are used. Sowing may be carried out only on comparatively better sites, where these are expected to be easily successful. Piak (Alnus nitida) along nala and sowing of Deodar can be preferred. But

certainly Piak dibbling / sowing must be carried out only in marshy lands/nallas.

4.8.3 Beat-wise Area under Normal Plantation

4.8.3.1 Holi Block

A. Tiyari Beat

(i) Kalah DPF-I (Proposed area for Plantation-20 ha)

The DPF has a geographical area of 70.4 ha with Kalah Goth on its north, Kalah Nala on east, village Kalah on south and on west it is separated by Jhikli Tiyari north DPF. The general aspect of the DPF is south-western and has very steep to precipitous slope with ground elevation varying from 1760 masl to 2940 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 1.5 km from newly proposed Kalah nursery. The general view of the area to be planted is shown in **Figure-4.10**.

Figure-4.10: General View of the Area to be Planted

(ii) Kalah DPF-II (Proposed area for Plantation-10 ha)

The DPF has a geographical area of 362.2 ha with Kalah Goth on its north, Kalah Nala on east, village Kalah on south and on west it is separated by Jhikli Tiyari north DPF. The general aspect of the DPF is south-western and has very steep to precipitous slope with ground elevation varying from 1800 masl to 2900 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 1.5 km from newly proposed Kalah nursery. The general view of the area to be planted is shown in **Figure-4.11**.

Figure-4.11: General View of the Area to be Planted

(iii) Upper Tiyari DPF (Proposed area for Plantation-10 ha)

The DPF has a geographical area of 210 ha with Kalah and Oi Nal DPF on its north, ridge separating Kalah Nal DPF on east, village Upper Tiyari and Jhikli Tiyari on its south and on west ridge separating Oi Nal DPF. The general aspect of the DPF is western to north-western and has very steep to precipitous slope with ground elevation varying from 2040 masl to 3111 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 1.0 km from proposed Kalah nursery. The general view of the area to be planted is shown in **Figure-4.12**.

Figure-4.12: General View of the Area to be Planted

(iv) Lower Tiyari DPF (Proposed area for Plantation-10 ha)

The DPF has a geographical area of 131.60 ha with Kalah and Oi Nal DPF on its north, ridge separating Kalah Nal DPF on east, village Upper Tiyari and Jhikli Tiyari on its south and on west Upper Tiyari DPF. The general aspect of the DPF is western to north-western and has very steep to precipitous slope with ground elevation varying from 2040 masl to 3111 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 1.0 km from newly proposed Kalah nursery.

(v) Oi Nal (N) DPF (Proposed area for Plantation-20 ha)

The DPF has a geographical area of 129.9 ha with Naripar Dhar and Oi Nala Dhar on its north, Tair cultivation on east and south and Rawa Da Nala on its west. The general aspect of the DPF is south-western and has very steep to precipitous slope with ground elevation varying from 1675 masl to 2110 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area are Kail and Devdar. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 2.0 km from newly proposed Kalah nursery.

B. Sutkar Beat

(i) Sadaser DPF-I (Proposed area for Plantation-10 ha)

The DPF has a geographical area of 53.42 ha with Sutkar cultivation on its north, Banoon cultivation on east, RF Sutkar on south and Sadaser DPF, compartment-II on its west. The general aspect of the DPF is northern and has steep to very steep slope with ground elevation varying from 2260 masl to 2680 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 1.0 km from Sutkar nursery. The general view of the area to be planted is shown in **Figure-4.13**.

Figure-4.13: General View of the Area to be Planted

(ii) Sadaser-II DPF (Proposed area for Plantation-20 ha)

The DPF has a geographical area of 108.05 ha with Satkhuni Dhar DPF on its north, Banoon cultivation on east, Drum Dhar DPF on south and west. The general aspect of the DPF is northern and has steep to very steep slope with ground elevation varying from 2480 masl to 3100 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 1.5 km from Sutkar nursery. The general view of the area to be planted is shown in **Figure-4.14**.

Figure-4.14: General View of the Area to be Planted

(iii)Kutehr DPF-I (Proposed area for Plantation-20 ha)

The DPF has a geographical area of 150.95 ha with Ravi river on its north, Kutehr cultivation on east, Kutehr DPF, compartment-III on south and Bharmali DPF North and ridge separating Rupighar Nagbani RF on its west. The general aspect of the DPF is north-eastern and has steep to precipitous slope with ground elevation varying from 1670 masl to 2884 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area are Devdar, Kail and Ban. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 1.5 km from Sutkar nursery. The general view of the area to be planted is shown in **Figure-4.15**.

Figure-4.15: General View of the Area to be Planted

(iv) Kutehr DPF-II (Proposed area for Plantation-20 ha)

The DPF has a geographical area of 51.80 ha with River Ravi on its north, Tulang (Ki Nala) on east, Kutehr DPF, compartment-IV on south and Kutehr cultivationon its west. The general aspect of the DPF is north-eastern and has very steep to precipitous slope with ground elevation varying from 1705 masl to 2285 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area are Devdar, Kail and Ban. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 2.0 km from Sutkar nursery.

(v) Andralagram DPF (Proposed area for Plantation-10 ha)

The DPF has a geographical area of 42.08 ha with Andralagram RF on its north, Hali Nala on east, Dand Dhar DPF on south and RF Andralagram and Chilmili DPF on its west. The general aspect of the DPF is north-eastern and has moderate to very steep slope with ground elevation varying from 2080 asl to 3260 masl. The texture of the soil is shallow to deep in depth. The species, naturally growing around the area are Devdar, Kail and Ban. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 2.5 km from Hali nursery. The general view of the area to be planted is shown in **Figure-4.16**.

Figure-4.16: General View of the Area to be Planted

(vi) Sutkar (N) DPF (Proposed area for Plantation- 20 ha)

The DPF has a geographical area of 56.55 ha with Sutkar and Ki village on its north, Sutkar cultivated area and Sutkar RF on east, Dand Dhar RF on south and Tulang Nala on its west. The general aspect of the DPF is northern and has moderate to steep slope with ground elevation varying from 1675 asl to 2360 masl. The texture of the soil is shallow to fairly deep in depth. The species, naturally growing around the area are Kail and Banokh. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 0.8 km from Sutkar nursery.

C. Deol Beat

(i) Tuh DPF (Proposed area for Plantation- 20 ha)

The DPF has a geographical area of 88.10 ha with village Banthu and and river Ravi on its north, local Nala separating two cultivation on east, cultivation of village Guwar on its south and west. The general aspect of the DPF is north-eastern and has moderate to steep slope with ground elevation varying from 1920 masl to 2280 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area is Ban. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 2.5 km from Holi nursery.

(ii) Jabla DPF (Proposed area for Plantation- 5 ha)

The DPF has a geographical area of 15.78 ha with river Ravi on its north, Jawla and Kuleth village on east, Kuleth cultivation and Gwala north DPF on its south and Holi Nala on west. The general aspect of the DPF is north-

western and has moderate to steep slope with ground elevation varying from 1695 masl to 1980 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Robinia, Kail, Deodar, Piyak. It is proposed to carry out normal afforestation in 5 ha area, for which the nursery plants shall be transported to about 1.5 km from Holi nursery.

(iii)Phat DPF (Proposed area for Plantation- 10 ha)

The DPF has a geographical area of 38.85 ha with village Bringti and Kalighodi North DPF on its north, RF Deol and Sanghela DPF (C-I & II) on east, Sara DPF on its south and DPF Gawar and Tuh Nala on west. The general aspect of the DPF is north-western and has moderate to steep slope with ground elevation varying from 2090 masl to 3470 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Deodar, Kail and Fir / Spruce. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 4.0 km from Holi nursery.

(iv) Nehra DPF (Proposed area for Plantation-5 ha)

The DPF has a geographical area of 19.43 ha with river Ravi on its north, Tuh Nala on east, Tuh Nala cultivation on its south and Banthu and Kuleth villages cultivation on west. The general aspect of the DPF is north-eastern and has moderate to steep slope with ground elevation varying from 1775 masl to 2040 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Piyak, Robinia. It is proposed to carry out normal afforestation in 5 ha area, for which the nursery plants shall be transported to about 4 km from Holi nursery.

(v) Gawala DPF (Proposed area for Plantation-30 ha)

The DPF has a geographical area of 118.98 ha with Jabla North DPF on its north, Guwar and Kuleth cultivation on east, Raundhar and Bukhar North DPF on its south and Holi Nala on west. The general aspect of the DPF is north-western and has very steep to precipitous slope with ground elevation varying from 2010 masl to 2275 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Kail, Fir and Deodar. It is proposed to carry out normal afforestation in 30 ha area, for which the nursery plants shall be transported to about 3.0 km from Holi nursery.

(vi) Kiur DPF (Proposed area for Plantation- 20 ha)

The DPF has a geographical area of 259 ha and is situated near village Kiur. The general aspect of the DPF is eastern and has moderate to steep slope with ground elevation varying from 2250 masl to 3200 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Kail, Fir/Spruse. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 6.0 km from Holi nursery.

(vii) Deol DPF (Proposed area for Plantation- 5 ha)

The DPF has a geographical area of 23.60 ha and is situated near village Deol. The general aspect of the DPF is north-eastern and has moderate to steep slope with ground elevation varying from 2195 masl to 2375 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Kail and Deodar. It is proposed to carry out normal afforestation in 5 ha area, for which the nursery plants shall be transported to about 4.0 km from Holi nursery.

(viii) Sangella (C-I, C-II) DPF (Proposed area for Plantation- 30 ha)

The DPF has a geographical area of 95.8 ha and is situated near village Deol. The general aspect of the DPF is northern and has moderate to steep slope with ground elevation varying from 2590 masl to 3475 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Kail and Deodar. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 5.0 km from Holi nursery.

(ix) Guwar DPF (Proposed area for Plantation- 10 ha)

The DPF has a geographical area of 73.25 ha and is situated near village Guwar. The general aspect of the DPF is north and north-eastern and has moderate to steep slope with ground elevation varying from 2225 masl to 3050 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Kail, Fir/Spruse. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 3.0 km from Holi nursery.

(x) Andrui DPF (Proposed area for Plantation- 50 ha)

The DPF has a geographical area of 716.68 ha and is situated near Deosar RF. The general aspect of the DPF is south-eastern and has moderate to steep slope with ground elevation varying from 1980 masl to 3182 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Deodar and Kail. It is proposed to carry out normal afforestation in 50 ha area, for which the nursery plants shall be transported to about 4.0 km from Holi nursery.

4.8.3.2 Barabanchhu Block

A. Bajol Beat

(i) Bajol North DPF (Proposed area for Plantation- 5.0 ha)

The DPF has a geographical area of 114.53 ha with Pathar Dhar (North DPF)on its north, Bajoli North DPF on east, Bajoli village cultivation on south and Dug ka Nala on its west. The general aspect of the DPF is southern and has moderate to steep slope with ground elevation varying from 2440 asl to 3555 masl. The texture of the soil is shallow to fairly deep. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 5.0 ha area, for which the nursery plants shall be transported to about 1.5 km from Bajoli nursery.

(ii) Bajoli DPF (Proposed area for Plantation- 10.0 ha)

The DPF has a geographical area of 57.87 ha with Sukram Goth on its north, Duga Ki Dhar on east, Bajoli village cultivation on south and Bajoi North DPF on its west. The general aspect of the DPF is southern and has moderate to steep slope with ground elevation varying from 2590 masl to 3415 masl. The texture of the soil is shallow to fairly deep. The species, naturally growing around the area are Kail and Deodar. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 1.5 km from Bajoli nursery.

(iii)Gowar DPF (Proposed area for Plantation- 20.0. ha)

The DPF has a geographical area of 228.84 ha with Chantan Goth on its north, Duga Ka Nala on east, Ravi River on south and Pathar Dhar North DPF on its west. The general aspect of the DPF is south-western and has moderate to steep slope with ground elevation varying from 1675 masl to 3720 masl. The texture of the soil is shallow to fairly deep. The species, naturally growing around the area is Kail. It is proposed to carry out normal afforestation in 20 ha area, for which the nursery plants shall be transported to about 2.0 km from Bajoli nursery.

B. Nayagram Beat

(i) Nawai RF (Proposed area for Plantation- 15ha)

The RF has a geographical area of 97.13 ha with Dug and Nawai village cultivation on its north, Jumar Nali and Jumargoth on east, Riyali Dhar PF on south and Luwan Nala on its west. The general aspect of the RF is northern, eastern and western and has steep to precipitous slope with ground elevation varying from 2420 masl to 3400 masl. The texture of the soil is shallow to fairly deep. The species, naturally growing around the area are Kail, Deodar and Fir. It is proposed to carry out normal afforestation in 15.0 ha area, for which the nursery plants shall be transported to about 2.0 km from Nayagram nursery.

(ii) Agrali RF-II (Proposed area for Plantation- 10 ha)

The RF has a geographical area of 7.42 ha with Nayagram DPF on its north, Agrali RF Compartment-I on east, Jotna goth on south and Jumar Nala on its west. The general aspect of the RF is north and north-east and has steep to very steep slope with ground elevation varying from 2000 masl to 2800 masl. The texture of the soil is shallow to fairly deep. The species, naturally growing around the area are Kail and Deodar. It is proposed to carry out normal afforestation in 10 ha area, for which the nursery plants shall be transported to about 2.5 km from proposed Nayagram nursery.

(iii) Swein RF (Proposed area for Plantation- 30 ha)

(iv) Pani Nali (C-I & CII) (Proposed area for Plantation- 15 ha)

4.8.3.3 Lamu Block

(i) **Lamu DPF (Proposed area for Plantation- 5ha)**

(ii) **Hilling DPF-I & II (Proposed area for Plantation- 25ha)**

Table-4.8: Details of Area Proposed for Normal Plantation in Holi, Barabanchho & Lamu Blocks under Different Beats

Sr. No.	Name of Block	Name of Beat	Legal Status	Area Proposed for Afforestation	Details of Nursery from where the plants will be raised and transported	
					Name of Nursery	Distance from Nursery, km.
1.	Holi	Tiyari	Kolah DPF-I	20	Kolah (proposed)	1.5
			Kolah DPF-II	10		1.5
			Upper Tiyari DPF	10		1.0
			Lower Tiyari DPF	10		1.0
			Oi Nal (N) DPF	20		2.0
		Sub-Total Normal Plantation in Tiyari Beat		**70**		
2.		Sutkar	Sadaser DPF-I	10	Sutkar	1.0
			Sadaser DPF-II	20		1.5
			Kutehr DPF-I	20		1.5
			Kutehr DPF-II	20		2.0
			Andralagram DPF	10		2.5
			Sutkar (N) DPF	20		0.8
		Sub-Total Normal Plantation in Sutkar Beat		**100**		
3.		Deol	Tuh DPF	20	Holi	2.5
			Jabla DPF	05		1.5
			Phal DPF	10		4.0
			Nehra DPF	05		4.0
			Gowala DPF	30		3.0
			Kiur DPF	20		6.0
			Deol DPF	05		4.0
			Sangela (C-I & C-II) DPF	30		5.0
			Guwar DPF	10		3.0
			Andrui DPF	50		4.0
		Sub-Total Normal Plantation in Deol Beat		**185**		
4.	Bara Banchu	Bajol	Bajol (N) DPF	05	Bajoli (proposed)	1.5
			Bajoli DPF	10		1.5
			Guwar DPF	20		2.0
		Sub-Total Normal Plantation in Bjol Beat		**35**		
		Naya Gram	Nawal RF	15	Nayagram (proposed)	2.0
			Argali RF-II	10		2.5
			Swein RF	30		1.5
			Pani Nali (C-I & CII)	15		6.0

Sr. No.	Name of Block	Name of Beat	Legal Status	Area Proposed for Afforestation	Details of Nursery from where the plants will be raised and transported	
					Name of Nursery	Distance from Nursery, km.
		Sub-Total Normal Plantation in Nayagram Beat		70.0		
5.	Lamu	Lamu	Lamu DPF	15.0		1.0
			Hilling DPF-I & II	25.0		2.0
Sub-Total Normal Plantation in Bjoi Beat				40.0		
Total Proposed Area for Normal Plantation				500.00		

4.9 ENRICHMENT PLANTATION

Enrichment plantation will be carried out in degraded forest area in the Catchment, so as to increase stocking in already existing open forest. This has to be a selective process and should result in better diversity / abundance of key species. A norm of 800 plants per ha (notional) would be adopted and tall plants of the desired species would be planted under this component. Since such planting would be scattered in the nature, the traditional barbered wire fencing is not to be done; instead of individual protection to the tall plants using thorny bushes, will be resorted to. Provision for such individual protection has been included in the cost norms. No maintenance is being prescribed under this component and the proposed plantation will be started after 5 years from the implementation of this CAT Plan.

A total of **480 ha** have been indentified for planting including thorny brush protection guard under this scheme for a total outlay of **Rs. 114.00 lac**. The preliminary forest identified for this purpose is as under:

4.9.1 Holi Block

(A) Tiyari Beat

(I) Kalah DPF-II (Proposed area for Enrichment Plantation-10ha)

The DPF has a geographical area of 362.2 ha out of which about 10 ha is available for enrichment plantation. The DPF has boundary with Kalah Goth on its north, Kalah Nala on east, village Kalah on south and on west it is separated by Jhikli Tiyari north DPF. The general aspect of the DPF is south-western and has very steep to precipitous slope with ground elevation varying from 1800 masl to 2900 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out enrichment plantation in 05 ha area, for which the nursery plants shall be transported to about 1.5 km from newly proposed Kalah nursery.

(ii) Upper Tiyari DPF : 20 ha
(iii) Lower Tiyari DPF : 30 ha
(iv) Oi Nal (N) DPF : 10 ha

(B) Sutkar Beat

(i) Sadaser-II DPF (Proposed area for Enrichment Plantation-20 ha)

The DPF has a geographical area of 108.05 ha with Satkhuni Dhar DPF on its north, Banoon cultivation on east, Drum Dhar DPF on south and west. The general aspect of the DPF is northern and has steep to very steep slope with ground elevation varying from 2480 masl to 3100 masl. The texture of the soil is coarse loamy with shallow depth. The species, naturally growing around the area is Kail. It is proposed to carry out enrichment plantation in 20 ha area, for which the nursery plants shall be transported to about 1.5 km from Sutkar nursery.

(ii) Sadaser DPF-I : 20 ha.
(iii) Kutehr DPF-I : 30 ha
(iv) Kutehr DPF-II : 20 ha
(v) Chillmily DPF : 30 ha

(C) Deol Beat

(i) Gawala DPF (Proposed area for Enrichment Plantation-30 ha)

The DPF has a geographical area of 118.98 ha with Jabla North DPF on its north, Guwar and Kuleth cultivation on east, Raundhar and Bukhar North DPF on its south and Holi Nala on west. The general aspect of the DPF is north-western and has very steep to precipitous slope with ground elevation varying from 2010 masl to 2275 masl. The texture of the soil is coarse loamy shallow to fairly deep. The species, naturally growing around the area are Kail, Fir and Deodar. It is proposed to carry out enrichment plantation in 30 ha area, for which the nursery plants shall be transported to about 3.0 km from Holi nursery.

(ii) Andrui DPF : 40 ha
(iii) Kiur DPF : 30 ha

4.9.2 Barabanchho Block

(A) BAJOL BEAT

(i) Bajol DPF (10 Ha)

Total area available is about 10 ha. It has southern aspect. The slope is moderate to steep. Tree species like Kail, F/Sp, etc.found in the area Deodar, Horse Chest Nut (Goon) etc. species can be tried in the area. Nearest nursery is Bajol (Proposed) at a distance of about 1.5 Km. The Elevation of proposed area is 2440 m to 3355 m. Soil of the proposed area is Clay Loamy, moderate to fairly deep.

(ii) Guwar DPF : 10 Ha

(B) NAYAGRAM BEAT

(i) Suwen RF (10 Ha)

Total area available is about 10 ha. It has northern and northern eastern aspect, the slope is gentle steep. Tree species like Kail, F/Sp, Deodar etc. found in the area Ban species can be tried in the area. Nearest nursery is Nayagram (Proposed) at a distance of about 1.5 Km. The Elevation of proposed area is 1900 m to 2800 m. Soil of the proposed area is Clay Loamy, shallow to superficial.

(ii) Pani Nalli (C-II) RF : 10 Ha

4.9.3 Lamu Block

In Lamu block the enrichment plantation shall be carried out in Banog, Chanhail and Lamu beat in 70 ha, 60 ha and 20 ha area respectively.

(A) Banog Beat
(i) Dalli DPF : 20 ha
(ii) Jeena DPF : 20 ha
(iii) Bhatara DPF : 20 ha
(iv) Saloon DPF : 10 ha

(B) Chanhail Beat
(i) Bharadi DPF : 30 ha
(ii) Ori DPF : 30 ha

(C) Lamu Beat
(i) Hiling RFC-I: 20 ha

4.9.4 Details of Area Proposed for Enrichment Plantation

The enrichment plantation shall be carried out beat-wise as per detail location shown in **Table-4.9**.

Table-4.9: Details of Area Proposed for Enrichment Plantation in Holi, Barabanchu and Lamu Block

Sr. No.	Name of Block	Name of Beat	Legal Status	Area Proposed for Afforestation	Details of Nursery from where the plants will be raised and transported	
					Name of Nursery	Distance from Nursery, km.
1.	Holi	Tiyari	Kalah DPF-II	10	Kalah (proposed)	1.5
			Upper Tiyari DPF	20		1.0
			Lower Tiyari DPF	30		1.0
			Ol Nal (N) DPF	10		2.0
		Sub-Total Enrichment Plantation in Tiyari Beat		**70**		
2.		Sutkar	Sadaser DPF-I	20	Sutkar	1.5
			Sadaser DPF-II	20		1.0
			Kutehr DPF-I	30		1.5
			Kutehr DPF-II	20		2.0
			Chimily	30		4.0
		Sub-Total Enrichment Plantation in Sutkar Beat		**120**		
3.		Deol	Gawala DPF	30	Holi	3.0

			Andrui DPF	40		4.0
			Kiur DPF	30		6.0
		Sub-Total Enrichment Plantation in Deol Beat		**100**		
4.	Bara Banchu	Bajol	Bajol (N) DPF	10	Bajol (proposed)	1.5
			Guwar DPF	10		2.0
		Sub-Total Enrichment Plantation in Bjol Beat		**20**		
		Naya Gram	Swein RF	10	Nayagram (proposed)	1.5
			Pani Nali (C-I & CII)	10		6.0
		Sub-Total Enrichment Plantation in Nayagram Beat		**20**		
5.	Lamu	Banog	Dalli DPF	20	Bag	1.5
			Jeena DPF	20		1.0
			Bhatara DPF	30		1.0
		Sub-Total Enrichment Plantation in Banog Beat		**70**		
		Chanail	Bharadi DPF	30		3.0
			Ori DPF	30		3.0
		Sub-Total Enrichment Plantation in Chanail Beat		**60**		
		Lamu	Hiling RFC-I	20	Lamu	2.5
		Sub-Total Enrichment Plantation in Lamu Beat		**20**		
Total Proposed Area for Enrichment Plantation				**480**		

Enrichment Plantations over these **480 ha** are proposed to be completed in 5 years. Sequence of forests for planting in table is merely suggestive and not binding. Due to any administrative exigencies, Divisional Forest Officer, Bharmour may make any adjustment in the yearly sequence.

4.10 ENERGY PLANTATION

Energy plantation would be carried out to fulfill the wood and fodder requirements of the local people. The locally available fuel wood and fodder plant species in various agro-climatic conditions will be planted. The energy plantation would be carried out over **470 ha** land in the vicinity of the habitations. Owing to the increased biotic pressure in these areas, greater emphasis would be placed on effective closure and hence 5 strand barbed wire fencing 3 strand & 2 cross wise; with creosoted wooden fence posts would be adopted. 5000 tall plants per ha of Fuel & Fodder value will be planted. Maintenance intervention shall be taken by direct funding of user group. The provisions for outlay of **Rs. 408.195 lac** including fencing have been considered under this scheme. The details of area proposed for Energy Plantation in Holi, Barabanchu & Lamu Block is shown in **Table 4.10**.

Table-4.10: Details of Area Proposed for Energy Plantation in Holi, Barabanchu & Lamu Block

Sr. No.	Name of Block	Name of Beat	Legal Status	Area Proposed for Energy Plantation	Details of Nursery from where the plants will be raised and transported	
					Name of Nursery	Distance from Nursery, km.
1.	Holi	Tiyari	Kalah DPF-II	15	Kalah (proposed)	1.5
			Upper Tiyari DPF	10		1.0
			Lower Tiyari DPF	15		1.0
			Oi Nal (N) DPF	05		2.0
			Kandli DPF	60		4.0
		Sub-Total Energy Plantation in Tiyari Beat		**105**		
		Sutkar	Sadaser DPF-II	20	Sutkar	1.0
			Kutehr DPF-I	25		1.5
			Kutehr DPF-II	20		2.0
			Chilmily	25		4.0
		Sub-Total Energy Plantation in Sutkar Beat		**90**		
		Deoi	Gawala DPF	20	Holi	3.0
			Andrui DPF	55		4.0
			Kiur DPF	10		6.0
		Sub-Total Energy Plantation in Deoi Beat		**85**		
2.	Bara Banchu	Bajol	Bajol (N) DPF	05	Bajol (proposed)	1.5
			Guwar DPF	05		2.0
		Sub-Total Energy Plantation in Bjol Beat		**10**		
		Naya Gram	Agrali DPF	35	Nayagram (proposed)	3.0
			Pani Nali (C-I & CII)	10		6.0
		Sub-Total Energy Plantation in Nayagram Beat		**45**		
3.	Lamu	Banog	Dali DPF	10	Bag	1.5
			Jeena DPF	10		1.0
			Bharara DPF	15		1.0
		Sub-Total Energy Plantation in Banog Beat		**35**		
		Chanal	Bharadi DPF	25		3.0
			Ori DPF	25		3.0
		Sub-Total Energy Plantation in Chanal Beat		**50**		
		Lamu	Hiling DPF-I	20	Lamu	2.0
			Hiling DPF-II	10		2.5
			Jumed DPF	15		3.0
			Choli DPF	05		4.0
		Sub-Total Energy Plantation in Lamu Beat		**50**		
Total Proposed Area for Energy Plantation				**470**		

4.11 NURSERY DEVELOPMENT

In the light of the fact that the CAT plan entails plantation over approximately **1450 ha** area, a huge requirement of 33 lac saplings / plants is comprehended. Such requirement shall have to be met out from the existing and proposed nurseries. In Tretha range, the area under the existing nurseries is 4.10 ha which can be further extended to about 0.50 ha. Thus, the existing nurseries are too inadequate to meet the requirement. Being a mountainous area the suitable sites for developing new nurseries are not too many. Besides, the free of cost saplings shall be distributed to the JFM group for raising horticulture crops and private pasture development.

Availability of quality planting material well in time and in close proximity to the areas where afforestation is to be undertaken, remains a major constraint in implementation of large scale afforestation. The proposed large scale afforestation in the area due to establishing of various hydro electric projects, will certainly lead to establishment of decentralized nurseries through credit support. Small nurseries can also be raised, polyhouses and mist-chambers can also be constructed in some of the nursery area as per the local need so as to take the off-seasonal advantage. Staff will also be trained in raising modern nursery techniques.

The cost of strengthening along with renovation of the existing nurseries for implementing nursery support and raising quality planting stock has been assessed as **Rs. 70 lac**. The nurseries to be strengthened and extended are shown in **Table-4.11**.

Table-4.11: Details of existing nurseries proposed for strengthening and extension:

Sl. No.	Forest Nursery	Forest Block	Existing Area under Nursery (ha)	Area Under Extension	Allocation (Rs. in Lacs)
1	Lamu	Lamu	1.65	0.20	20.00
2	Holi	Holi	1.50	-	20.00
3	Sutkar	Holi	0.75	-	15.00
4	Bag	Bara Banchho	0.20	0.20	15.00
	Total		**4.10**	**0.5**	**70.00**

It is also proposed to create new nurseries in 2.0 ha each at Kala Nala in Tiyari beat and at Bajol in Bajol beat. The cost of developing new nurseries in 2.0 ha area @ at Rs. 25.0 lac work out to Rs. 50.00 lac. The Cost Estimates for Implementing Nursery Support is given in **Table-4.12**. The overall cost under nursery support is reckoned as **Rs. 256.58 lac**.

Table-4.12: Cost Estimates for Implementing Nursery Support

Sl. No.	Item	Amount (Rs. in Lac)
1.	Nursery equipments/ tools	14.00
2.	Barbed wire fencing with RCC post/ repair of barbed-wire fencing in existing nurseries.	10.00
3.	Preparation of additional beds in existing nurseries, soil layering in nurseries, establishment of Poly-house/ Poly-tunnels, soil working, establishment of compost and vermin-compost units, strengthening of irrigation facilities, providing insecticides, etc.	70.00
4.	Establishment of two new nurseries 2.0 ha each @ Rs. 40.00 lacs/ha	160.00
5.	Miscellaneous	2.58
	Total (Rs. in Lac)	**256.58**

The following Bio-engineering Species of Local origin have been identify for their propagation in the above mentioned Nurseries and subsequent planning in Forest area. These plants species will be planting along the various Nallas, Slip and Ghars to reduce Soil erosion and bank stabilization.

Sr.No.	Local Name	Botanical Name
1	Aakhe	*Rubus Spp.*
2	Bhekal	*Prinsepia utilis*
3	Benus	*Salix spp.*
4	Piyak	*Alnus nitida*
5	Khat-Mits	*Rumex hastatus*
6	Jangli- Gulab	*Rosa Spp.*
7	Yuca	*Yuca americana*
8	Robinia	*Robinia psudocasea*
9	Siaru	*Debregeasia hypoleuca*
10	Karaneh	*Spiraia lindeleyana*

4.11.1 Nursery Layout for Raising Healthy Stock

The features of a modern nursery, its layout and other components of it have been illustrated at **Annexure-V**.

4.12 SUBSIDIARY SILVICULTURE

Under the subsidiary silvi culture operation, the following activity will be carried-out:-

- Cutting of bushes.
- Trimming of branches.
- Gully plugging.

The proposed area under the scheme has been shown beat-wise with location in **Table-4.13**. A total of **574 Ha** has been indentified for subsidiary silviculture under this scheme for a total outlay of **Rs. 86.10 lacs**.

Table-4.13: PROPOSED AREAS FOR SUBSIDIARY SILVI CULTURE IN BARABANCHHO BLOCK

Sr. No	Name of Block	Name of Beat	Legal Status	Area proposed for Enrichment Plantation (Ha)
1.	Hali	Tiyari	Kalanala DPF	36
			Oi Nala	36
		Total Proposed Subsidiary Silviculture Area in Tiyari Beat		**72**
		Deol	Jabala DPF	36
			Jwai dhar DPF	36
		Total Proposed Subsidiary Silviculture Area in Deol Beat		**72**
		Sutkar	Kutehr Nala DPF	50
			Sadasar DPF (C-I & C-II)	57
			Sutkar RF	50
		Total Proposed Subsidiary Silviculture Area in Sutkar Beat		**157**
2	Barabo-nchho	Bajol	Guwar DPF	14
			Bajol DPF	21
		Total Proposed Subsidiary Silviculture Area in Bajol Beat		**35**
		Nayogram	Agrali RF(C-I,II,III)	43
			Luwain	14
			Nawai RF	22
			Pani Nali RF (C-I,II)	14
		Total Proposed Subsidiary Silviculture Area in Nayagram Beat		**93**
3	Lamu	Lamu	Hilang RF C-I	29
			Rakshnu RF	57
			Jumed DPF	22
		Total Proposed Subsidiary Silviculture Area in Lamu Beat		**108**
		Chanhail	Bharadi DPF	20
			Oi DPF	17
		Total Proposed Subsidiary Silviculture Area in Chanhail Beat		**37**
Grand Total for Proposed Silviculture Area				**574**

4.13 SOIL & WATER CONSERVATION

A total budget provision of **Rs. 1125 lac** has been made towards the Soil Stabilization and Engineering measures to be taken-up in free draining catchment of Kutehr HEP covered under Holi & Bajoli (part) forest blocks and the impact area under Lamu block of Tretha range. It has been observed that the main rivulets / nallas joining with river Ravi are perennial and have solid stable banks and rocky beds in major length while some of the stretches of these nallas, due to poor geological configuration, the banks are unstable and highly susceptible to bed and bank erosion and their bed is strewn with loose boulders. The nallas flow with heavy, medium & low discharge depending upon the season. The minimum discharge is observed during the winter months when these nallas discharge with their base flow. Seasonal nallas run during monsoon and bring lot of hill wash while flowing through poor geological rocks. The details of various areas requiring treatment under bio-engineering measures and hard civil engineering structures and the treatment measures for nallas / drainage lines is furnished in the following sections. Wherever possible, jute mash/matting can also be used to hold the loose soil till plants and bio engineering spp. are established. The cost under bio-engineering and engineering measures have been provided under **Annexure-VI & VII.**

4.13.1 Holi Block

1. Tiyari Beat

a) Nirpat Dhar Land Slides RF

The land slide / slip zones are scattered within the Nirpat Dhar RF and are in dynamic state. The affected area is about 05 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp. Zanthoxylumacatum, Daphnecannabina, Debregeasia hypoleuca etc.

Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

b) Kalah Nala

The nalla drains though Kalah DPF-I & II in about 10 km length and is perennial in nature with medium flow. It originates from Patoli Goth near Sariki Dhar. Trees along the nalla on its bank are mostly Kail. Some portions of the nalla in about 03 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

c) Tiyari Nala

The nalla drains through Upper Tiyari DPF in about 03 km length and is perennial in nature with medium flow. It originates from Halsean Goth. Trees along the nalla on its bank are mostly Kail. Some portions of the nalla in about 02 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

d) Oie Nala

The nalla drains through Oi Nala DPF in about 12 km length and is perennial in nature with medium flow. It originates from Halseon Goth. Trees along the nalla on its bank are mostly Kail and Deodar. Some portions of the nalla in about 02 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

e) Keshia Dhar (Proposed for Treatment – 20 ha)

f) Kujay da nala

Some portions of the nalla in about 02 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

g) Barola Slides

The land slide / slip zones are on the right bank of river Ravi in Lower Tiyari DPF and are located below village Barola. The slides have resulted due to tow erosion of the right bank during high floods. The length of the slide zone is about 500 meter. The affected area is about 5 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp, Zanthoxylumacatum, Daphnecannabina, Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

h) Tiyari Lower Slides

The land slide / slip zones are on the right bank of river Ravi in Lower Tiyari DPF and are located below village Barola. The slides have resulted due to tow erosion of the right bank during high floods. The length of the slide zone is about 400 meter. The affected area is about 5 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp, Zanthoxylumacafum, Daphnecannabina, Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

2. Sutkar Beat

a) Oans Slip

The land slide / slip zone is within the Chilimilli DPF and is in dynamic state. The slip zone has been resulted due to heavy rains on scrubbed areas.

The affected area is about 05 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp. Zanthoxylumacatum. Daphnecannabina. Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

b) Kee Nala

The nalla drains through Satkuni Dhar area in about 12 km length and is perennial in nature with medium flow. Trees along the nalla on its bank are mostly Kail, Fir/spurs. Some portions of the nalla in about 02 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

c) Tulang Nala

The nalla drains through Satkuni DPF, originates from El 4722, in about 10 km length and is perennial in nature with medium flow.

Trees along the nalla on its bank are mostly Kail, Fir/spurs. Some portions of the nalla in about 1.5 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

d) Oans Nala (Proposed length to be treated – 01 km)

e) Udani Nala

The nalla drains through Sadaser-II DPF in about 10 km length and is perennial in nature with low flow. Trees along the nalla on its bank are mostly Kail. Some portions of the nalla in about 0.5 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

f) Darman Nala

The nalla drains through Kutehr DPF. Trees along the nalla on its bank are mostly Deodar, Kail and Ban. Some portions of the nalla in about 1.5 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

g) Kutehr Nala

The nalla drains through Kutehr DPF-IA in about 4.5 km length and is perennial in nature with low flow. Trees along the nalla on its bank are mostly Kail, Deodar and Ban. Some portions of the nalla in about 1.0 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

h) Tarmoli Nala

The nalla drains through Sadaser DPF-II and is seasonal in nature with low flow. Trees along the nalla on its bank are mostly Kail. Some portions of the nalla in about 0.5 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

3. Deol Beat

a) Kuleth Slide

The land slide / slip zone is within the Nehra DPF and is in dynamic state. The slip zone has been resulted due to heavy rains. The Ravi while negotiating its course near village Kuleth, flows in inner curve, has badly eroded the left bank, which is made-up of talus and soft material easily amenable to erosion and sinking. The width of the river bed has been drastically reduced due to debris / huge rock mass aggraded and deposited from the rock fall / detachment of the vertical rock outcrops of the right bank. Keeping in view the severity of erosion and the flood discharge of the Ravi being in the order of 6681 cumecs, wire crate boulder spurs in three tiers shall be provided. Repelling spurs aligned on u/s of flow direction at 15° shall be provided at river bed level. However, the slope of the sinking zone shall be treated by adopting biological engineering measures. The affected area is about 20 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp. Zanthoxylumacotum. Daphneconnabina. Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

b) Holi Slide

Both banks of Holi nala, d/s of the road bridge, near the confluence with the Ravi are dynamically sliding and need to be treated soundly. The affected area is about 10 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp, Zanthoxylumacatum, Daphnecannabina, Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

c) Deol Slide

The land slide / slip zone is within the Deol RF and is in dynamic state. The slip zone has been resulted due to heavy rains on scrubbed areas. The affected area is about 10 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp. Zanthoxylumacatum. Daphnecannabina. Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

d) Adhour Slide

The land slide / slip zone is within the Gwala DPF and is in dynamic state. The slip zone has been resulted due to heavy rains on scrubbed areas. The affected area is about 05 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp. Zanthoxylumacatum. Daphnecannabina. Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

e) Bonthu Nala

Approximate length of the nalla is about 2.5 km. Trees along the nalla on its bank are mostly Kail, Deodar and Fir/Spruce. Some portions of the nalla in about 1.0 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

f) Deol Nala

Approximate length of the nalla is about 6.0 km length. The lower portion of nalla is totally loose strata, good vegetation, having sparse bushes. Nalla is perennial with medium flow of water. Trees along the nalla on the upper portion are Kail,Deodar,Ban,F/sp etc. Bushes- Berberis spp. Princepia utilis, Ariesma, Rosa moschata, Daphne etc . Some portion of the nalla about 3500 m length having latitude N 32°-17'10'', longitude E 076°-35'22'' and height 2400 mtr is affected by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalla.

Slides have been found in both sides of the nalla which can be treated with check walls, check dams & crate check dams with vegetative support.

g) Kuleth Nala

Approximate length of the nalla is about 1.0 km length. The nalla is totally loose strata, good vegetation, having sparse bushes. Nalla is seasonable with low flow of water. Trees along the nalla on the upper portion are Kail, Deodar, Ban,F/sp etc. Bushes-Berberis spp. Princepia utilis, Ariesma, Rosa moschata, Daphne etc. Some portion of the nalla about 1000 m length having latitude N 32°-18'55'' longitude E 076°-34'15''and height 2400 mtr is affected by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalla.

Slides have been found in both sides of the nalla which can be treated with check walls, check dams & crate check dams with vegetative support.

h) Guad Nala

Approximate length of the nalla is about 1.5 km. The lower portion of nalla is totally loose strata, good vegetation, having sparse bushes. Nalla is seasonable with low flow of water. Trees along the nalla on the upper portion are Kail,Deodar,Ban,F/sp etc. Bushes- Berberis spp. Princepia utilis, Ariesma, Rosa moschata, Daphne etc . Some portion of the nalla about 1500 m length having latitude N 32°-17'45'', longitude E 076°-33'50'' and height 2580 mtr is affected by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalla.

Slides have been found in both sides of the nalla which can be treated with check walls, check dams & crate check dams with vegetative support.

4.13.2 Barabanchho Block

1. Bajol Beat

a) Satar So

Approximate length of the nalla is about 4.5 km. The nalla is totally stabilized with rocky base, good vegetation, having sparse bushes, nalla is perennial with medium flow of water. Trees along the nalla on the upper portion are F/Sp,Ban etc. Bushes- Berberis spp. Princepia utilis, Ariesma, Rosa moschata, Daphne etc. Some portion of the nalla about 1000 m in length having latitude N 32°-18'32'', longitude E 076°-39'40'' and height 2385 mtr is affected

by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalla.

Some slides in small patches have been found in different portions of the nala which can be treated with Check walls, Check Dams & Crate Check Dams with vegetative support. Middle & Lower portion of nalla is rocky and narrow.

b) Gohar Nali

Approximate length of the nalli is about 1.5 km. The nalli is having totally loose strata and surrounding of nalli is having good vegetation and sparse bushes. Nalli is seasonal with medium flow of water. Trees along the nalli on the upper portion are F/Sp,Ban etc. Bushes- Berberis spp. Princepia utilis, Ariesmia, Rosa moschata, Daphne etc. Some portion of the nalla which is about 1000 m length having latitude N 32°-16'35'', longitude E 076°-39'30'' and height 2370 mtr is affected by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalli.

Slides in small patches have been found in different portions of the nalli which can be treated with Check walls, Check Dams & Crate Check Dams with vegetative support.

2. Nayagram Beat

a) Chuned Nala

Approximate length of the nalla is about 3.0 km. The lower portion of nalla is totally stabilized with rocky base, good vegetation, having sparse bushes. Nalla is seasonable with medium flow of water. Trees along the nalla on the upper portion are Kail, Deodar, Ban, F/sp etc., Ariesma Bushes- Berberis spp. Princepia utilis, Rosa moschata, Daphne etc. Some portion of the nalla about 2000 m length having latitude N 32°-16'20'', longitude E 076°-39'50'' and height 2480 mtr is affected by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalla.

Some slides in small patches have been found in both sides of the nalla which can be treated with check walls, check dams, crate check dams with vegetative support.

b) Agrali Nala

Approximate length of the nalli is about 1.0 km. The lower portion of nalli is totally stabilized with rocky base, good vegetation, having sparse bushes. Nalli is seasonable with low flow of water. Trees along the nalla on the upper portion are Kail, Deodar, Ban, F/sp etc. Bushes- Berberis spp, Daphne Ariesma, Princepia utilis, Rosa moschata, etc. Some portion of the nalli about 500 m length having latitude N 32°-16'55'' and longitude E 076°-39'15'' and height 2420 mtr is affected by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalla.

Some slides in small patches have been found in both sides of the nalli which can be treated with check walls, check dams & crate check dams with vegetative support.

c) Garoh Nala

Approximate length of the nalla is about 6.0 km. The lower portion of nalla is totally stabilized with rocky base, good vegetation, having sparse bushes. Nalla is perennial with medium flow of water. Trees along the nalla on the upper portion are Kail, Ban etc. Bushes: Berberis spp, Princepia utilis, Ariesma, Rosa moschata, Daphne etc. Some portion of the nalla about 3000 m length having latitude N 32°-16'50'', longitude E 076°-36'40'' and height 2870 mtr is affected by soil erosion along the bank and needs side stabilization by Bioengineering measures for the protection of the nalla.

Some slides in small patches have been found in both sides of the nalla which can be treated with check walls, check dams & crate check dams with vegetative support.

d) Lingti Ghar (Area to be treated – 8 ha)
e) Nayagram Nalla (Length to be treated – 1 km.)
f) Agrali Ghar (Area to be treated – 10 ha)

4.13.3 Lamu Block

1. Chanhel Beat

a. Bhardi Slip

The land slide / slip zone is within the Bhardi DPF and is in dynamic state. The slip zone has been resulted due to heavy rains. The affected area is about 05 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis spp, Zanthoxylumacatum, Daphnecannabina, Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

b) Arga Slip

The land slide / slip zone is within the Arga PF and is in dynamic state. The slip zone has been resulted due to heavy rains. The affected area is about 10 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp. Zanthoxylumacatum. Daphnecannabina. Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

c) Gulei

The land slide / slip zone is within the Arga DPF and is in dynamic state. The slip zone has been resulted due to heavy rains. The affected area is about 05 ha and is proposed to be treated with retaining structures like check walls / retaining walls / boulder wire crates at intermediate levels and the slide surface to be treated with vegetative species like Berberis-spp. Zanthoxylumacatum. Daphnecannabina. Debregeasia hypoleuca etc. Stabilization of the slip / slide can be done by broadcasting of seeds of indigenous grass supplemented by planting native grass.

d) Sua Nala

The nalla drains through Dharavi DPF in about 2.0 km length and is perennial in nature with low flow. Trees along the nalla on its bank are mostly Kail, Deodar and Ban. Some portions of the nalla in about 1.0 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

e) Maina Nala

The nalla drains through Bharadi DPF in about 1.5 km length and is perennial in nature with low flow. Trees along the nalla on its bank are mostly Kail, Deodar and Ban. Some portions of the nalla in about 0.5 km are affected by soil erosion and need side stabilization by bio-engineering measures. Slides in small patches can be treated with retaining structures like check wall / check dam with vegetative support.

2. Banoj Beat

a. Uder Nala (Length to be treated – 1.5 km)

b. Prahi Slip (Area to be treated – 5 ha)

c. Buk Nala (Length to be treated – 1 km)

d. Bragan Slip (Area to be treated – 10 ha)

e. Rawa Nala (Length to be treated – 1.5 km)

3. Lamu Beat

a. Lamu Nala (Length to be treated – 1.0 km)

b. Yol Nala (Length to be treated – 0.8 km)

c. Baggi Nala (Length to be treated – 1.5 km)

d. Brai Slip (Area to be treated – 10 ha)

e. Rakshnu Slip (Area to be treated – 15 ha)

f. Charoli Nala (Length to be treated – 1.2 km)

Different treatment measures shall be taken up from top to bottom in a scientific way and the following measures will be implemented under this head.

a. **Bio-Engineering Measures**

The bio-engineering methods are being developed for controlling the soil erosion in a cost effective manner & provide lasting solution to problem of soil erosion. These are very effective when used in combination with civil structures and reinforced those structures. These are being successfully used where the availability of stones, steels, cement, sand etc at the site is poor. Various biological materials like grass tufts, pine needles and various agricultural waste is being used to stabilize the loose soil on slopes or in gullies. The bio engineering species will be raised and planted every year up to 8 years of plan. Wherever feasible, stress would be on undertaking bio-Engineering measures and detailed site specific plan will be worked out at the time of implementation of the plan. An elaborate note on bio-engineering measures is enclosed as **Annexure-VIII**.

b. **Soil Conservation Works**

These works will be taken up as erosion control measures in gullies and eroding stream and river training works. This component concentrates on protection works where lasting benefits will be assured in the lower catchment areas. The type of structure will be decided as per site specific physical requirement accompanied by tree planting to stabilize banks and planting for short vegetative cover in the land slide prone areas through brushwood and perennial grasses. The following measures are suggested to be undertake; depending upon site specific requirements:

- Vegetative structures like fascines, brush-wood check dams, bamboo crib etc.
- Live hedge vegetative spurs along the nalla shall be put up.
- Local species, which are known as good soil binders like Salix, Alnus nitida, Ailanthus, bamboo species etc will be planted.

An elaborate note on engineering measures and the cost of nala/drain line treatment are enclosed as **Annexure-IX and X** respectively.

4.14 INFRASTRUCTURE BUILD-UP & FOREST PROTECTION

A total provision of **Rs. 675.0 lac** is being made under various heads for Forest Protection measures. The details are as follows:

I. Repair of boundary pillars

Though the boundary pillar registers have been maintained but all of these are required to be updated. The boundary pillars of most of the DPF's have been erected randomly. At places whole rows of boundary pillars can be seen, but at other places the boundary pillars are too distantly placed. Therefore, it is necessary that a plan be prepared for construction of large

and intermediate BP's in all forests. All the BP's along the cultivations shall be taken due care of and should be constructed of used Railway graders with GPS reading. A sum of **Rs.61.00 lacs** is kept under this component as shown in **Annexure-XI.**

ii. **Fire Protection**

Where necessary fire preventive & control will be entrusted to village level user groups/SHG's etc. & they would be incentivized by making suitable provision of monetary award for this work. A provision of **Rs 55 lac** has been made for the first five years of the project for this activity / purpose as shown in **Annexure-XII.**

iii. **Infrastructure Development**

a) **Buildings**

Various types of buildings have been constructed in the recent past; however, there is still necessity of some more inspection huts and living quarters for field staff. Most of the field staff huts have miserably damaged and needs to be replaced. These are required to be reconstructed. The existing forest rest houses are very poorly furnished. An amount of Rs. **90.0 lac** has been kept for new buildings and maintenance/furnishing of existing buildings. APO shall be prepared and got approved before taking up activity under this head. Project level committee shall prioritize and make final selection. List is enclosed as **Annexure-XIII.**

b). **Roads, Paths and Bridges**

No jeepable road would be constructed in the catchment area; otherwise this would lead to increased siltation. Only bridle paths, inspection paths and footbridges shall be constructed/maintained for which an amount of Rs. **195.50 lac** has been kept. No major roads will be constructed in the scheme. The details of paths and bridges to be constructed / maintained under each watershed are as per **Annexure- XIV.**

Fuel Wood for Project Labour and Administrative Staff- Project Authority's responsibility.

Administrative staff will be adequately paid and will be expected to purchase kerosene and cooking gas which is readily available from existing outlets at Bharmour.

During the construction of the project, it is estimated that a peak labour force of 1200 will be employed but it will be gradually increased and after attaining the peak force, it will be gradually decreased towards the completion of the project.

It would be the responsibility of the project authorities to provide for the requirements of their labour force & administrative staff.

iv. Operational Support

In order to execute the catchment area treatment plan, the forest department would be requested to establish a catchment area treatment cell for which the executing agency shall need necessary infrastructure support. Accordingly, provisions have been made for purchase of office equipment and inspection vehicles with O & M charges for ten years including maintenance period for plantation. For movement of the field staff and labour, forest footpath and bridges/culvers would need construction and repair. Besides, the forest staff shall have to camp nearby the site of work for which the existing rest houses would require extension and improvements. The cost of works proposed under the head works out to **Rs. 70.50 lac** and is shown in **Table-4.14**. The cost of the items mentioned from serial number 1 to 6 shall be provided in kind to the user agency by the project proponent.

Table-4.14: Cost Estimate for Support Infrastructure

Sr. No.	Description	Amount (Rs. in Lacs)
1.	Field Vehicle / Inspection vehicles.	20
2.	Computers with Printer and Fax machine, Photocopy Machine, Scanner and plotter etc.	14
3.	GPS, Differential GPS	3.5
4.	Misc. Office Furniture Almirahs, File Racks etc.	05
5.	Fire Equipments	1.0
6.	Binoculars, Digital Camera, Forest Book	2.0
7.	R&M of vehicles and machinery for 5 years @ Rs. 6.00 lacs per year.	25
	TOTAL	**70.5**

v. Energy Saving Devices

In order to reduce the pressure in the forest particularly for fuel wood exerted by villagers living near forest areas under the catchment, who are totally dependent upon the fuel wood for cooking purpose some alternate source of energy, is to be provided. It is proposed to provide LPG gas connection with cylinder at subsidized cost. Beneficiary under this component shall be the weaker section of society; families headed by women and scheduled caste households. The Principle for providing subsidy and cost sharing by the beneficiaries shall be as follows:

i) For Women Headed Households: 90% subsidy and 10% cost sharing
ii) For Schedule Cast Households: 75% subsidy and 25% cost sharing

Identification of women headed households and Schedule Cast households should be backed by data available with Panchayat Secretary and with local NGOs. Besides LPG, the stakeholders (1270) in the catchment shall be provided solar pressure cooker and electricity saving device like CFL with each household distributed 8 CFL during the project period. The break-up of cost under different non-conventional and fuel saving devices is shown in

Table-4.15. An amount of **Rs. 31.0 lac** is earmarked for this activity under the CAT Plan.

Table-4.15: The Break-up of Cost under Different Non-conventional and Fuel Saving Devices for Stake-holders

Sl. No.	Item	Quantity	Rate (Rs.)	Amount (Rs. in lac)
1.	LPG Gas connection			
	a. At 100% subsidy	300	3500.00	10.50
	b. At 90% subsidy	300	3150.00	9.45
2.	Solar cooker @ 50% subsidy	600	1000.00	6.00
3.	CFL 1270 x 08 = 10160 no. @ 50% subsidy	10160	50.00	5.08
4.	Fuel wood substitute to Labourers			79.00
			Total	**31.03**
			Say Rs.	**31.00**

The execution of Kutehr HEP and appurtenant works there under have been proposed to be completed in 84 months. Infrastructure facilities shall be developed, *pari passu*, with construction activities. With the commencement of construction activities deployment of labour force comprising of skilled/semi skilled/unskilled work force will take place and at a given point of time about 1200 workers shall be engaged. Fuel need of the laborers/workers shall be attended in an organized manner; otherwise the labour may resort to indiscriminate felling of trees and shrubs owing to their proximity with forest areas. Consequently deforestation shall adversely affect the ecosystem. The fuel shall be required by the labour for cooking purpose, warming the rooms during cold months, and also for warming water. In natural course, if the workforce is allowed to manage these at their will, the first choice shall be the free and readily available natural and conventional resources, i.e., fuel wood. Thus pressure due to immigrating labour using fuel wood extracting free from the local forest shall increase in alarming proportion, which may lead to deteoration of forest in nearby pockets. Therefore, to avoid the pressure for fuel wood in the adjoining forest and consequential increased production of carbon emission it is proposed to use LPG for cooking and electricity for heating in the camps in addition to kerosene stoves.

A practical work plan has been prepared for implementing the subsidized fuel scheme for the work force of the project. It is proposed to provide LPG connection for cooking, kerosene, and electricity for heating purposes. The cost of providing fuel wood substitute which is debitable to the CAT plan is shown in **Table-4.16**.

Table-4.16: Cost of providing fuel wood substitute to Labourers

S. No	Item	Unit	Estimated Consumption			Rate (Rs.)	Cost (Rs. in lac)
			Per day	Per month	Project period		
A	Conventional Fuel wood @ 1.5 kg/person/day	Quintal	22.5	675	40500	600	243.00
B	Alternate fuel						
1	LPG	Cylinder	14	420	25200	1147	289.04
2	Kerosene stoves	Litre	60	1800	108000	10	1080
3	Electricity (heating)	Unit	375	11250	675000	3.30	22.28
						Sub Total (B)	322.12
C	Difference between conventional and alternate Fuel (A) – (B)					Say Rs 79.0 lacs.	(-) 79.12

The overall cost under this scheme works out to **Rs. 110.00 lac**.

vi. Silt Observation Post

Five silt observation post one each at Holi Nala, Kurkhed, Kalo Nala, Tulang Nala and Dug ka Nala, as shown in **Figure-4.17** for regular monitoring of silt load coming in tributaries of micro-watersheds falling under high and very high categories have been suggested. This would ensure monitoring efficacy of implementation various treatments measures suggested as in CAT plan. Monitoring would be undertaken for a period of 05 years including. Cost towards this should be kept in project estimates and could be taken as below:

Cost of five laboratories – Rs 3.50,000/- for silt analysis per laboratory = **Rs. 17.50 lac**

Cost of five huts one at each site @ Rs 3,00,000/ hut = **Rs. 15.0 lac**

Cost for hiring services of persons @ one person each site assuming average salary = Rs 10,000/- for next 05 years = **Rs. 30.0 lac**

Cost for hiring services of two supervisors for all the sites assuming salary of Rs. Rs. 15,000/- for next 05 years = **Rs. 18.0 lac**

Consumables items for lab work @ Rs. 2.50 lacs per year for next 05 years = **Rs. 12.50 lac**

Total cost = Rs. 93.00 lac

4.15 GENERAL AWARENESS / PUBLICITY

Mass awareness and education programme in the project area villages is a must to reduce anthropogenic pressure. Education and awareness generation programmes for garnering public support for biodiversity conservation is the need of the day. Community education and involvement is a crucial component of a biodiversity conservation strategy because the condition of the environment is reflected by the manner in which the communities treat and manage the natural resources.

Under this programme, various activities viz. trainings, publishing of research documents, pamphlets, brochures, hoardings, etc. shall be carried out during the implementation period of CAT plan. Awareness should be imparted to the school teachers in the area for introduction of environment education among the school children and exchange of knowledge on environment and ecology between the monastic and village school. The basic purpose of this is to create awareness among young generation and also among the local villagers so as to protect the wildlife for future generation.

Biodiversity education and community awareness will therefore be strengthened in a variety of ways to reach people of all sections. Activities like opening of biodiversity register in every village and promotion of traditional farming, advertisement of hazardous effect of fire through press, sign boards and public meetings will form the important activities under this component. A provision of **Rs. 60 lacs** has been kept for the purpose.

4.15.1 Training of Forest Officers / Officials and Community

The specialized training and study tours for forest officials / officers, who are executing the plan, will be provided. The objective of this training component would be to provide the officers and the staff to augment their skills, professional knowledge, and capacity building to be effective and efficient. The basic components of capacity building include:

- Developing human resources through training and education.
- Generate new information for better knowledge and understanding.
- Providing an adequate institutional framework and material support to enable acquired skills to be fully utilized.

Training for staff will be organized at the Forest Training Institutes of HP Forest Department, where services of resource persons from specialized institutions / organizations in the field of Soil & Water Conservation, Information Technology, Environment, Socio-economic issues etc. would be utilized for imparting practical training to the forest field staff & also communities.

The provision for outlay of **Rs. 100 lac** has been allocated under the scheme.

4.15.2 Participatory Action Research for Minimizing Negative Impact of Transhumance

Chamba district is characterized by presence of transhumant groups viz- Gaddis & Gujars, due to the presence of high altitude pastures. These groups follow a routine of moving from place to place with the change of season, in a customary usage pattern, with their flocks. Regulations on grazing lands, size of flocks permitted to graze in defined pastures; grazing rights, etc are some of the problem frequently encountered in the area, relating to migratory grazers. For in-depth understating of the real issues involved, Participatory Action Research is an effective tool and could provide workable solutions to the problem. Under the CAT Plan, provision of **Rs. 65 lac** is being made for undertaking Participatory Action Research (PAR) for minimizing the negative impact of Transhumance in the catchment and then implementing the good practices emerging out of this PAR.

4.16 PAYMENT FOR ENVIRONMENTAL SERVICES INCLUDING ECO-TOURISM DEVELOPMENT

4.16.1 Development of Eco-tourism

Trekking routes such as trek to Mani Mahesh Shrine with camping facilities can help to boost eco-tourism in the area. Concept of "Homesteads" can be promoted. Such host families who are enterprising and having reasonable traditional accommodation in the village en-route to good eco-treks can accommodate tourists on payment basis. Such financial support to rural people can boost the activity. Involvement of local youths can provide self employment services like guides, porters, and making arrangements for boarding and lodging of eco-tourists. The poor families can earn wages by transporting manually or by mules or other small works. Eco- tourism societies can be formulated under the overall control of the special purpose vehicle (SPV) arrangement for anchoring the eco-tourism activities. There exists scope for eco-tourism in the area where tourists can see its wild virgin and pristine glory and catching the everlasting enthralling moments in their mind while enjoying and learning the nature. In keeping with the Revised Policy on Development of Eco-tourism in Himachal Pradesh, 2005, and guidelines dated 30-09-2009, issued by the Forest Dept. one percent of the CAT plan should be earmarked for eco-tourism purposes. Therefore, under this head improvement of track to Manimahesh and construction of a forest rest house to be located in existing forest complex near Jail Khad enroute Mani Mahesh and another at Sutkar have been proposed. The cost component for the eco-tourism has been earmarked as **Rs. 180 Lac which shall** be met from the total outlay of **Rs. 450.00 lac**, which also includes the cost for pasture reclamation work.

4.16.1.1 Strategy for Developing Ecotourism

In the first two years of the project a study would be conducted to access the Eco tourism potential & requirements of the area & to suggest a modus operandi for operationalizing Eco-tourism. The study on Eco-tourism would form part of the study being proposed under the PES component, though the

implementation of the Action Plan on Eco-Tourism, emerging out of the PES study.

4.16.1.2 Provision for Specific Study on Catchment Area

The provision for conducting specific study on catchments to identify proposals and activities to be undertaken for subsequent years is also covered under the sub-head PES. Provision for implementation of the identifed activities after approval by the HPFD, has been earmarked as **Rs. 60.0 lac**.

4.16.2 Payment for Environmental Services

As per guidelines issued in this direction, a provision @ 10% of the CAT plan outlay shall have to be earmarked on this count. A provision of **Rs. 450.00 lac**, @10% of the CAT plan outlay is being made under this sub-head for carrying out such works which enhance the environmental status and also reduce the adverse impact on the environment and ecology. Funds for identified and approved activities for Payment for Environmental Services have also been provided under this component. The scheme *inter-alia* includes construction of contour trenches, construction of sprinkler irrigation and small flow irrigation kules and irrigation tanks, incentives for fire protection on private as well as on government land/forests, provision of funds for live hedge fence on private land and payment for environmental services as per approved Himachal Pradesh Forest Department activities and norms.

The silt contribution of private landholding is very significant. The agriculture land is not developed properly and coupled with faulty agricultural practices, like interrupting the natural drainage, contributes heavy soil erosion as compared to the other land use categories like dense forest/ open forest. Therefore, better land management shall help in reducing the sediment flow besides increasing the land productivity by way of arresting the loss of soil cover and increased soil moisture content. Accordingly, funds for the following activities on private lands will be made available:

1. Live hedge fencing of private lands - Payment shall be made as per schedule of rates of labour and works of Chamba Forest Circle, as applicable on the date of establishment of live hedge fence.
2. Contour trenches in private land – norms to be fixed in consultation with Agriculture Department.
3. Incentives for prevention of forest fires shall be provided village-wise.

Fire management and control plan expenditure for the catchment area will be done under the PES Component. For success and survival of bio-engineering plantations, protection against the fire will also be very important. In general protection against forest fire hazards and incidents following indicative action points are proposed to manage and control fire in the catchment area:

- To prevent and tackle fire incidences awareness campaign against the fire hazards and involvement of local people in controlling and prevention of fire incidences to be ensured.
- Identification of sensitive hot-spots on past record and accordingly increased patrolling by deploying of appropriate manpower during fire-season.
- Maintenance of fire-lines as per the Working Plan.
- Winter control burning to be ensured as per the Working Plan.
- Strengthening of communication network to ensure timely and immediate response to tackle fire incidences.
- Enforcing fire rules and regulations especially during the fire season.
- Need based fire equipment be purchase and to be kept at appropriate places.
- Fire watch towers and fire huts to house equipment and manpower during fire season be constructed based on requirement after getting approval from the Conservator of Forests, Chamba.

For nomadic tribes, who migrate along with sheep and goats across the area, necessary veterinary assistance by providing medicines and other support to maintain hygiene and health of the animal stock based on the suggestions of local veterinary office will be provided at pre-identified sites along with time schedule to be worked out as per the migration period/ time. The cost of medicines and other assistance based on realistic assessment and inputs from Veterinary Office/ Department will be charged to PES.

4.16.3 Pasture Reclamation

A total of 1050 ha has been indentified for Posture Reclamation under this scheme for a total outlay of **Rs. 210 lacs**. The preliminary forest identified for this purpose is as under:

4.16.3.1 Holi Block

A. Tyari Beat

i) Nirpat Dhar

Pasture reclamation in an aggregate area of 50 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity. On the basis of agreements with the local users / stakeholders the rotation closure of the pastures shall be restored to.

ii) Druni Dhar

Pasture reclamation in an aggregate area of 10 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

iii) Serartu Dhar

Pasture reclamation in an aggregate area of 50 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

iv) Druni Goth Dhar

Pasture reclamation in an aggregate area of 25 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

v) Panal Goth Dhar

Pasture reclamation in an aggregate area of 10 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

vi) Rani Goth Dhar

Pasture reclamation in an aggregate area of 10 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

vii) Dhermbad Goth Dhar

Pasture reclamation in an aggregate area of 15 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

viii) Dhermbthen Dhar

Pasture reclamation in an aggregate area of 100 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

B. Sutkar Beat

I) Satkuni Dhar

Pasture reclamation in an aggregate area of 100 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity. On the basis of agreements with the local users / stakeholders the rotation closure of the pastures shall be restored to.

ii) Dhruni Dhar

Pasture reclamation in an aggregate area of 30 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

ii) Jutta Dhar

Pasture reclamation in an aggregate area of 50 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

C. Deol Beat

I) Phat DPF

Pasture reclamation in an aggregate area of 05 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

ii) Sara Dhar

Pasture reclamation in an aggregate area of 50 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

iii) Sarud Dhar

Pasture reclamation in an aggregate area of 40 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

iv) Sad Dhar

Pasture reclamation in an aggregate area of 35 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

v) Roun Dhar

Pasture reclamation in an aggregate area of 30 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

4.16.3.2 Barabanchho Block

A. Bajol Beat

i) Gwar Dhar

Pasture reclamation in an aggregate area of 50 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity. On the basis of agreements with the local users / stakeholders the rotation closure of the pastures shall be restored too.

B. Nayagram Beat

i) Riyal Dhar

Pasture reclamation in an aggregate area of 50 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity. On the basis of agreements with the local users / stakeholders the rotation closure of the pastures shall be restored too.

4.16.3.3 Lamu Block

C. Lamu Beat

i) Saui Dhar

Pasture reclamation in an aggregate area of 50 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity. On the basis of agreements with the local users / stakeholders the rotation closure of the pastures shall be restored too.

ii) Dalli Kutla Dhar

Pasture reclamation in an aggregate area of 250 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity. On the basis of agreements with the local users / stakeholders the rotation closure of the pastures shall be restored too.

Dalli Kutla Dhar

iii) Channail Beat

ii) Chur Dhar

Pasture reclamation in an aggregate area of 20 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity. On the basis of agreements with the local users / stakeholders the rotation closure of the pastures shall be restored too.

iii) Dharaul Dhar

Pasture reclamation in an aggregate area of 20 ha shall be carried-out by broadcasting of seeds of indigenous grass species supplemented by planting of the native grass. For improvement of soil moisture regime small ponds, two per hectare, shall be constructed, which shall help in the improvement of bio-diversity.

The beat-wise cost of pasture reclamation has been assessed as **Rs. 210.0 lacs** as shown in **Table-4.17.** This cost shall be met from the capital outlay of **Rs. 450.00 lac** earmarked under the head providing environmental services and eco-tourism.

Table-4.17: Proposed Areas for Pasture Reclamation

Sr. No	Name of Block	Name of Beat	Legal Status	Area proposed for Pasture Reclamation, ha	Cost @ Rs. 0.20 lac/ha. Rs. Lacs
1	Holi	Tiyari	Nirpat Dhar	50	10.00
			Druni Dhar	10	2.00
			Seratu Dhar	50	10.00
			Druni Goth	25	5.00
			Panal Goth	10	2.00
			Rani Goth	10	2.00
			Dhermbad Goth	15	3.00
			Dharmbathen Dhar	100	20.00
		Total Proposed Area for Pasture Reclamation in Tiyari Beat		**270**	**54.00**
		Sutkar	Satkuni Dhar	100	20.00
			Dhruni Dhar	30	6.00
			Jutta Dhar	50	10.00
		Total Proposed Area for Pasture Reclamation in Sutkar Beat		**180**	**36.00**
		Deol	Phat DPF	5	1.00
			Sara Dhar	50	10.00
			Sarud Dhar	40	8.00
			Sad Dhar	35	7.00
			Roun Dhar	30	6.00
		Total Proposed Area for Pasture Reclamation in Deol Beat		**160**	**32.00**
2	Barabanchho	Bajol	Gwar Dhar	50	10.00
		Total Proposed Area for Pasture Reclamation in Bajol Beat		**50**	**10.00**
		Nayagram	Riyal Dhar	50	10.00
		Total Proposed Area for Pasture Reclamation in Nayagram Beat		**50**	**10.00**
3	Lamu	Lamu	Saul Dhar	50	10.00
			Dali Kutta Dhar	250	50.00
		Total Proposed Area for Pasture Reclamation in Lamu Beat		**300**	**60.00**
		Chanhail	Chur Dhar	20	4.00
			Dharaul Dhar	20	4.00
		Total Proposed Area for Pasture Reclamation in Chanhail Beat		**40**	**8.00**
Total Proposed Area for Pasture Reclamation				**1050**	**210.00**

4.17 WILDLIFE MANAGEMENT AND BIODIVERSITY CONSERVATION PLAN

A plan for conserving the biodiversity of the area, ecological rehabilitation of the tract by pasture development and enrichment, afforestation and land stabilization measures, improving water regime and control of illicit poaching has been made under **Biodiversity Management Plan** in Chapter-6. The cost of the plan has been assessed as **Rs. 225.00 lac.**

4.18 MONITORING AND EVALUATION

A close watch on annual basis shall be maintained in respect of such areas where habitat improvement works have been carried out so as to verify the work executed on site itself and also to ascertain the rate of survival of plants and / or any damage to the new work. For monitoring of works under forestry operation, the use of remote sensing technique by using digital satellite imagery of IRS P6 LISS-III with high resolution (2.5 m x 2.5 m) should be made obligatory. The monitoring through satellite scene should be done before commencement of works under CAT plan and in a block of two years after it till five years after completion of CAT plan. The work of monitoring of various works under the CAT plan should be entrusted to an external agency which has long experience of carrying out similar work on land use data and evaluating environment impact.

A provision of **Rs. 315.00 lac** @ 7% of the CAT plan outlay is being made for monitoring and evaluation activities including the expenditure likely to be incurred on conducting meetings / seminar / workshops at the head quarter and outside. This will include payments made to the non-official members of the monitoring evaluation committee on accounts of their expenditure on traveling and boarding etc. The payment to the external agencies shall also be met out from this part.

4.19 MISCELLANEOUS ACTIVITIES

4.19.1 Support for preparing Site specific work plan

A provision of **Rs. 135.00 lac** @ 3% of the CAT plan outlay has been earmarked as contingent amount against these activities for span of 11 years.

4.20 INSTITUTIONAL MECHANISM

4.20.1 Role of Project Proponent

The forest department would implement the Catchment Area Treatment Plan. A joint inspection group is suggested that would include officers drawn from State Forest Department of H.P. and officials from the Environment Cell at JSW Ltd. The management will have liaison with the forest officials. As far as the financial disbursement to undertake activity involvement of various stake

holders and collaborative public participation should be encouraged to have transparency in the system.

4.20.2 CAT Implementation

The designated Environmental Officer of project proponent would coordinate with the forest department for the implementation of the proposed Plan. The Environment Officer would evaluate/monitor financial aspects. The modalities of financial disbursement need to be worked out. The implementing agency shall submit completion certificate in the light of guidelines fixed by CAMPA. The implementation of CAT Plan should have enough flexibility and should be subject to changes as per requirements of specific ecosystem and periodic gains. A monitoring committee as per the MoEF guidelines such as Kutehr CAT Plan Society with its headquarters at Bharmour may be constituted for the project for administrative guidance and smooth realization of targets.

4.20.3 Project Monitoring and Reporting Procedures

Meetings would be held every three months to resolve problems arising in plan implementation. A Joint committee may be formed with the Environment Cell of JSW Ltd and State Forest Department; the team members must ensure implementation and monitoring of the CAT works and review the progress from time to time. Quarterly progress reports and completion certificates would be submitted to JSW Ltd for evaluation and disbursement of finance. In addition, the work done should be published through public awareness campaigns. Visual and print media may be used to gain maximum benefit by beneficiaries. Such efforts would resolve conflicts which otherwise are potential sources for project delays.

4.21 SUMMARY OF COST OF WORKS

The cost of all works proposed in the CAT plan is enumerated in **Table-4.18**. Year-wise Tentative Break-up of Engineering and Biological Measures is shown in **Annexure-XV**.

Table-4.18: Abstract of Cost of CAT Plan of Kutehr HEP (240 MW)

Sr. No.	Items	Out Lay(In Lacs)
1.	Afforestation measures (25%)	1125.00
2.	Soil & Water Conservation measures (25%)	1125.00
3.	Payment for Environmental services including Eco-Tourism (10%)	450.00
4.	Research, Training & Capacity Build-up (5%)	225.00

Sr. No.	Items	Out Lay(In Lacs)
5.	Infrastructure build-up & Forest Protection (15%)	675.00
6.	Improvements & Development wildlife & wildlife habitate (5%)	225.00
7.	Monitoring & Evalution (7%)	315.00
8.	Support for Preparing Site Specific plan (3%)	135.00
9.	Contingency (5%)	225.00
	TOTAL OUTLAY(In Lacs)	**4500.00**
	Rupees Four Thousand Five Hundred Lac Only	

CHAPTER-5: JOINT FOREST MANAGEMENT

5.1 INTRODUCTION

The total forest cover of India, as per 2007 assessment, has been assessed as 690899 sq. km. constituting 21.05% of the geographical area of the country. The dense forest constitutes 83510 sq. km. (2.54%), moderately dense forest 319012 sq. km. (9.71%) and open forest 288377 sq. km. (8.77%) of the country's geographical area (State Forest Report, 2009). India has the world's largest livestock population out of which about 25% i.e. over 100 million, graze on forest lands that have an estimated capacity to support only 31 million. Due to whopping dependency of the population on forests for meeting basic needs of fuel wood, fodder, small timber for agriculture implements, house construction and even food and medicine in the form of NTFP and for cash income for many poor households to make their both ends meet, the forests have been over used in some areas. The steady depletion of forest resources and increasing deforestation has brought into the focus the realization that the active participation of the communities is necessary for the success of any forest regeneration programme. It is stark reality that village communities would have little incentive to participate unless they benefit directly from it. The process of degradation of forest is reversible when it is managed sustainably with the involvement of local communities in its protection and management. The stake holders have to be sincerely motivated enmass in the protection and development of forest resources.

5.2 EMERGENCE OF JOINT FOREST MANAGEMENT

Ever since the GoI, on June 1, 1990, issued guidelines to the state governments for involving local communities in the protection and development of the degraded forests, the JFM programme has been extensively adopted in large number of states which *inter-alia* includes Himachal Pradesh. The sole objective of the JFM is to provide a discernible role to the local communities in the matter of planning, management and protection of forests and to give them due share in the benefits from these forests. The programme aims at empowering local people for their active participation as co-partner in the management of the forest resources and sharing the benefits derived from its protection and management. It also aims at acquiring technical and management capability available at the grass-root level. Over a time it has emerged as power tool of sustainable forestry. In a period of about 10 years since its inception the area covered under JFM programme in twenty-two states of the country was 1,02,48,586ha of forests being managed by 36,130 JFM committees. The area covered under JFM programme and the number of JFM committees have increased manifold and of-late it has been assessed that in 27 of states 62,890 JFM committees have been constituted for managing 1,42,54,846 ha of forest area.

5.3 JOINT FOREST MANAGEMENT IN HIMACHAL PRADESH

Showing concern over certain highly degraded areas in the protected forests beside some areas under the HP Ceiling on Land Holding Act, 1972, and Village Common Lands (vesting and utilization) Act, 1974 and transferred or to be transferred to the Forest Department are barren or have degraded in the past, the state government has resolved for conservation of these areas so as to arrest their further environmental degradation and to augment fuel wood, fodder and small timber production for use by local people by their active participation in the planning, protection, afforestation and judicious use for eco-development of aforesaid areas.

In pursuance of the GoI letter No. 6-21/89-FP dated June 1, 1990 in the subject matter of formation of village forest development committees for joint forest management in the village in Himachal Pradesh, the state government, vide notification No. Forest (C) 3-4/80V of 12-05-1993, has notified for constituting village forest development committees for participatory forest management, judicious use for eco-development of aforesaid areas thereby bringing 50% of the feasible area under forest cover by 2000 AD in accordance with the policy of JFPM.

The notification lays down detailed procedure for constitution of Forest Development Committees, ingredients of constitution of executive body, schedule of meetings of general house and executive body, registration of the committees, duties, responsibilities and power of the VFDCs besides specifying duties and responsibilities of forest department vis-à-vis VFDC and the instrument for resolving disputes / arbitration / termination of agreement and the appellate matters.

The Government of Himachal Pradesh launched the Sanjhi Van Yojana (SVY) scheme in 2001 for sustainable management of forest resources in the state in collaboration with the local communities. The scheme amalgamated the existing Sanjhi Van Yojana Scheme, 1998, the Parishram Hamara Van Hamara Scheme, 2000 and the Apna Van, Apna Dhan Scheme. Subsequently, based on the experience, the process of institutionalizing people's participation in forest protection and regeneration began. This type of collective endeavour in protection and management of forests through people's involvement was later termed as Joint Forest Management. At present, total number of VFDCs managing and protecting 111,247 ha area under JFM is 914. The special features of Sanjhi Van Yojna Scheme, 2001 are reproduced hereunder:-

i.) Involvement of grass root level institutions such as gram panchayats, mahila mandals, yuvak mandals, ex-servicemen's bodies, schools, Village Forest Development Societies (VFDSs), User groups, other Community Based Organizations (CBOs) and NGOs in sustainable management of forest resources;

ii.) Grant of 100 % income from plantations to the VFDSs and Panchayats;

iii.) Grant of total usufruct rights to the VFDSs;

iv.) Regeneration of degraded forest areas and conservation & sustainable use of better forests through community involvement.

v.) Involvement of local communities in the choice of species to be planted under the scheme;

vi.) Creation and enhancement of social, physical and financial capital of the participating communities for poverty reduction;

vii.) Special emphasis on involvement of women in the scheme;

viii.) Address problem of rural unemployment by utilising degraded forest land for large scale plantations;

ix.) Establish linkage between Food for Work Programme and the present scheme by making payments in the shape of food grains under the scheme;

x.) Increasing productivity of the Forest areas by improvement of nursery stock and adoption of mixed plantations.

xi.) Training of forest staff, VFDS members and CBOs/NGOs for facilitating and strengthening community participation.

xii.) Gradually empower local communities and local level institutions to become more pro-active in sustainable forest management.

xiii.) To help VFDSs achieve financial viability and sustainability by introducing proper mix of short and long duration cropping patterns as a short and long term objective to ensure their continued participation in the scheme.

xiv.) Gradually empower local communities and local level institutions to become more pro-active in sustainable forest management.

xv.) To help VFDSs achieve financial viability and sustainability by introducing proper mix of short and long duration cropping patterns as a short and long term objective to ensure their continued participation in the scheme.

5.4 PREPARATION OF MICRO PLAN

For the long-term success and the sustainability of the village level institutions, it is important that proper and adequate methods of community organization and management are followed. Thus, normally in the zero and first year of schedule of implementation of CAT plan, major emphasis should be laid on the systematic and sequential formation of VFDSs, training of local communities, CBOs and community members. Towards the end of the first year, a well documented but simple and understandable micro plan for each

beats of a sub-watershed needs to be formulated for approval by competent authority and its implementation.

The micro plans should be prepared by the Forest Officers and Village Forest Protection Committees after detailed PRA exercise and should reflect the consumption and livelihood needs of the local communities as well as provisions for meeting the same sustainably. It should utilize locally available knowledge as well as aim to strengthen the local institutions. It should also take into account marketing linkages for better returns to the stakeholders and should also reflect the needs of local industries/ markets. This should be done with due regards to the environmental functions and productive potentials of the forests and their carrying capacity as also their conservation and biodiversity values.

i.) If the existing working plans are in force (till their revision in future), for incorporation of micro plans in the working plans, a special order may be issued by the PCCFs for implementation of the micro plan. In these areas, micro plan should aim at ensuring a multi product and more NTFP oriented approach. Without changing the basic principles of silviculture, deviations may be approved in the existing working plans if necessary. To ensure this, the concerned DFO and CF should dovetail the requirements of micro plans with the working plans.

ii.) The micro plan should also take into consideration and provide suitable advice for areas planted/ to be planted on community lands and other Government lands.

iii.) Infrastructure/ Eco- development under micro plan should form a separate entity for funding it through concerned developers.

5.5 JFM VIS-A-VIS KUTHER CAT PLAN

The habitat improvement work involving plantation activities through afforestation, bio-engineering, high density energy plantation, treatment of alpine pastures, and reservoir rim treatment over a total area of 1890 ha., costing **Rs. 1693 lac**, besides small size soil and water conservation work, shall be executed based on the model of JFM. Though there are 21 numbers of villages in the free draining catchment, yet, registered VFDCs have been constituted in only five villages viz., Deol, Kuleth, Tiyari, Bhanog and Sutkar. Viewing the enormity of the CAT plan there is an emerging need to constitute more VFDCs besides enrolling such NGOs which have experience in similar work in the state.

The local panchayat specific VFDS will be formed which will supervise and carry out the works. The various activities planned in the JFM are given below:-

Community Participation:- Local people and committees will be engaged for the CAT plan works such as plantation and maintenance etc. instead of hiring

the labour. The wages will be met out from the provision incorporated in the norms. The engagement of Non-governmental Organization (NGOs) and Community Based Organizations (CBOs) would be encouraged for strengthening the JFM works. VFDC will be formed for this specific purpose. Besides, the active Mahila Mandals and Yuvak mandals will be approached to carry out the various works of the CAT plan.

Women Participation in JFM:- Considering the immense potential and genuine need for women's participation in JFM programme, meaningful participation of women should be encouraged in JFM by forest department. Al-least 50% members of the JFM general body should be women. For the general body meeting, the presence of at-least 50% women members should be quorum for holding the general body meeting.

Plantation in Degraded Forest Land: Provisions have been kept for plantations in the degraded and open forests and available non-forest areas. For plantations, however, the forest department shall continue to supply planting material to the VFDS on demand, free of cost for three years including the year of plantation. Thereafter, for any more supply of plants price shall be charged from the VFDS.

Income Generation Activities (IGA) The major thrust of the CAT plan is on Income Generation Activities (IGA), so that people get their livelihood without entering in the forests. In order to enhance the economic stake of rural communities in the conservation and sustainable utilization of forest resources as well as to create means of income for the VFDS and its members, forestry related income generation activities should be promoted under JFM. Such activities may include water harvesting and its use for irrigation / drinking purposes. Introduction of improved grasses and development of village pastures, high density fuel wood / fodder plantation. These examples are illustrative only and suitable income generation activities can be adopted as per the requirements of the local populace.

Non-wood Forest Products including Medicinal and Aromatic Plants Plantation: Non-wood Forest Products (NWFP) are important source of supplementing incomes for rural households. Its sustainability and management are thus crucial to rural livelihoods. Medicinal and aromatic plants constitute an important aspect of NWFP management. *In-situ* or *Ex-situ* growing of medicinal plants of high economic value should be promoted within the selected areas or even on private lands.

Training, Workshop and Exposure Visit: The basic objective of the training is to develop the capacity of different stakeholders especially the forest staff, VFDS members and CBOs / NGOs and the villagers for facilitating and strengthening community participation. In terms of training, particular attention shall be given to the ways in which issues of participation and organizational changes are dealt with. Trainings will be conducted after formulation of a concrete training plan in the initial stage of the micro plan.

Forest Fire Management: Forest fires cause irreparable damage to forest biodiversity, wildlife, water sources and forest based livelihoods and well being. Participation of local communities should be encouraged in fire management including its prevention.

Control of Grazing: Grazing poses another significant impact on the forests. This can be resolved by evolving a consultative mechanism with the involvement of the Gram Panchayat and the local community to address grazing issues.

CHAPTER-6: BIODIVERSITY MANAGEMENT PLAN

6.1 INTRODUCTION

The forests of the Ravi Valley in Himachal Pradesh vary from sub-tropical to temperate. The total forest required for the proposed barrage of the Kutehr hydro-electric project is 61.4083 ha. The vegetation of project site falls under Sub-tropical region. The flora coming within the barrage pond would be lost and the fauna will migrate during the project construction and operation. A baseline assessment of flora and fauna were carried out in the submergence as well as impact zone. The study was aimed to assess their diversity, priority, seasonality, habitat and habitat dependence and food preference, migratory routes of wildlife, assessment of population and habitat loss in order to formulate conservation plan for land reclamation and wildlife restoration in the impact zone using modern scientific methods. NOC received from Wild Life Division, Chamba is enclosed as **Annexure-XVI**.

6.1.1 Wild Biodiversity

The plant resources of the impact zone consist of 286 species, which include 232 herbaceous species, 36 shrubs & 16 trees. Out of these species, 92 species are ethno-botanically important, 32 species are medicinally important, 7 timber species, 28 edible plants, 22 fodder plants and 15 fuel wood species.

Among the faunal diversity as many as 31 species of butterflies, 66 species of birds and 15 species of mammals were recorded during the survey in the impact zone. Few of the faunal species recorded from the impact zone are listed in IUCN Red List, 2008 such as Himalayan Tahr (*Hemitragus jemlachicus*), Asiatic Ibex (*Capra ibex*), Asiatic Black Bear (*Ursus thibetanus*) and Himalayan Brown Bear (*Ursus arctos*). Within the flora recorded from the study area *Aconitum heterophylum* (herb), *Angelica glaica* (shrub), *Picrorhiza kurroa* (Herb) were reported to be endangered and *Bergenia stracheyi* (herb) and *Ferula jaeskeana* (shrub) are reported Vulnerable as per the IUCN red data.

6.1.2 Cultivated Biodiversity

The project area falls under notified tribal areas of the state and is largely inhabited by the Gaddi tribal community in Brahmour district of Himachal Pradesh. Due to very unfavourable climate, peculiarly cold and dry, poor geographical accessibility, and lack of basic infrastructural facilities the study area remains one of the backward regions in the state. Cultivation of crops in the region is mainly restricted to river valley between El 1500 masl to El 3700 masl.

Holi area is located relatively at lower elevation in Bharmaur region. Hence, it is climatically best suited for growing pulses. The pulses account for about one third (32.63%) of the total cropped area in this area. Rajmah alone

occupies about one fifth of the total cropped area among the overwhelmingly dominated by the food grains with subsistence agricultural economy produced for self consumption (Jaglan and Thakur, 2006). The total cropped area in the neighborhood is depicted in **Figure 6.1**.

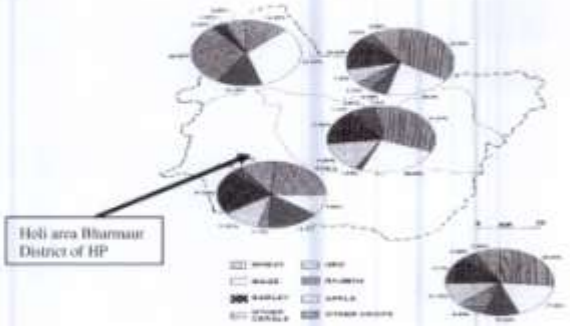


Figure-6.1: Total cropped area in the project area
Source: Jaglan and Thakur, 2006 ***J. Hum. Ecol., 19(1): 13-20 (2006)***

The contribution of agriculture in livelihood is limited due to small size of land holding and lack of irrigation facilities in the area. To compensate their income Gaddis raise large flocks of sheep and goat. The lush mountainous meadows and grazing grounds in the area facilitate rearing of sheep and goats. The population of goats, especially in tribal areas, is high as it is a companion animal and is valued for both its milk and meat. It contributes to as a conspicuous niche for household. The population of goats in the flock of sheep and goats are higher than sheep in Bharmour area. Livelihood of workers in the survey area showed that about 60 per cent of the total time devoted to all the activities was used in livestock rearing. Thus, the important cultivated crops shall be identified, documented for evolving effective management plan through mechanism for conservation of cultivated biodiversity.

6.2 MANAGEMENT PLAN FOR WILD BIODIVERSITY

Based on the baseline information recorded during the survey about the flora and fauna following management plan for the wild biodiversity has been formulated:-

6.2.1 Integrated *in-situ* and *ex-situ* Conservation of wild biodiversity

Documentation of the flora and fauna in the project area shall be made at regular intervals to tack the changes in the vegetation pattern and to

undertake *in-situ* and *ex-situ* conservation measures for site specific mitigation measures with indigenous species at different altitudinal level.

6.2.2 Enhancing Non Wood Forest Products for Livelihoods

In support of overall project development objective, this component aims at income augmentation through promoting value addition in crop, livestock, and non-timber forest products (NTFP's) produced, and support off-farm economic activities. This component will focus on the demand side, marketing, and establishing linkages between farmers, poor women, vulnerable groups-typically the landless-and for finance demand driven economic activities. Bee keeping is one of the oldest economic activities of mountain communities. Market oriented medicinal plants such as *Aconitum heterophyllum*; *Angelica glauca*; *Picrorhiza kurrooa*; *Bergenia stracheyi*; *Ferula jaeskeana*; and *Viola canescens* are the few important species, which have potential for cultivation, and are found in abundance in the project area. Marketing mechanism, awareness creation, optimum cultivation & harvesting technique introduction in this area with adequate marketing mechanism will certainly improve the conservation and livelihood in the project area.

6.2.3 Habitat/Eco-region based improvement and management

The upstream and downstream areas should be vegetated to improve the habitat leading to landscape restoration. Landscape approach should address critical ecosystems and economic tools for biodiversity conservation approach through connectivity and cooperation for scientific approach for technological input involving various stockholders.

6.2.4 Awareness and Education

Mass awareness programme in the fringe villages is a must to reduce anthropogenic pressure. Awareness will also help in minimizing human-wild life conflicts.

6.2.5 Monitoring of the existing population of wild fauna

The population of Himalayan Tahr, Asiatic Ibex, Asiatic Black Bear and Himalayan Brown Bear are to be documented, and monitored at regular intervals through well defined monitoring mechanism by the wildlife experts. Such monitoring will help in developing suitable conservation measures for wildlife in the area.

6.3 MANAGEMENT PLAN FOR CULTIVATED BIODIVERSITY AND DOMESTICATED ANIMALS

The Integrated Tribal Development Project (ITDP) was introduced in 1974 in this tribal region, aimed at socio-economic development to transform the subsistence agricultural economy. Since the cultivation of agriculture crops is

largely restricted to specific sites in the river valleys, to preserve cultivate diversity and the traditional knowledge of the indigenous tribal documentation of the cultivated agro biodiversity domesticated animals be made by engaging short term consultant or assigning to any local university or NGO to evolve effective management plan .

6.3.1 Tribal Museum for Traditional Ecological Knowledge

The project area falls under tribal notified area. The ethnic tribal community has contributed in maintaining distinct identity of the Himalayan region with their traditional ecological knowledge. To represent their ethnicity a tribal museum shall be set up in the project adjacent area involving the local communities under social management plan. The traditional knowledge used for practicing agriculture, crop, animal husbandry, bee-keeping, medicinal plants and samples for representing those activities shall be preserved.

6.3.2 Pasture, Fodder and Livestock Development

The economy of local people is agriculture and allied activities such as sheep and goat rearing for livelihood. Sheep and goat rearing is a major enterprise involving majority of the time of the local people. Thus it is proposed to improve the productive potential through improvement of pasture land, fodder, management practices, and genetic improvement of the livestock. Scientific support shall be obtained from fodder institutes for improving the pasture land and for identification of local indigenous fodder species for promotion of cultivation. For this a central nursery shall be established at identified area for multiplication of good quality seedlings with the help of local communities.

Indigenous livestock health shall be improved by complementing existing practices with additional support in terms of medicines, de-worming, vaccination, veterinary aid kits and organizing veterinary health camps on regular intervals. Also, preservation of indigenous gene of the livestock shall also be done for conservation of indigenous livestock in the project area.

6.4 FINANCIAL ALLOCATION

The comprehensive biodiversity management plan requires a detailed biological diversity assessment in the project area and in the downstream upto the powerhouse site. The financial allocation is based on the identified components under the plan. However, keeping in view the minimal submergence area and impact zone, an amount of Rs. 225 lac has been proposed, the break-up of which is shown in **Table-6.1**.

Table.6.1

Wildlife Improvement & Development		
S.No.	1. Planning	Amount in Lacs
1.1	**Planning Perspective, Approach and Objectives**	4.5 (In first two years)
	Landscape/an Eco regional Perspective	
	The Key Issues	
	Planning Approach	
	Objectives	
	Working with the local communities to reduce/mitigate their dependencies on the natural resources.	
1.2	**Assess the strengths and assets of the natural resource dependent community members (with an emphasis on the women of poor households) to establish explicit links between the CAT plan activities and livelihood priorities of these people.**	6.75 In first two years)
1.3	**Facilitate organizing of sustainable community based organizations, user groups of rural poor and women, preferably with strong linkages to the local village councils known as Panchayats. Establish the biodiversity conservation efforts at Panchayat level through the consultative process of micro planning.**	11.25 (In first two years)
	Formation of Self Help Groups	
	Preparation of Micro Plan	
	2. Implementation	
2.1	**Implementation of developmental or income generation programmes so that they better address the livelihood priorities of the local people and facilitate conservation of the CAT Plan area biodiversity.**	112.50
	Income generation activities based on micro-planning	
	Street Theatre for WL awareness	
	Energy saving devices	
	Non conventional energy such as solar	

2.2	**Help resolve man-animal conflict with emphasis on social and environmental justice especially for farmers**	22.50
	Compensation for animal damage	
	Chemical Restraint: Traps, Cages	
2.3	**WL Habitat Management: Maintain and protect the natural vegetation communities, populations of large ungulates (with emphasis on Himalayan species), carnivores and pheasants; Protection of unique WL habitats such as gorges, burrowing sites of WL, etc.**	56.25
	3. Training	
3.1	**Develop competence based training programmes including Monkeys & Wildlife Trapping for the Forest staff and the local community, gun licence holder, and NGOs,**	4.5
	4. Research & Monitoring	
4.1	**Provide facilities and opportunities in natural areas for purposes of formal and informal education, research and the study and the Long Term Ecological Monitoring (LTEM).**	4.5
	5. Contingency	
5.1	**Contingency, other interventions**	2.25
	Total	**Rs 225 Lakhs**

ANNEXURE-I:

COPY OF LETTER NO. J-12011/67/2007-IA-I, DATED JULY 5, 2011 BY MINISTRY OF FOREST & ENVIRONMENTS, NEW DELHI

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS BY SPEED POST

E-mail: sanchita@nic.in
sansom_2859@yahoo.co.in

Telefax: 011-24360488

J-12011/67/2007-IA-I

Dated: 5th July, 2011

To

The Associate Vice President (Hydro)
JSW Energy Ltd.
D-9, Phase-1, Sector-1
New Shimla
Himachal Pradesh - 171 009

Subject: **Kuther 240 MW Hydro Electric Project in Chamba District of Himachal Pradesh by M/s JSW Energy Ltd. - Environment Clearance regarding.**

Sir,

This has reference to your letters no. JSW/KutehrHEP/07/10-11/390 dated 18.9.2010 and 4.1.2011 on the above mentioned subject.

2. It is noted that the project envisages construction of a 23 m high barrage across Ravi River in Chamba District of Himachal Pradesh to generate 240 MW of hydropower. This is Run-of-the-River scheme. The total land requirement for the project is 85.36 ha out of which 79.18 ha was forest land which has now been reduced to 61.40, as recommended by the State Forests Department for Forests diversion. About 6.18 ha is private land. An underground powerhouse is proposed on the left bank of the river near village Subaga with 3 units of 80 MW each. Ten (10) villages consisting of 30 families are likely to be affected due to this project. No village will be submerged. No National Park/Sanctuary/ Biosphere Reserve/Historical monument exists in the vicinity of the project area. The total cost of the project is about Rs. 1798.13 Crores.

3. The Project proposal was considered by the Expert Appraisal Committee for River Valley & Hydroelectric Power Projects in its meetings held on 12.11.2010 and 22.1.2011. Public Hearings for the Project was conducted on 16.4.2010 and 17.4.2010 in Chamba District, Himachal Pradesh.

4. After appraising the Project Proposal from environmental angle, the Ministry of Environment and Forests hereby accords environmental clearance to the Project as per the provisions of Environmental Impact Assessment Notification, 2006 and its subsequent amendment 2009 subject to compliance of the following conditions:

Part A : Specific Conditions

(i) The following Catchment Area Treatment Plan as proposed in the EIA/EMP Report shall be completed in 4 years-:

Treatment Measures	0 Year	I Year	II Year	III Year	IV Year	Total
(A) Biological Measures						
Afforestation (ha)	131	130	130	130	130	651
Timber Plantation (ha)	77	50	50	50	50	277
Fodder Plantation (ha)	77	55	55	45	45	277
Pasture development (ha)	39	25	25	25	25	139
NTFP cultivation (ha)	11	11	11	11	11	55
(B) Engineering Measures						
Wire crate check dams (No)	84	84	84	84	84	420
Wire crate boulder spur (No)	128	128	128	128	128	640
Contour stagger trenching (ha)	10	10	10	10	10	50
DRSM check dams (No)	420	420	420	420	420	2100
Catch dam (RM)	1400	1400	1400	1400	1400	7000

(ii) The details of land holding of project affected persons whose land is being acquired shall be submitted to this Ministry. The R&R benefits for the land losing households will be as per the National Rehabilitation and Resettlement Policy, 2007 (NRRP, 2007) or as per the State Rehabilitation and Resettlement Policy, whichever is heigher. Adequate publicity of the compensation package shall be made in the affected villages.

(iii) All the commitments made during the public hearings shall be fulfilled completely.

(iv) A Monitoring Committee for R&R should be constituted which must include representatives of project affected persons from SC/ST category and a woman beneficiary.

(v) Consolidation and compilation of the muck shall be carried-out only in the designated muck dumping sites, approved by the State Pollution Control Board . As per the proposed muck disposal plan, about 1.84 lakh m^3 muck will be reutilized for construction & other filling purposes out of the total 15.77 lakh m^3 of total generatation of muck from the project and the remaining 13.92 lakh m^3 will be disposed off at 13 designated disposal sites of 17.4926 ha for this purpose.

(vi) To support and sustain the aquatic life in the downstream of the river, a minimum of 20% of the average lean season flow of 90% dependable year of 4 consecutive leanest months shall be maintained as environmental flow from the dam.

(vii) Continuous Monitoring system for environmental flow measurement shall be installed and data be displaced at appropriate site for information of civil society and stake holders. Six monthly results shall be submitted to the concern Regional Office of the Ministry and SPCB.

(viii) Fishery Conservation & Management Plan as proposed in the EMP and through letter dated 4th January 2011 to the Ministry shall be implemented completely in consultation with the Fisheries Department, Government of Himachal Pradesh. The up-gradation of existing facilities of fish farm at Holi village shall be taken-up strictly and the allocated budget of Rs. 160 lakhs shall not be diverted to any other purpose. A fish ladder shall be provided for migration of fish.

(ix) Real time telemetry and data acquisition system including all weather hydro metrological stations shall be installed for in-flow monitoring and advance flood warning. Advance flood warning and advance communication system shall be installed in consultation with the downstream District Authorities.

(x) As proposed in the EMP, the Afforestation Programme on 123 ha of land with 12 plant species @1500 plants per hectare shall be taken-up immediately. The allocated funds of Rs. 212 lakhs shall not be diverted to any other purpose.

(xi) Greenbelt development along the approach roads, residential areas, office complex, barrage site and other working areas with a total of 21,000 saplings shall be undertaken immediately The allocated budget of Rs. 21 lakhs shall not be diverted to any other purpose.

(xii) The Biodiversity Conservation and Wildlife Management Plans, as proposed in the EMP shall be taken up immediately and implemented in consultation with the State Forest Department without any diversion of allocated funds. A report of implementation shall be included in the sixth monthly compliance report to be submitted to the Ministry.

(xiii) About 1.5% of the total project cost shall be spent for the Local Area Development. Cost estimates for all other aspects as provided in EIA/EMP shall be adhered to.

(xiv) The equipment likely to generate high noise levels during the construction period or otherwise shall meet the ambient noise standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2010 under the Environment Protection Act (EPA), 1986.

(xv) Any other clearance from any other organization/department, if required, shall be obtained.

Part-B: General Conditions

(i) Adequate arrangement for providing free fuel like kerosene/wood/LPG shall be made at project cost for the labour engaged in the construction work so that indiscriminate felling of trees is prevented.

(ii) Medical facilities as well as recreational facilities shall also be provided to labourers.

(iii) All the labourers to be engaged for construction works shall be thoroughly examined by health personnel and adequately treated before issuing them work permit.

(iv) No fugitive dust emissions should be observed at the construction sites. Water sprinkling arrangements should be made to suppress the fugitive emissions

(v) Potable drinking water and proper sanitary facilities shall be provided for the labour force and the local area people.

(vi) Restoration of construction area including dumping site of excavated materials shall be ensured by levelling, filling up of burrow pits, landscaping etc. The area should be properly treated with suitable plantation.

(vii) Financial provision of Rs. 78.32 Crores shall be made in the total budget of the project for implementation of the above suggested safeguard measures.

(viii) Environmental parameters shall be monitored and six monthly reports shall be submitted to the concerned Regional Office of the Ministry and State Pollution Control Board for review.

(ix) The project proponent shall also submit six monthly compliance reports of the stipulated EC conditions (both hard copies as well as by e-mail) to the respective Regional Office of MoEF and State Pollution Control Board. Both monitoring report and compliance report shall be up-loaded on the web-site of the Proponent.

5. The Project Proponent shall provide full cooperation and all required documents / data to the Officials of relevant Regional Office of MOEF who would be monitoring the implementation of environmental safeguards.

6. Besides the above stated conditions, the Project Proponent and Government of Himachal Pradesh shall also implement all other environmental safeguards, as proposed in the EIA/EMP report and other reports from time to time.

7. The Environmental Management Plan shall be strictly adhered to and a sum of Rs..7800.32 Lakhs, the budgetary provisions provided for implementation of EMP shall not to be diverted for any other purpose.

8. Any change in the scope of the project shall be intimated to the Ministry and fresh approval if required, shall be taken from the Ministry.

9. The Ministry reserves the right to add additional safeguard measures subsequently, if found necessary and to take action including revoking of the clearance under the provisions of the Environment (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

10. This clearance letter is valid for a period of 10 years from the date of issue of this letter for commencement of construction work.

11. A Multi-disciplinary Committee for monitoring the implementation of environmental safe guards during construction shall be constituted by the Ministry in consultation with the Proponent. The Proponent shall suggest the members for approval of the Ministry. Proponent shall organise six monthly meetings of the Committee and submit the monitoring report to the Ministry.

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12. A copy of the clearance letter shall be sent by the Proponent to concerned Panchayat, Zilla Parishad/ Municipal Corporation, Urban local body and the local NGO, if any, from whom suggestions/ representationswere received while processing the proposal. The clearance letter shall also be put on the website of the Company by the Proponent.

13. The proponent should advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letter are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry of Environment and Forests at http://www.envfor.nic.in

14. After 5 years of the commissioning of the Project, a study shall be undertaken regarding impact of the project on the environment and downstream ecoiogy. The study shall be undertaken by an independent agency, decided in consultation with the Ministry.

15. The project proponent shall also submit six monthly reports on the status of compliance of the stipulated EC conditions including results of monitored data (both in hard copies as well as by e-mail) to the respective Regional office of MoEF and Zonal Office of CPCB and the SPCB.

Yours faithfully,

(**Sanchita Jindal**)
Director

Copy to:

1. The Secretary. Ministry of Power, Shram Shakti, Bhawan, Rafi Marg, New Delhi-110 001.
2. The Adviser (Power), Planning Commission, Yojna Bhawan, New Delhi-110 001.
3. The Principal Secretary (MPP & Power), Government of Himachal Pradesh,Shimla.
4. The Secretary, Department of Environment, Government of Himachal Pradesh, Shimla.
5. The Chief Engineer, Project Appraisal Directorate, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi- 110 066.
6. The Regional Office, Ministry of Environment & Forest, Chandigarh.The Member Secretary, Himachal Pradesh State Pollution Control Board, Phase-III, Him Parivesh, New Shimla- 171 009.
7. EI- Division, Ministry of Environment & Forests, New Delhi-110 003.
8. Guard file.

(**Sanchita Jindal**)
Director

ANNEXURE-II:

COPY OF LETTER NO. 2/HP/25/CEA/98-PAC/3698-3727 DATED AUGUST 31, 2010 BY CENTRAL ELECTRICITY AUTHORITY, NEW DELHI

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भारत सरकार/Government of India
केन्द्रीय विद्युत प्राधिकरण/Central Electricity Authority
सेवा भवन/Sewa Bhavan
आर.के.पुरम/R.K. Puram
नई दिल्ली/New Delhi - 110606
***

[ISO : 9001-2008]

No.2/HP/25/CEA/98-PAC/3698-3727 Dated the 31st August, 2010

OFFICE MEMORANDUM

Subject: **Kutehr Hydro Electric Project (3x80=240 MW) in Himachal Pradesh by M/s. JSW Energy Limited (JSWEL) at an estimated Completed cost of US $ 4.11 Million + Rs.1778.99 Crores including IDC & FC of Rs.353.94 Crores & Rs.6.74 Crores respectively- Issue of Concurrence.**

M/s JSW Energy Limited (JSWEL) submitted Four (4) sets of the Detailed Project Report (DPR) of the generation scheme of Kutehr Hydro Electric Project (3x80=240 MW) vide their letter No. JSW/Kuther/08-09/13-16,dated 6.6.2009 and Eighteen(18) sets vide their letter No. JSW/Kutehr HEP/01/08-09/33, dated 1.8.2009. The presentation of the scheme was made by M/s.JSWEL on 31.8.2009 to appraisal groups of CEA/CWC/GSI.

In the DPR submitted by M/s. JSWEL, certain vital inputs were found to be inadequate. M/s. JSWEL had planned the scheme in such a way that tail water level of Kutehr HE Project was interfering with FRL of down stream project. Further, geological investigations carried out were not complete, as a result of which the appraising groups found it difficult to vet the proposed orientation of underground structures of the project, namely PH, desilting chamber, HRT etc. Alignment of HRT was mostly based on surface mapping. In the last phase of appraisal of DPR, M/s. JSWEL submitted revised labour rates notified by the Govt. of Himachal Pradesh, which resulted in recasting of cost estimates. To resolve the above issues, discussions and meetings were held with M/s. JSWEL which entailed a lot of time.

The proposal for establishment of Kutehr Hydro Electric Project (3x80=240 MW) in Chamba District of the State of Himachal Pradesh proposed by M/s JSWEL was considered in the 300th Meeting of CEA held on 10.08.2010 at Sewa Bhawan, R.K. Puram, New Delhi-110606 based on the Agenda note circulated vide CEA letter No.3/106/300th /2006-PAC/3060-85, dated 05.08.2010.

2. In exercise of the powers vested with the Authority under Section 8 of the Electricity Act, 2003, the Central Electricity Authority accords Concurrence to the aforesaid scheme at an estimated Completed cost of US $ 4.11 Million + Rs.1778.99 Crores including IDC & FC of Rs.353.94 Crores & Rs.6.74 Crores respectively with the following stipulations:-

(i) the cost of the scheme shall not exceed the above cost except on account of:-

(a) Variation in foreign exchange rate in respect of US $.
(b) Change in rates of Indian taxes and duties such as custom duty, excise duty, sales tax, works tax & service tax and additional taxes and duties levied, if any, subsequent to issue of this O.M.
(c) Change in Indian Law resulting in change in cost.
(d) Variation in actual interest rate.

(ii) Interest During Construction (IDC) and Financing Charges (FC) shall be as per actuals but not exceeding the amount as indicated at ***Annex-I*** except for variation in actual interest rate(s) and the pro-rata variation in hard cost, as stated in clause 2 (i) (a), (b) & (c) of this O.M.

3. The abstract of Completed Project Cost approved by CEA, is furnished at ***Annex-I, IA and IB.*** The summary of tentative Financial Package, as submitted by M/s. JSWEL and considered by CEA and the salient features of the scheme are given in ***Annex- II & III*** respectively.

4. This Concurrence is subject to fulfilment of the following conditions:

i) The following conditions/circumstances shall not be a re-opener of the Project Cost / Concurrence:-

(a) Non-acquisition of land.
(b) Non-finalisation of power purchase agreement.

ii) M/s JSWEL shall incorporate the suggestions/observations of Central Water Commission (CWC) on Hydrology, Design Flood, Sedimentation, Barrage Design, Hydel Civil Design, Gates Design, Foundation Engineering & Seismic Design aspects and those of Central Soil and Material Research Station (CSMRS) etc. during the detailed design stage as given in ***Annex-IV.***

iii) M/s JSWEL shall complete balance explorations/investigations works by Nov. 2010 before detailed design stage as per schedule given in ***Annex-V and VA*** and the results of the explorations/investigations should be communicated from time to time for appraisal. M/s JSWEL shall submit the monthly progress report on balance explorations/investigations to CEA/CWC/GSI regularly. Further, the suggestions of GSI furnished as comments from time to time shall be followed. Cost for changes required subsequent to investigations shall be absorbed by the company.

iv) In case, changes are made in design parameters during construction due to site conditions or otherwise, the same shall be intimated and got concurred from the Authority before M/s JSWEL implements such changes.

v) The site specific seismic studies shall be expedited and their report shall be put up to the National Committee on Seismic Design Parameters for recommendations on seismic design parameters for detailed design of different components of the project.

vi) M/s JSWEL shall obtain clearances of the project from Ministry of Environment & Forest (MoE&F) from Environment and Forest angles. A provision of Rs 27.3 crores @2.5% of hard cost of civil and E&M works (i.e. Rs 808.83 crores for civil works and Rs 281.81 crores for E&M works) has been made for CAT Plan out of a total provision of Rs 58.30 crores under the sub-head 'Ecology and Environment'.

vii) M/s JSWEL has sought provisions @1.5% of final cost towards Local Area Development. This additional provision has not been considered while working out the estimated cost of the project. Since as per Hydro Policy 2008 of Ministry of Power, Government of India, an additional 1% free power over the life of the project would be provided by the developer for Local Area Development Fund. The policy also recommends that the host State Government would also provide matching 1% from their share of 12% free power towards this corpus.

viii) Under the cost of civil works, total provision under the head "Land" has been made as Rs 13.26 crores.

ix) If any impact on wild life is observed, M/s JSWEL shall obtain clearance from Indian Board of Wild Life.

x) As Schedule Tribe population is getting affected, clearance from Ministry of Social Justice and Empowerment/ Tribal Affairs shall be obtained by M/s JSWEL.

xi) M/s JSWEL shall obtain clearance from Ministry of Defence.

xii) M/s.JSWEL shall get amended Memorandum of Agreement (MoA) signed on 1st March, 2008 to reflect the present capacity as 240 MW of the project and submit a copy of the same to CEA.

xiii) M/s JSWEL shall comply with the guidelines for participation of foreign Companies in tender work packages of Hydro electric Projects in sensitive areas issued by Ministry of Power vide No. 7/1/2002-DO(NHPC) [Vol.II], dated 03.09.09 appended at ***Annex- VI.***

xiv) M/s JSWEL has forwarded a copy of DPR to Govt. of Punjab and BBMB as desired by CWC while conveying clearance from Interstate aspects. DPR has also been forwarded to GoHP, who have confirmed that consumptive use from projects on river Ravi is only in the shape of evaporation which accounts for negligible losses(***Annex-VII***).

xv) MoWR vide letter dated 15th June, 2010 has cleared the DPR from Indus Water Treaty angle mentioning therein that the project is located on the river Ravi and as per Indus Water Treaty, water of Ravi is available for unrestricted use by India.

xvi) M/s JSWEL shall take appropriate precautions to avert flooding of power house by adopting measures listed at ***Annex-VIII.***

xvii) Fly ash and fly ash based products shall be used in the construction of various works to the extent possible in accordance with MoE&F notification dated 14.09.99 and its amendment dated 27.08.2003. The construction material surveys shall include the required investigations for use of fly ash and fly ash based products in various works, infrastructure facilities etc. and their feasibility be ascertained by M/s JSWEL.

xviii) M/s JSWEL shall deploy modern tools/software for construction monitoring of the project by establishing IT based monitoring system and linking the same to CEA network.

xix) Information in respect of tying up essential inputs/statutory clearances, results of investigations/studies shall be submitted to CEA/CWC/GSI on receipt of same later from time to time.

xx) M/s. JSWEL shall submit the updated DPR incorporating all the changes/modifications agreed during the appraisal process to the State Govt., Appropriate Electricity Regulatory Commission and Central Transmission Utility.

xxi) Concurrence is subject to compliance by M/s JSWEL of various policies/guidelines etc. issued by Govt. of India from time to time.

xxii) The broad technical aspects of the project proposal in the project report have been scrutinized in CEA in consultation with CWC, GSI and other concerned agencies. The scrutiny is based on the data, assessment and certificates presented in the report and information/clarifications received as compliances to the observations on the assumption that the data and information furnished are accurate and have been collected reliably by the project authorities from the dependable sources and/or after carrying out detailed surveys and investigations as presented in the report.

5. The cost of the project cleared by the Authority is indicative. The tariff of the project shall be regulated by the appropriate Electricity Regulatory Commission. M/s. JSWEL propose to avail the potential benefit of the Green House Gas (GHG) abatement by selling carbon credits under the Clean Development Mechanism (CDM) of Kyoto Protocol. Benefits due to above shall also be regulated by the appropriate Regulatory Commission.

6. Commissioning schedule of the generating units from the zero date i.e. 01.10.2017 shall be as follows:

Unit – 1 : 58th month
Unit – 2 : 59th month
Unit – 3 : 60th month

7. Monthly Status Report of compliance of the conditions stipulated under para 4 of this Concurrence letter shall be submitted to Secretary, CEA.

8. Monthly Progress Report of the project shall be submitted to Hydro-Project Monitoring (HPM) Division of CEA. Three (3) copies of the half-yearly reports on both physical progress of the scheme and expenditure actually incurred, duly certified by statutory auditors shall be submitted to the Authority till the Commercial Operation Date of the plant. The project authorities shall give free accessibility to CEA officers and staff to have on the spot assessment of various aspects of the project.

9. Monthly status of the project from the date of Concurrence to Financial closure shall be furnished to Secretary, CEA as per the proforma enclosed at ***Annex-IX***.

10. In case the time gap between the Concurrence to the scheme by CEA and the actual start of work by M/s JSWEL is three years or more, a fresh Concurrence of CEA shall be obtained by M/s JSWEL.

11. The Authority reserves the right to revoke this concurrence, if the conditions stipulated in this Office Memorandum are not complied with to the satisfaction of the Authority.

Encls: ***Annexes I, IA, IB, II, III, IV, V,VA, VI, VII, VIII & IX.***

7/8/10

(AMARJEET SINGH)
SECRETARY, CEA

1. General Manager (Hydro), JSW Energy Limited, D-9, Phase-I, Sector-1, New Shimla, Himachal Pradesh -171 009.

2. Secretary, Ministry of Power, Govt. of India, Shram Shakti Bhawan, Rafi Marg, New Delhi –110119.

3. Secretary, Ministry of Environment & Forests, Government of India, Paryavarun Bhawan, CGO Complex, Lodhi Road, New Delhi – 110003.

4. Chairman, Central Electricity Regulatory Commission, Core-3, 5th Floor, Scope Complex, 7 Institutional Area, Lodhi Road, New Delhi-110003.

5. Chairman, Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi – 110606.

6. Chairperson, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi.

7. Chairman-cum-Managing Director, Power Grid Corporation of India Limited, Saudamini, Plot No.2, Sector 29, Gurgaon - 122001 (Haryana).

8. Secretary (Department. of Power), Government of Himachal Pradesh, Secretariat, Shimla, Himachal Pradesh -171 002.

9. Adviser (Energy), Planning Commission, Yojana Bhawan, New Delhi – 110001

10. Member (D&R), Central Water Commission, Sewa Bhawan, R. K. Puram, New Delhi - 110606.

11. Member (WP&P), Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi – 110606.

12. Member (Hydro / Planning / Thermal / Grid Operation & Distribution / Economic & Commercial / Power System), CEA, Sewa Bhawan, R.K. Puram , New Delhi – 110606.

13. Joint Secretary (Hydro), Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi-110119.

14. Chief Engineer (HPA/ SP&PA/ F&CA/ TCD/ Legal/ HPM / IRP/ HP&I / HE&TD/ LD&T), CEA, Sewa Bhawan, R.K. Puram, New Delhi – 110606.

15. Chief Engineer (PAO), CWC, Sewa Bhawan (S), R.K. Puram, New Delhi – 110606.

16. Director (LHM&EPE Division), Geological Survey of India, A-II, Pushpa Bhawan, Madangir Road, New Delhi – 110062.

K. D. C.

Annex-I

Kutehr Hydro Electric Project (3x80=240 MW) – Himachal Pradesh by M/s JSW Energy Limited (JSWEL)

Estimated Completed Cost

1 US$ = Rs. 46.58

S.No.	Description	Foreign component		Domestic Component (Rs. Crs.)	Total (Rs. Crs.)
		Million $	Equv. INR (Rs. Crs.)		
1.	Civil works	-	-	1050.80	1050.80
2.	Electro-Mechanical Works	4.11	19.14	367.51	386.65
3.	**Total Hard Cost**	**4.11**	**19.14**	**1418.31**	**1437.45**
4.	IDC	-	-	353.94	353.94
5.	FC	-	-	6.74	6.74
	Total Cost	**4.11**	**19.14**	**1778.99**	**1798.13**

Note : This cost does not include cost of Transmission line of 220 kV D/C line with twin zebra conductor from Kutehr to Lahal.

ANNEXURE- III:

TOPOSHEET OF THE CATCHMENT AREA FOR KUTHER HEP

ANNEXURE-IV:

COST NORMS FOR NORMAL AFFORESTATION, ENERGY PLANTATION AND ENRICHMENT PLANTATION

Annexure-IV

Afforestation cost/Ha of plantation including maintenance

A) Plantation including Fencing:

S. No	Description	Unit	Rate	Cost(Rs)
1.	Survey & demarcation of plantation & area I/C marking of seditions, path preparation of maps	1Ha	80.80	80.80
2.	Cutting & preparation of wooden fence posts2 mtr & 8 to 10Cm diameter I/C debarking & fashioning the top 15Cms in conical shape	60 No	1036.02 per%	621.61
3.	Carriage of fence posts upto 2mtr long & 8 to 10cm diameter over a distance of 2Kms	60 No	272.20 /%/Km	326.64
4.	Charring & coal tarring of the ends of the fence posts	60No	223.60/%	134.16
5.	Preparation & digging of holes 20-30 cm dia. & 45cm deep	60 No	725.41/%	435.25
6	Fixing of wooden posts I/C strutting	60 No	572.80	343.68
7.	Carriage of 8.wire bundles uphill over an average distance of 2Km	0.7Qtl.	65.40./Qtl/Km	91.56
8.	Stretching & fixing of barbed wire with U- stapple in 3 strand	540 Rmt.	3.80	2052.00
9.	Interlacing of thorny bushes with barbed wire obtained from planting site.	180 Rmt.	3.30	594.00
10	Preparation of Live hedge Fencing (Two Rows)	180 Rmt (Each).	10.60/Rmt	3816.00
10.	Preparation of inspection path60cm wide	250 Rmt.	8.70	2175.00
11.	Preparation of water retention mounds/trenches	L/S	L/S	2200.00
12.	Digging of pits(30x30x30) cm	660No	381.86/%	2520.30
13	Digging of pits(45x45x45) cm	440 No	763.53/%	3359.55
14	Filling of pits(30x30x30) cm	660No	152.66/%	1007.58
15	Filling of pits(45x45x45) cm	440 No	218.77/%	962.59
16	Carriage of plants in P.Bags from nursery site over an average distance of 2Km uphill	1100 No	174.46/%/Km	3838.12
17	Planting of plants raised in P. Bags	1100	174.58/%	1920.40
18	Planting of grass tufts/preparation of strips I/C sowing in strips 100x30x5cms for grass sowing	500 strips	735.99/%	3679.98
19	Cost of 8. Wire/U- nail	0.70Qtl	7000	4900.00
21	G.Total			35059.22
22	**Or Say**			**35100.00**

B) Nursery Cost of Plants 1100 3.80/plant **4180.00**

C) Maintenance:

1st Year Maintenance	3600.00
2nd Year Maintenance	2500.00
3rd Year Maintenance	1400.00
Total Maintenance	**7500.00**
Total (A + B + C)	**46780.00**

Add 25% escalation for tribal area (excluding cost of material)

i.e. Rs. 46780 – 4900 Rs. 10470

Grand Total (New & Maintenance) **Rs. 57250/-**

(8)

Energy Plantation cost/Ha of plantation (No Maintenance)

A) Plantation including Fencing:

S.No	Description	Unit	Rate	Cost(Rs)
1.	Survey & demarcation of plantation & area I/C marking of seditions, path preparation of maps	1Ha	80.80	80.80
2.	Layout of pits/patches per Ha	1Ha	81.78	81.78
3.	Cutting & preparation of wooden fence posts2 mtr & 8 to 10Cm diameter I/C debarking & fashioning the top 15Cms in conical shape	60 No	1036.02 per%	621.61
4.	Carriage of fence posts upto 2mtr long & 8 to 10cm diameter over a distance of 2Kms	60 No	272.20 /%/Km	326.64
5.	Charring & coal tarring of the ends of the fence posts	60No	223.60/%	134.16
6.	Preparation & digging of holes 20-30 cm dia. & 45cm deep	60 No	725.41/%	435.25
7	Fixing of wooden posts I/C strutting	60 No	572.80	343.68
8	Carriage of 8.wire bundles uphill over an average distance of 2Km	1.17.Qtl.	65.40/Qtl/Km	153.04
9.	Stretching & fixing of barbed wire with U- stapple in 5 strand	900 Rmt.	3.80	3420.00.
10.	Interlacing of thorny bushes with barbed wire obtained from planting site.	180 Rmt.	3.30	594.00
11	Preparation of Live hedge Fencing(Two Rows)	180 Rmt (Each).	10.60/Rmt	3816.00
12.	Digging of pits(30x30x30) cm	5000No	381.86/%	19093.00
13	Carriage of plants in P.Bags from nursery site over an average distance of 2Km uphill	5000 No	174.46/%/Km	17446.00
14	Planting of plants raised in P. Bags	5000 No	174.58/%	8729.00
15	Filling of pits(30x30x30) cm	5000No	152.66/%	7633.00
16	Cost of B. Wire/U- nail	1.17.Qtl	7000	8190.00
17	G.Total			71097.96
18	Or Say			71100.00
B.	**Cost of Nursery Plants**	**5000**	**3.80**	**19,000.00**
	Total (A + B)			**90,100.00**
	Add 25% enhancement for tribal area (excluding cost of material)	**81910**	**0.25**	**20,478.00**
	Grand Total			**1,10,578.00**
	Say Rs.			**1,10,600.00**

Per Hactare Cost of Enrichment Plantation

A) Plantation with Thorny brushwood guard protection around individual plant (No Fencing& maintenance):

S.No	Description	Unit	Rate	Cost(Rs)
1.	Digging of pits(45x45x45) cm	800 No	763.53/%	6108.24
2.	Filling of pits(45x45x45) cm	800 No	218.77/%	1750.16
3.	Carriage of plants in P.Bags from nursery site over an average distance of 3Km uphill	800 No	174.46/%/Km	4187.04
4.	Planting of plants raised in P. Bags(Tall plants)	800	174.58/%	1396.64
5.	Thorny brushwood guard protection around individual plant	800	7.00	5600.00
	Total			19042.08
	Or Say			**19000.00**
B.	**Cost of Nursery Plants**	**800**	**3.80**	**3040.00**
	Total (A + B)			**22040.00**
	Add 25% enhancement for tribal area (excluding cost of material)	**22040**	**0.25**	**5510.00**
	Grand Total			**27550.00**

ANNEXURE-V:

FEATURES OF A MODERN NURSERY, ITS LAYOUT AND OTHER COMPONENTS.

NURSERY LAYOUT FOR RAISING HEALTHY STOCK

A. POLY HOUSE/GERMINATION CHAMBERS.
B. IRRIGATION SYSTEM-SPRINKLERS, FOGGRES, WATER PUMP ETC.
C. PERFORATED TRAYS.
D. VERMI COPOST UNITS.
E. COMPOST HOUSE.
F. CHAFF CUTTER/CHOPPER.
G. REGISTERS.

POLY HOUSE/GERMINATION CHAMBERS:-

Poly house should have the following articles:-

i. Size : 4-6 x 2x1.5 m.
ii. Foggers/splinklers, irrigation system.
iii. Max.-Min. thermometers.
iv. Hygrometer for recording humidity.
v. Perforated trays.
vi. Register.
vii. Plantation-Micro Planning, Grading of plants, Size of pits, closure cases.

Date of sowing	Date of Germination	No. of Days for acclimatization	Date of Pricking	Date of shifting	Study of growth pattern

Vermi Compost:

- Vermi Compost Unit 4 to 6 in Nos.
- Collection of twigs/weeds/leaves.
- Chopping into small pieces.
- Mixing with cow dung.
- Mixing inTubs/buckets.
- Adding in vermin compost unit.
- Verms 2 to 3 Kg. per pit.

Compost House: -

- Register.

Date of Chopping	Date of mixing with Urea.	Date of adding in compost house.	Date of taking out.

Date	Time 3 Pm.	Min. Temp.	Max. Temp.	Humidity

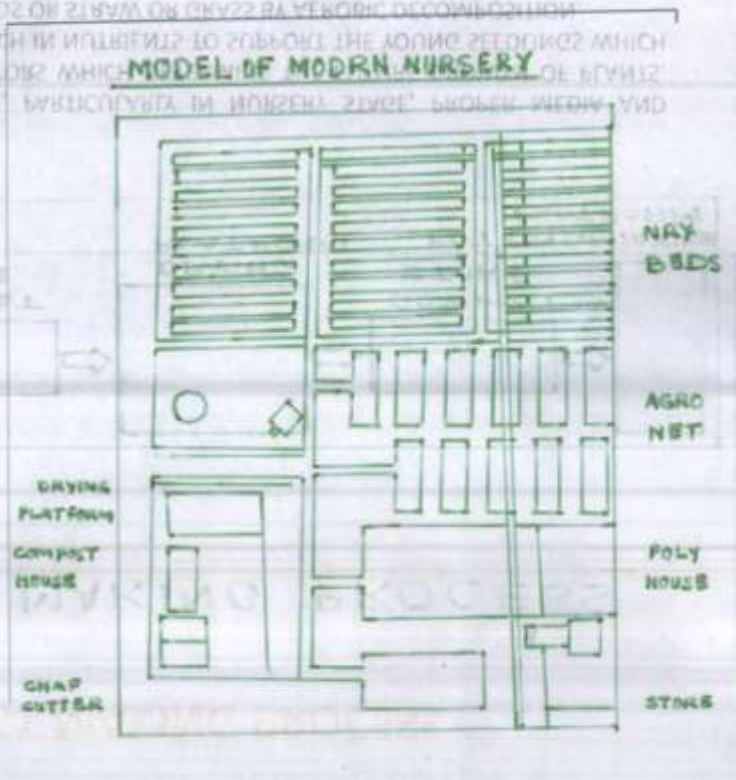
Sowing of Seeds: -

- Trays should be field 1:1 sand & Vermi compost.
- 2nd fortnight of Jan./Ist fortnight of Feb. depending upon location/weather.
- Germination timing is different for different species.

MODERN NURSERY

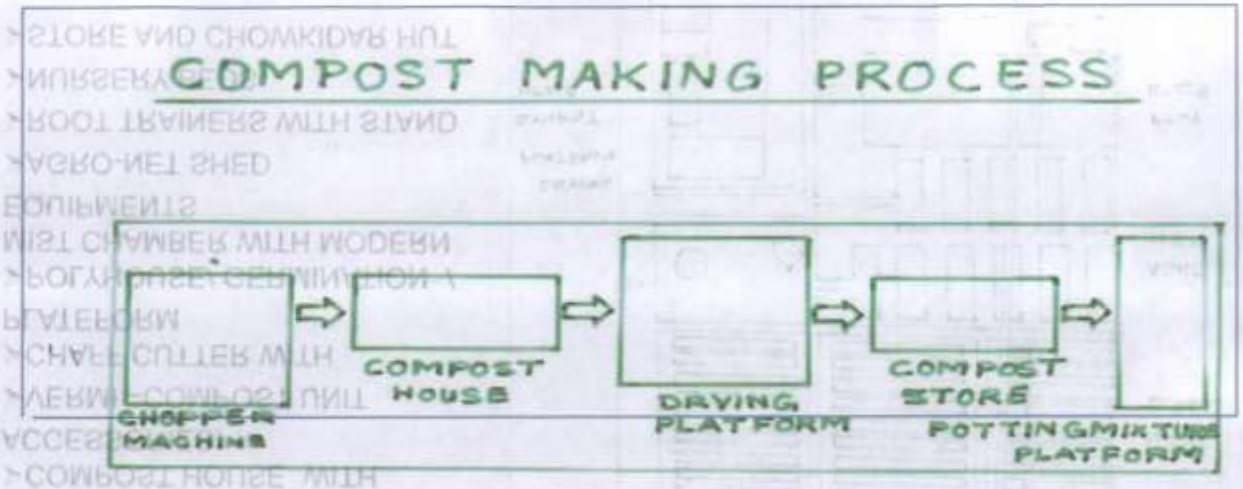
IT HAS FOLLOWING COMPONENTS:-

- COMPOST HOUSE WITH ACCESSORIES.
- VERMI –COMPOST UNIT
- CHAFF CUTTER WITH PLATEFORM
- POLYHOUSE/ GERMINATION / MIST CHAMBER WITH MODERN EQUIPMENTS
- AGRO-NET SHED
- ROOT TRAINERS WITH STAND
- NURSERY BEDS
- STORE AND CHOWKIDAR HUT



Dr. Suresh Kumar, IFS
CF, Chamba.

COMPOST MAKING PROCESS



IN THE INITIAL STAGE OF PLANT LIFE, PARTICULARLY IN NURSERY STAGE, PROPER MEDIA AND NUTRITION ARE VERY IMPROTANT FACTORS WHICH DETERMINE THE FUTURE GROWTH OF PLANTS. THE COMPOST IS LIGHT, FRIABLE AND RICH IN NUTRIENTS TO SUPPORT THE YOUNG SEEDLINGS WHICH CAN BE PREPARED FROM CHOPPED WEEDS OR STRAW OR GRASS BY AEROBIC DECOMPOSITION.

Platform for drying

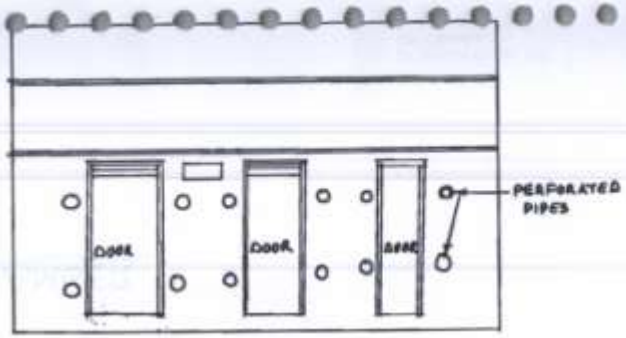
Cemented platform of 10 feet to 8 feet provided in front of composting shed.

Compost extracted from the shed is removed and put on the platform for drying.

Dry it and sieve it and will be ready for use in the route trainers.

Compost so prepared will be light, friable and riche in nutrients to support the young seedlings.

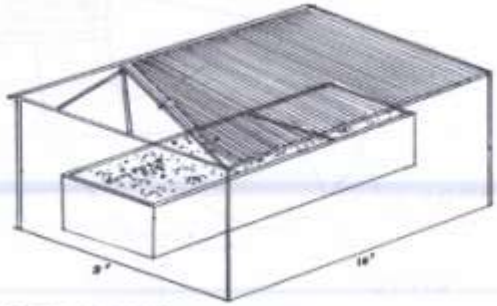
Compost so prepared is mixed with sand 1 part and compost 2 parts in route trainers, preferably the sand should be sterilized by heating before it is mixed with compost.



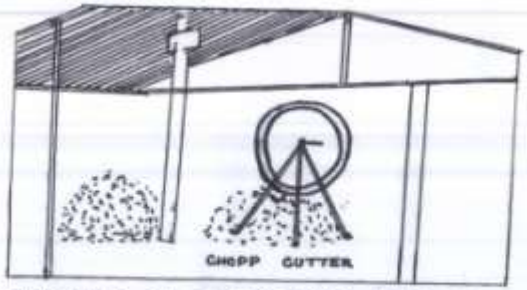
COMPOST HOUSE

Vermi –Compost Unit

- Above ground pit is constructed upto 1' & 2'.
- The twigs, grasses chopped and mixed with FYM to make slurry in big tub.
- Doom like packing are filled in the pit.
- Verms are put in the pit @ of 2 - 3 Kg. per pit developing upon the vermi compost is prepared.
- These pits is covered with grasses in order to give proper environment.
- Vermi compost is seived & colleted after 30-35 days and packed in gunny bags.
- The verms increased in number of geometric regression and number of pits be increased accordingly.

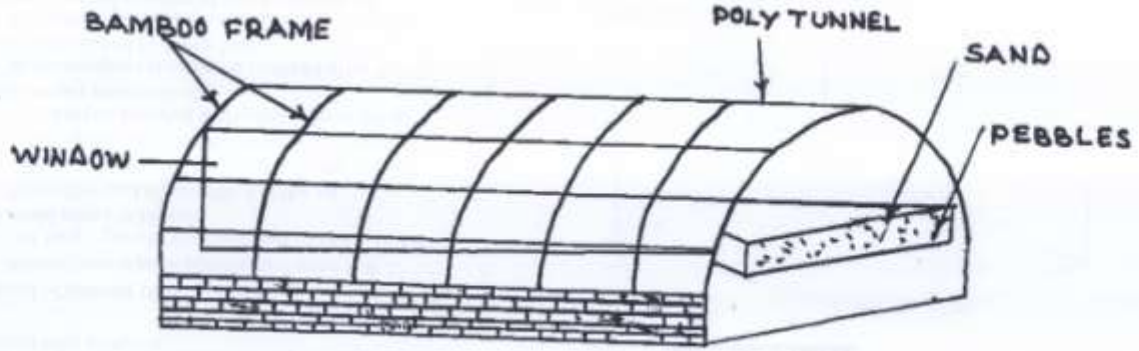


VERMI-COMPOST



CHOPPING OF EUPETORIUM BEFORE FEEDING IN COMPOST HOUSE

Dr. Suresh Kumar, IFS



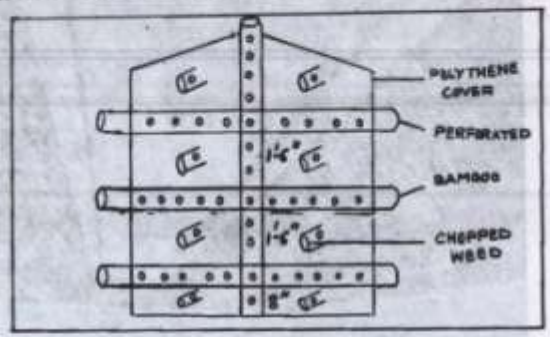
GERMINATION CHAMBER

Dr. Suresh Kumar, IFS
CF. Chamba.

ESTABLISHMENT OF MODREN NURSERIES WIT

The compost unit is a masonry chamber shed of fitting by 15' length 5' in width & 4 ' in height depending upon the amount of compost to be produced.

- Shed is divided into 3 chambers
- Roof of the shed and top portion is covered with transparent polythene sheets of proper thickness.
- The foundation and plinth is in masonry cement & floor is of cement concrete.
- Sheds are provided with 4 " PVC or cemented pipes with holes inbuilt for proper aeration.
- 1st pipe is kept about 8" above the ground and the second & subsequent are at 1.5' above it as shown in the diagram.
- The pipe shown criss –cross for proper circulation of air.
- Doors of the shed are made of wood.
- Material used (weeds, twigs or grasses) for making compost is mixed with approximately 1 Kg. of Urea in about 1 m^3 of chopped material and duly moisturized to give a good compost (preferably 4-5 days material is mixed for facilitating proper decomposition).
- Aerobic degradation starts in optimum temperature of 25^0 C-30^0 C. and once decomposition starts the heat is generated upto 55^0 to 60^0 C.
- During the process various chemical reactions takes place.
- Register is maintained for recording the daily temperature and amount of compost produced.
- High temperature is the indication of process of composting whereas falling temperature to the atmospheric temperature is indication of Completion of process.
- Compost will be ready in about 25 to 30 days if, suitable moisture and temperature is maintained for aerobic decomposition.
- Record for minimum & maximum temperature is maintained in a register.



AEROBIC DECOMPOSITION FOR MAKING COMPOST FROM WEEDS

Dr. Suresh Kumar, IFS

Poly house/Mist chamber/Germination Chamber

- Shed is fabricated and supported by G.I. pipe frame.
- Being technical, help of trained personnel is procured.
- It is covered with ultra-violet stabilized plastic sheet of 200-micron thickness.
- Misting/Fogging, sprinkler irrigation, temperature, and humidity recording instruments are provided in the chamber.
- If necessary exhaust fans also provided.
- Record be maintained on the register for showing date of germination, date of pricking, height of seedling & height of the plants are transplanting in the field.
- Used for germination of hard coated seeds & for growing valuable species.
- Germination, seedling or plants are put in route trainers on stand.

Agro-Net shed

This shed stands on the angle iron at a height 7 feet to 8 feet.

Shed is covered with agronets with 50 % shade.

Arrangement for sprinkler irrigation are made.

Route trainers on stand are put inside the shed.

The route trainers used to give a good height and good route system before planting in the rainy season.

Nursery beds are also prepared for consuming the extra seedlings so produced and for comparison of results in and outside.

Proper register is kept for recording the data.

ANNEXURE-VI:

COST UNDER BIO-ENGINEERING MEASURES

Annexure-VI

Cost of Bio-Engineering Works Proposed under Kuther (240 MW) CAT Plan

Sr. No.	Block	Beat	Legal Status	Name of Ghar	Total Area of Ghar in (Ha)	Activity				Total Amount (Sl. No. 8+ Sl. No.10) (Rs. in Lac)
						Protection work of Land		Bio-engg works		
						Qty (m^3)	Cost @ Rs.1200/m^3 (Rs. in Lac)	Area (Ha)	Cost @ Rs.62700/ha (Rs. in Lac)	
1	2	3	4	5	6	7	8	9	10	11
1	Holi	Tiyari	Nirpat	Nirpat	5	570	6.84	4	2.51	9.35
2			Lower Tiyari	Barola	5	800	9.60	4	2.51	12.11
3			Lower Tiyari	Tiyari	5	805	9.66	4	2.51	12.17
4			Kensla Dhar	Kensla	20	1050	12.60	18	11.29	23.89
5		Sutkar	Chilmili	Oans	5	400	4.80	4	2.51	7.31
6		Deol	Nehra DPF	Kuleth	20	1950	23.40	20	12.54	35.94
7			Holi DPF	Holi	10	1250	15.00	7	4.39	19.39
8			Deol DPF	Deol	10	1005	12.06	7	4.39	16.45
9			Gwala DPF	Adhaur	5	420	5.04	4	2.51	7.55
10			Toah DPF	Banthu	5	600	7.20	4	2.51	9.71
11	Barabanchha	Bajol	Gowar DPF	Gowar	10	1065	12.78	8	5.02	17.80
12		Nayagram	Chuned DPF	Chuned	12	1100	13.20	10	6.27	19.47
13			Tunda Munda DPF	Lingti	8	1025	12.30	6	3.76	16.06
14			Agrali DPF	Agrali	10	845	10.14	7	4.39	14.53
15			Nayagram DPF	Nayagram	10	895	10.74	7	4.39	15.13
16	Lamu	Chanhail	Bharadi DPF	Bharadi	5	400	4.80	3	1.88	6.68
17			Arga DPF	Arga	10	980	11.76	8	5.02	16.78
18			Arga DPF	Gulei	5	520	6.24	4	2.51	8.75
19		Banog	Batada DPF	Prahi	5	600	7.20	4	2.51	9.71
20			Saloon DPF	Bragan	10	880	10.56	7	4.39	14.95
21		Lamu	Heiling RF	Brai	10	850	10.20	8	5.02	15.22
22			Rakshnu RF	Rakshnu	15	1290	15.48	12	7.52	23.00
					200	**19300**	**231.60**	**160.00**	**100.32**	**331.92**

ANNEXURE-VII:

COST UNDER ENGINEERING MEASURES

ANNEXURE: VIII:

AN ELABORATE NOTE ON BIO-ENGINEERING MEASURES

Annexure-VIII

BIOENGINEERING MEASURES

CONCEPT, APPROACH AND PRACTICABLE TECHNIQUES OF BIOENGINEERING

1 Concept of Bioengineering

Wood and living plants were the only materials for hill and slope stabilization works for hundreds of years. These days some of the old techniques have been modified and applied, which mainly use live material such as willow branches, willow cuttings, and rooted deciduous trees. The duration for implementing vegetation for slope stabilization works depend on the technique of soil bioengineering measure and the type of the plant that has been used. The techniques used in soil bioengineering are traditional and have been used since very long time ago.

Bioengineering is a sustainable approach where the combination of live and dead plants and plant parts are used as building materials for erosion reduction and upland slope prevention. This is based on engineering concept. The combination of vegetative engineering systems and civil engineering systems normally offers the most complete natural and cost effective solution to the variety of instability problems affecting a site

The overall objective is to provide better living conditions to the population by the provision of environment sound and improved sustainable mountain system so as to make a rapid economic growth in tune with economic growth of the country. Specifically bioengineering is adapted with a view to

i) examine soil bioengineering needs of project,
ii) monitor existing slope stabilization works.
iii) study plant species compositions and plant species which can be used for future soil bioengineering purpose.
iv) survey a plan of soil bioengineering activities.
v) test plant species in combination with different soil-bioengineering techniques for its suitability in winter plantations.
vi) stabilize the unstable slopes through a suitable application of vegetation in different soil-bioengineering methods, either alone or in combination with civil engineering structures.
vii) use indigenous materials, low capital costs compared to civil engineering structures.

Slope bioengineering is totally labour based approach providing benefits to the local people. It focuses on minimizing the damage to the natural environment as well as reducing the future maintenance costs. Major portion of the cost of the hill stabilization goes toward the payment of wages to the local labour. Hydro Project construction approach incorporates social, environmental and technical issues. The people's participation is most essential for the success of slope conservation works. The use of local materials motivates local people's participation. Soil bioengineering is an important and an integral part of construction, which is environment sound and cost effective. The use of plants for land stabilization is applied either alone, or in conjunction with civil engineering structures and non-living plant materials to reduce shallow-seated instability and erosion on slopes.

2 Bioengineering Approach

Experiences have proven that without adequate planning hills are not sustainable. Evidences have also shown that in the past some hill slopes of the Himalayan region needed rehabilitation because of no maintenance or very poor maintenance. The conventional method of hydro power project construction are generally being followed and are increasingly being questioned due to the use of large scale engineering structures with high investments.

3 Practicable Ways for Technique Adoption and Construction of Nurseries

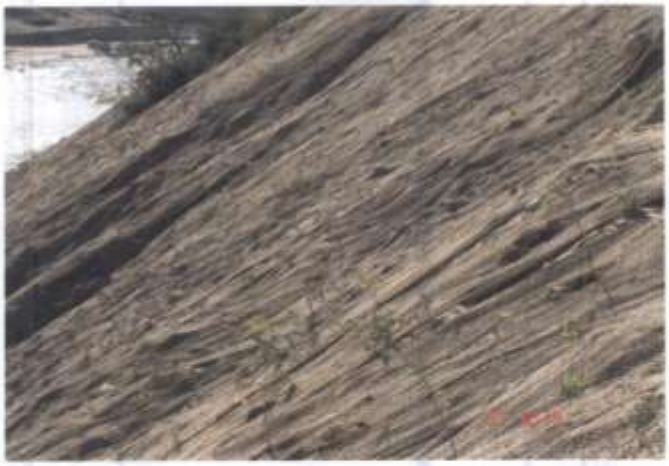
Bioengineering methods can be used to protect almost all type of slopes against erosion and reduces the instance of shallow failures. However, the establishment process may take some time. Vegetation is more dynamic than inert and takes some time to reach their maximum strength. They tend to become stronger over time. The application of soil bioengineering in combination with civil engineering structures would be most appropriate.

Dry stone walls or gabion retaining structures are built in the valley side of the road to protect the fill volume to reduce mass wasting and erosion process. Erosion control plantings are carried out on bare fill surface. Every attempt is made to maintain mass balance of hill slopes (cut and fill). The incorporation of soil bioengineering is a vital and integral part of road construction.

Cuttings and rooted plants are used during the dormant season. Various methods are available for hill side slope stabilization.

Jute and Wire Matting

The methods for seeding are dry-seeding and hydro-seeding. The seed will be protected with straw in combination with bitumen or meshes of jute and wire on exposed areas. The stabilization can be increased through transplanting stump sprout deciduous trees after re-vegetation with seeding. Jute matting is a tested method in many areas where soil is loose and difficult to hold as such. A few photographs has been depicted to the authenticity in Kol Dam area. This matting will be spread in between the check walls and Bioengineering works will be carried out by planting suitable local spp such as Agave, Yucca, Vitex etc. The matting will be affixed with wooden pegs and after some time this will biodegrade with the time



Loose rock slopes can be stabilized with different types of brush layering. The applications with rooted plants are known as hedge layer. The uprooted plant installations are brush layer. A combination of both is a hedge brush layer.

Dewatering and stabilization of wet slopes can be done through the use of drain and slope fascines. The fascines consist of live branches of willows that are tied together with wire.

There are numerous different hill side slope stabilization methods, which utilize plants in combination with construction of wood, stone and wire such as planted pole walls, live slope grids, live bamboo crib walls, vegetated stone walls and vegetated gabions. Choosing the right method depends on various factors such as the position of slope, ground and available material. The sections given below presents the techniques adopted in brush layer, drainage fascines, pallisade, single tree planting and grass planting. The advantages and disadvantages of each of these techniques are also given under the respective techniques.

3.1 Brush Layer Techniques

Brush Layer consists of placing live branch cuttings laid in small benches excavated into slopes. The benches can range from 2 to 3 ft wide. Live materials should be 1/2 to 2 inches in diameter. It is long enough to reach the back of the bench. The side branches should remain intact for installation.

Brush layer construction placing live branch cuttings in slopes

The cuttings are placed into slopes and oriented perpendicular to slopes. This is a more effective for earth reinforcement and mass stability of slope. It is also recommended on slopes up to 2:1 in steepness. It serves as tensile inclusions or reinforcing units. It assists in retarding runoff and reducing surface erosion.

The construction breaks up the slope length into series of shorter slopes separated by rows of brush layer. It also reinforces the soil with un rooted branch stems and reinforces the soil as roots develop, adding significant resistance to sliding or shear resistance.

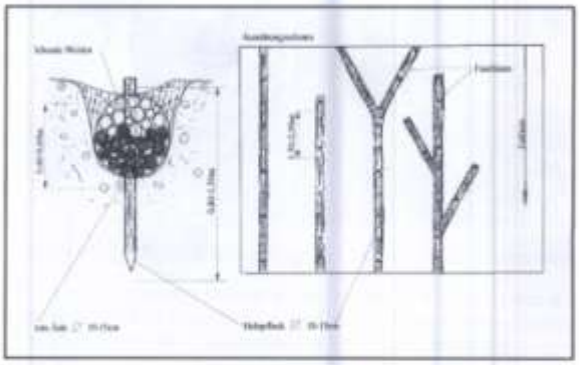
Whereas on dryer sites it helps infiltration on dry sites and drying excessively wet sites. It also adjusts the sites micro-climate, thus aiding seed germination and natural regeneration. The technique also acts as horizontal drains by redirecting and mitigating adverse slope seepage.

The construction is started at the toe of slope. Benches are excavated horizontally, on the contour, or slightly down the slope, if needed to aid the drainage. The surface of the bench slope should be constructed in such a manner that the outside edge is higher than the inside part. The live branch cuttings placed on the bench.

Branch growing tips (shoot bud) should be aligned towards the outside of the bench. The backfill is placed on top of the branches and compacted to eliminate air spaces. The brush tips should extend slightly beyond the fill to filter sediment. Each lower bench is backfilled with soil obtained from excavating the bench above.

3.2 Drainage fascines

Fascines are used for a variety of slope stabilization purposes. Fascines slow runoff, catch debris and reinforce the slope due to rooting. Drainage fascines in particular stabilize and drain slopes and are built into rills or small gullies. Immediately after establishment they have a draining effect because the water is channeled through the straight branches. With shoot and root development they form a strong line of vegetation. Additionally they achieve water-removal due to transpiration of plants.



Drainage fascines

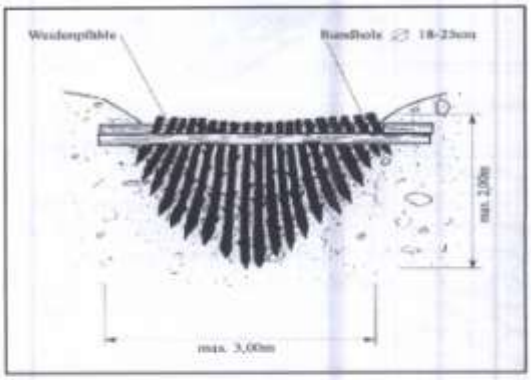
Draining fascines are long bundles of live branches or stems approximately 20 to 40 cm in diameter. The branches are placed with the butt ends pointing at the same direction into existing rills or dug trenches following the contour or desired angle precisely.

The bundles are tied together with 1.5 to 2.0 mm wire every 1 m and fixed into the ground every meter by wooden pegs or live stacks with a minimum length of about 80-100 cm. For the lower third of the fascine green branches of non-sprouting plants or gravel can be used. After placement the fascines are covered with a thin soil layer of about 3 to 4 cm. All branches should be in contact with soil to enable rooting and shoot development.

3.3 **Palisades**

Vegetated palisade constructions are ancient techniques, which were already used by the first people in Central Europe. At the beginning of the 20th century vegetated palisade constructions were still common in Bohemia, Moravia and Slovakia.

Palisades are used for protection of small but deeper, narrow gullies and shallow V-shaped rills. Immediately after construction they provide mechanical protection by catching debris, armouring and reinforcing gully floors. These effects are increasing after shoot development of cuttings. As a result of plant transpiration, they achieve water-removal from soil.



Palisades

Huge live poles are driven or dug half of their length, vertically into the ground. 5 to 20 live poles per running meter with at least 5 cm in diameter should be used. On their top they are fixed by wire on one or two cross beams, which have been anchored into the sides of the gully. The distance between the palisades depends on the steepness of the gully slope and profile of the gully floor. On slopes with less than 30° inclination 2 m are convenient, on slopes with an inclination between 30° and 60° a distance of 1 m is recommended.

3.4 **Single tree planting**

Growing shrubs and trees form a dense network of roots in the soil. Reinforcing and in the longer term anchoring, are the main engineering functions. Shrub and tree planting can be applied on almost every slope. It is often used in combination with other soil-bioengineering measures.

Rooted plants from the nursery (usually raised as polypot seedlings) are planted in off-set rows or in other specific pattern on the slope. One plant per m² should be enough. Main considerations are the costs of establishment and the period in which a dense plantation is required. The plants are put into a pit large enough for the rooting system. After filling soil carefully around the cylinder of roots and soil from the polypot, the soil is firmed gently around the plant. Stump-sprouting species should be preferred. Mulching, with for instance compost or chopped grass helps the young plants to grow faster by regulating the moisture and suppressing competing vegetation.

3.5 **Grass planting**

For grass planting, grass slips, cuttings, or clumps grown from seed are planted in lines or at random on the slope. Grass plantations protect the slope, due to rooting and by providing a surface cover. They reduce the speed of runoff, catch debris and armour the slope.

By using a planting bar holes just big enough for the roots are made. The grass slips or cuttings are placed into it, the soil filled around it and firmed gently. Grass planting is started from the top of the slope working downwards.

Different patterns of grass lines can be used as given below:

- Contour/horizontal lines: They reduce speed of runoff and catch debris thereby armouring the slope.
- Down-slope/vertical lines: Armour, reinforce and drain the slope. Used for damp sites and poorly drained materials where an intensified infiltration can lead to liquefaction of the soil.
- Diagonal lines: Main functions are armouring and reinforcing. Secondary they catch debris and drain the slope. Best compromise of horizontal and vertical planting.
- Random planting: It is often used in combination with jute netting on very steep harsh slopes where complete surface protection is needed.

The locally available grass species can be used for erosion control purpose and are useful for thatch, fodder, pasture and medicines.

ANNEXURE-IX:

AN ELABORATE NOTE ON ENGINEERING MEASURES

Annexure-IX

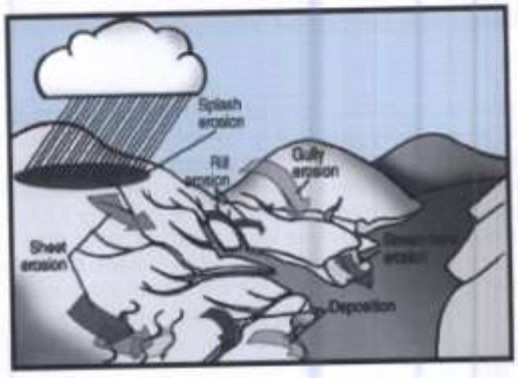
SOIL EROSION

Definitions

The loss of soil by wind and water or gravitational creep is known as erosion. Two categories are commonly recognized. **Normal erosion** - which proceeds at a pace much slower, than the process of soil formation? It is beneficial, as it checks soil senility. **Accelerated erosion** is excess of the normal and is chiefly due to changes in the nature and density of native vegetation by human activities. The process is invariably harmful as it leads to the removal of fertile top soil at the rate greatly exceeding that of soil formation. The discussion that follows is, therefore, mainly concerned with accelerated erosion.

Type of Erosion

The natural agencies chiefly responsible for accelerated erosion are wind and water. Since wind is not responsible for any serious erosion in this part of the land. We are mainly concerned with the latter. Erosion by water involves hydraulic action, abrasion, solution and transportation of soil. The velocity of flow has an important bearing on its erosion power. The following categories are recognized: -



Sheet Erosion
This applied to the removal of a more or less uniform layer of surface soil. The general contour of the land surface remains unaltered and so the insidious effects so unnoticed until most of the top soil have been lost. Sheet erosion is most active on cultivated lands but is unimportant in forests where unincorporated organic matter covers up the soil.

Rill Erosion (fingerling or incipient gullying)
This implies the formation of small channels in the land surface. It represents an intermediate stage between sheet and gully erosion. In forest areas, this type of erosion is generally seen along the extraction paths and in fire brunt areas.

Gully Erosion

This refers to the formation of large channels or gullies. This develops in situation where concentrated run off attains sufficient volume and velocity to cut deep into the soil body. Gullies have their origin in rills, side roads, trials, cattle treads of natural depressions. Gullying commonly proceeds by waterfall erosion at its head. If the material is easily eroded, the gullies tend to be deep and narrow but if the substratum is hard, the gullies are shallow with sides gently sloping. As a rule, gullies carry water only during or immediately after the rains.

Stabilization of Land Slips

Relatively weak geological structure of the terrain and its disturbance through road and other on-land construction programme disturb the strata and many a time results in landslips. Left unattended some of these get naturally stabilized whereas others aggravate to such an extent that special efforts are needed to stabilize these. Landslides seen in the catchment area can be stabilized with engineering and vegetative measures.

Stabilization of Stream Banks

The stretch of streams causing bank erosion has been identified. In the identified stretch it is necessary to provide crate wire structure on both banks to save the banks and simultaneously provide spurs so as to train the flow of water in a specified course. Forty structures are estimated to be needed along the banks and also spurs. There may be need for some odd bank protection structure or a spur here and there, which can also be adjusted within these funds.

Gullied Area

In totally degraded land, gullies can make up for a large part of the area. The objective of reclaiming these gullies is to prevent further erosion and utilize the land again for protective and productive use. Effective closures and afforestation will promote vegetal growth and retard further growth of gullies. However, to increase sedimentation to fill up the gulley gradually, check dams may have to been constructed where even seasonal water flow is still expected. Typical measures for reclamation of small gullies include brushwood plugs and loose stones. Their function is to reduce the velocity of the flood and 'comb out' the sediments so that gulley is gradually silted up.

Brushwood plugs

At first trenches which should follow the contour is dug 40 to 60 cm deep across the gulley bed and the banks. As seen from above, the layer will be more or less V-shaped. The brushwood which must be of sprouting species is placed upright and tightly together on the downstream side of the trench. Afterwards the trench is refilled and tamped.

Loose stone plugs

Smaller gullies of less than one meter in depth can often be stabilized by plugging them with loose stones, which may be simply heaped in the gully. It can be in combination with bushy brushwood which may not even be sprouting species.

Nallas

Large gullies and nallas have to be treated to prevent further deepening and widening. This is done mainly by various types of check dams.

The purpose of check dam is to reduce the gradient and break the velocity of the flow. Through check dams the water is conducted safely from a higher to a lower point without causing erosion at the gulley/nalla bed and banks. The water pools behind the dams promote the percolation of water into the soil. Check dams still serve their purpose even when they are completely silted up by reducing the gradient inside the gulley/nalla. Longer life-span should be aimed in case of check dams to be constructed in nallas. They should be constructed in places where the bed is narrow and the banks are firm. Curves or sites within or just below gulley/nalla junctions must be avoided.

In an ideal case, check dams should be spaced in such a way that the bottom of the upper check dam is in level with the top of the next lower one. In steep area as in the Himalayan region, this is difficult to achieve because too many check dams will be required. If the section between two successive check dams cannot be made level, the gradient should at least not exceed 5 percent for greater success.

The height of the dams influences their spacing. There is the alternative of constructing a few high or many low dams on a certain gradient. High check dams have to resist a greater pressure than the low ones and, therefore, are more liable to damages. While concrete or masonry dams can be built to any height, dry stone or brushwood dams should be low.

Check dams must be well anchored in the ground and particularly in the banks to prevent under-scouring and scouring between the dame and the banks. The flow is directed through a water spill or notch in the center of the dam. Below the dam where the water hits the bed, a protective apron must be constructed. For additional strength the check dam is filled up to the notch with soil on the upstream side.

Types of check dams are distinguished according to the material used.

Dry Masonry Check Dam

These are generally constructed in upper reaches of eroding nalas to reduce the bed slope, stabilize the grade and check the bed scouring and retain silt, sand and pebbles.

Depending upon the size of the dam depth of foundations may vary from 30cm to 60cm. Foundation should be dug across the nalla width extending well into the banks. The soil is piled up-stream to be used later for the refill. The largest stones are placed in the bottom layers. Larger check dams with steps in front are stronger, safer and more useful. In every layer of stones a step of 15 to 20 cm is left on the downstream side, so that width is reduced from base to top. The advantage is that the flow is gradually conducted down to the apron. Two wing walls with appropriate foundation are often constructed at the upper side to force the flow into the water spill or notch and prevent it from damaging the banks. The wing walls should form an angle of about 30° with the banks.

In the center of the "crown" a notch of concave shape is to be provided which must be wide enough to cope with the peak run-off. Generally a length of half the span of the dam and depth of 20 to 30 cm are considered appropriate.

Below the dam an apron has to be constructed with stones. On the up-stream side the dam has to get an earth fill for greater strength. Finally, the structure is supplemented by planting seedlings and cuttings of suitable species along the banks on the upstream side. Alnus & willows form good species for this purpose. Such check dams are provided in areas closed for afforestation.

In nallas strewn with boulders, with or without some water flow, check dams may be constructed of gabions, masonry with mortar or concrete. Each situation will have to be looked into for the type of dam that needs to be constructed.

ANNEXURE-X:

COST ESTIMATE OF NALA/DRAIN LINE TREATMENT

Annexure-X

Soil and Water Conservation Works Proposed on Nallah / Rivulet lies under Kuther HEP (240 MW)

Sl. No.	Block	Beat	Name of Nallah / Rivulet	Stone Masonary Check Dam		
				Quantity (cum)	Rate (Rs. / Cum)	Amount (Rs. Lac)
1	**Holi**	Tiyari	Kalah	800	1200.00	9.6
2			Tiyari	560	1200.00	6.72
3			Oie	640	1200.00	7.68
4			Kujay	600	1200.00	7.2
5		Sutkar	Kee	600	1200.00	7.2
6			Tulang	440	1200.00	5.28
7			Oans	600	1200.00	7.2
8			Udani	800	1200.00	9.6
9			Draman	700	1200.00	8.4
10			Kuther	500	1200.00	6
11			Tarmoli	200	1200.00	2.4
12		Deol	Banthu	800	1200.00	9.6
13			Deol	400	1200.00	4.8
14			Kuleth	1000	1200.00	12
15			Gwad	440	1200.00	5.28
16	**Barabanchhu**	Bajol	Gohar	200	1200.00	2.4
17		Nayagram	Chuned	240	1200.00	2.88
18			Agrali	400	1200.00	4.8
19			Gharoh	500	1200.00	6
20			Nayagram	400	1200.00	4.8
21	**Lamu**	Chanhail	Sua	300	1200.00	3.6
22			Maina	400	1200.00	4.8
23		Banog	Uder	400	1200.00	4.8
24			Kawa	800	1200.00	9.6
25			Bauk	340	1200.00	4.08
26		Lamu	Lamu	300	1200.00	3.6
27			Yoi	300	1200.00	3.6
28			Baggi	600	1200.00	7.2
29			Charoli	440	1200.00	5.28
30			Lohar	300	1200.00	3.6
31			Taut	600	1200.00	7.2
			Total	**15600**		**187.2**

ANNEXURE-XI:

COST BREAK-UP FOR REPAIR OF BOUNDARY PILLARS

Annexure-XI

Details of Boundary Pillars and Check Pillars

Sl. No.	Beat	Name of Forest (RF/DPF)	Boundary Pillars	Check Pillars
A. Reserve Forest				
1	Naya Gaon	Sewain	49	0
2		Nawai	26	0
3		Paniyali	29	0
4	Sutkar	Majharan	11	0
5		Algram	21	0
6		Sutkar C-1 & C2	25	0
7	Deol	Devsar	21	0
8		Deol	27	0
		Sub-Total RF (A)	**209**	**0**
B. Demarcated Protected Forest				
9	Tiyari	Dhar Naden	22	0
10		Tarnai Dhar	23	0
11		Khutni Dhar	6	0
12		Oi Nala-I	25	0
13		Oi Nala-II	13	0
14	Bajal	Dhar Pattar	38	0
15		Dhar Tattar	13	0
16		Bajal	24	0
17		Bag	13	0
18		Guwari	104	6
19		Bajali	52	0
20	Naya Gaon	Channed	82	16
21	Sutkar	Sutkar	105	0
22		Dhar Dhalli	13	0
23		Dhar Jutha	25	0
24		Dhar Satkhani	16	0
25		Sadaser-V	58	0
26		Sadaseri-VI	126	0
27		Tulang	72	0
28		Andriagraol	29	0
29		Chilmili	33	13
30		Sadaser-I	126	72
31		Sadaser-II	58	0
32		Satkuna Dhar	16	0
33		Dragn Dhar	13	0
34	Holi	Holi	27	0
35	Deol	Jabbla	15	0
36		Gaola	74	0
37		Nehra	43	0
38		Tarnai Dhar	23	0
39		Saad	27	38

40		Andrul	0	6
41		Dhar Saod	7	0
42		Kiur	60	12
43		Raan Dhar	18	5
44		Charda	43	8
45		Gawad	50	19
46		Phat	34	0
47		Kali Ghodi	146	23
48		Guwala	50	19
Sub-Total DPF (B)			**1722**	**237**
Grand Total (A+B)			**1931**	**237**

ANNEXURE-XII:

COST BREAK-UP OF FIRE PROTECTION

Annexure-XII

Cost Estimate for Forest Fire Lines

Sl. No.	Beat	Name of RF / DPF	Area, ha.	Length of Fire Line (km)
	Deol	Deosar RF		1.75
		Phat DPF		2.50
		Sad DPF		3.25
		Sangalla DPF		4.50
	Sutkar	Andarlagraon		3.25
		Sutkar RF C-I & II		4.50
		Kuther DPF (C-I, II & III)		5.75
	Tiyari	Kala DPF		4.50
		Oi Nala DPF		3.75
		Tiyari DPF upper & lower		2.75
		Total		**36.50**
		Cost for 36.50 fire line @ Rs. 1.50 lac/km		**54.75**
		Say (Rs. Lac)		**55.00**

ANNEXURE-XIII:

COST INVOLVED TOWARDS CONSTRUCTION OF BUILDINGS

Annexure-XIII

Cost Estimate for Construction and Repair of Buildings

Sl. No.	Name of Buildings	Name of Beat	Amount (Rs. Lacs)
A. Construction of New Buildings			
1	Mali hut	Holi	6.00
2	Tracking Hut at Kalah	Tiyari	50.00
		Sub-Total (A)	**56.00**
B. Repair of Buildings			
1	FRH Sutkar	Sutkar	14.00
2	Forest Guard Hut	Sutkar	2.50
3	Forest Guard Hut (02 Nos.)	Deol	5.00
4	Range Store at Holi	Deol	2.10
5	B. O. Residence at Holi	Deol	2.80
6	Peon Residence at Holi	Deol	1.90
7	Out house at Holi	Deol	1.80
8	Seed Store at Holi	Deol	1.20
9	Forest Guard Hut	Tiyari	2.70
		Sub-Total (B)	**34.00**
		Grand Total (A + B)	**90.00**

ANNEXURE-XIV:

COST BREAK-UP INVOLVED TOWARDS CONSTRUCTION OF ROAD, PATH AND BRIDGES

Annexure-XIV

Cost Estimate for Bridal & Inspection Paths

Sl. No.	Beat	Name of B/I Path	Length	Unit Rate/Km	Cost (Rs.)
A. Bridal Path					
1	Deol	Guwala to Tata pani	4.50	85000	382500
2	Sutkar	Sutkar to Algram via Chilmili	8.00		680000
		Chilmili to Tutta Dhar	3.50		297500
		Sutkar to Lamu via Kuther	8.50		722500
		Kienala to Kuther	4.50		382500
		Sub-Total (A)	**29.00**		**2465000.00**
B. Inspection Path					
1	Deol	Gowar to Saradal	6.50	150000	975000
		Deol to Saradal	6.50		975000
		Deosar to Kiur	3.50		525000
2	Sutkar	Tutadhar to Tulangpas	8.00		1200000
		Sutkar RF to Kuther via Tanuh	6.50		975000
3	Tiyari	Tiyari to Oi Nala	3.50		525000
		Kalah to Dravthon	8.00		1200000
4	Nayagram	Nayagram to Thanether	6.50		975000
		Garoh to Noi	4.50		675000
		Chuned to Noi	3.75		562500
		Sub-Total (B)	**57.25**		**8587500**
				Grand Total (A) + (B)	**11052500.00**
				Say (Rs. Lacs)	**110.50**

Annexure-XIV (Contd...)

Cost Estimate for Construction and S/R of Foot Bridges

Sl. No.	Beat	Name of Bridges	Cost (Rs. In Lac)
A. New Construction of Bridges			
1	Tiyari	Kalah Nala	15.00
2		Saloon Nala	15.00
3	Sutkar	Tulang Nala	15.00
4		Hali Nala and Tatapani	30.00
		Sub-Total (A)	**75.00**
B. Special Repair of Bridges			
1	Tiyari	Dharand gat	5.00
2	Sutkar	Kien Nala	5.00
		Sub-Total (B)	**10.00**
		Grand Total (A + B)	**85.00**

ANNEXURE-XV:

TENTATIVE BREAK-UP OF ENGINEERING AND BIOLOGICAL MEASURES

ANNEXURE-XVI:

NOC RECEIVED FROM WILD LIFE DIVISION, CHAMBA

No./ 4201 /
H.P. Forest Department.

From: -

Divisional Forest Officer,
Wild Life Division, Chamba.

To: -

General Manager,
JSW Energy Limited
Kuther Hydro Electric Project.
Distt. Chamba.

Dated Chamba, the/ 30-3-09 /

Subject: - Kuther HEP (260MW)- Issue of No Objection Certificate.

Sir,

Kindly refer to your office Letter No.-Nil- Dated 25-03-2009 on the subject cited above.

Necessary certificate in respect of Wild Life Division Chamba is enclosed herewith please.

Encl. - As above.

Divisional Forest Officer,
Wild Life Division, Chamba.

CERTIFICATE.

It is certified that no part of Kuther Hydro Electric Power Project (260MW) falls within the 10 Kms of boundaries of Tundah & Kugti Wild Life Sanctuaries of Wild Life Division, Chamba.

Divisional Forest Officer,
Wild Life Division, Chamba.