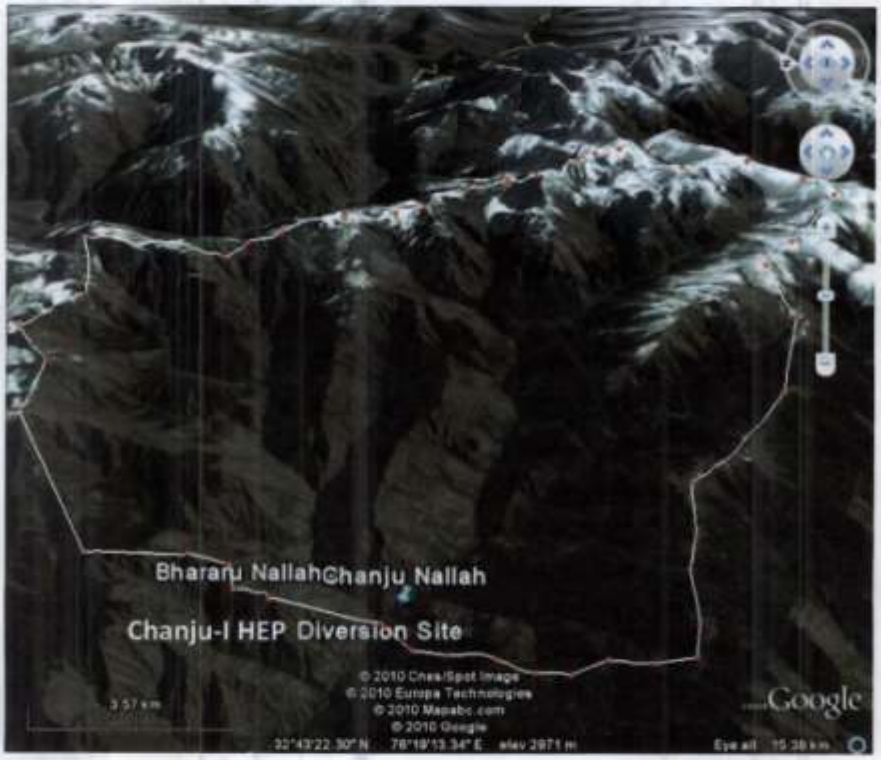
UNAMMENDED Draft - III (Revised)

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)

DISTRICT CHAMBA, HIMACHAL PRADESH



CATCHMENT AREA TREATMENT PLAN

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Revised December, 2010

ACKNOWLEDGEMENT

This proposal on Catchment Area Treatment Plan of the proposed Chanju-I Hydro-electric Project (36 MW) located in District Chamba, Himachal Pradesh, provides an account of degraded areas in the free drainage catchment of the project and suggests various measures for their treatment. The main theme of the exercise is to mitigate and reduce various degradation processes there by minimizing soil erosion in the free draining catchment of the proposed project in order to reduce silt in the Chanju nallaha water and prevent siltation of the small reservoir. The plan also aims at treating and stabilizing various degraded areas in the catchment with activities to reduce pressure on forests with active participation of human population dwelling in the area.

The proposal envisages undertaking biological as well as engineering treatment measures for prevention of soil erosion. It provides an insight into the quantum and variety of activities to be undertaken in the programme as per the proposed plan and will go a long way in achieving the goal of prevention of catchment degradation and soil erosion in Chanju nallaha basin. The physical and financial targets have been spread over a period of 7 years.

Indo Arya Central Transport Ltd. record their sincere appreciation and gratitude towards various functionaries of HP Govt. as also public representatives for their blessings, cooperation and guidance in developing this CAT Plan for Chanju-I HEP (36 MW) in Chamba Forest Division Chamba.

Amongst the Govt. we would especially record our gratitude to Hon'ble Chief Minister Shri Prem Kumar Dhumal for their blessing and guidance. We are grateful to Sh. Avay Shukla, Add. Chief Secretary, Sh. Vinay Tandon, Principal Chief Conservator of Forests, Sh. J. S. Walia, Add. Principal Chief Conservator of Forests, Dr. Goraya, Chief Conservator of Forest, Smt. Archana Sharma, Conservator of Forests (CAT Plan) for their Valuable suggestions and guidance, efforts have been made to incorporate their aspirations and expectations in the project.

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(Narender Goel)
Managing Director,

INDEX

Description	Page No.
Salient Features	1
Abstract of Cost of Total Works	2
Introduction	3-10
Catchment Area Treatment Plan	11-14
Afforestration	15-30
Conservation and Development of Medicinal Plant	31-33
Pasture Development	34-41
Soil Erosion	42-54
Bio-Engineering Measures	55-62
Forest Protection	63-69
Operational Support	70
Energy Saving Devices	71-72
Eco-Force / Eco Battalion	73-74
Joint Forest Management	75-83
Forestry Research	84
Development of Chanju Valley as Eco-Tourism	85-89
Eco-Services	90-105
Improvement & Development of Wildlife & Wildlife Habitats	106-111
Monitoring and Evaluation	112
Toposheet Showing Catchment Area	(Annexure-I)
Catchment Area Showing Tree & Snow Line	(Annexure-II)
Year Wise Breakup of CAT Plan Activities	(Annexure-III)

Description	Page No.
Silt Observatory Post	(Annexure-A)
Afforestration Scheme	(Annexure-B)
Pasture Development	(Annexure-C)
Replenishment Planting	(Annexure-D)
Soil & Moisture Conservation	(Annexure-E)
Bio-Engineering Works	(Annexure-F)
Forest Protection/Repair of Boundary Pillars	(Annexure-G)
Forest Protection Measures	(Annexure-H)
Energy Saving Devices	(Annexure-I)
Joint Forest Management & Micro Planning	(Annexure-J)
Eco-Tourism	(Annexure-K)

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
HIMACHAL PRADESH
CATCHMENT AREA TREATMENT PLAN
Salient Features

Sr. No.	Description	Remarks
1	Project Name	Chanju-I Hydro Electric Project
2	Location	Tehsil Churah , District Chamba
3	Installed Capacity	36 MW
4	River/Stream	Chanju Nallah which fall in Suil River ultimately joining Ravi River
5	Catchment Area up to Diversion Site	307 Sq. Km. **(Annexure-I)**
6	Snow fed Area	67 Sq. Km.
7	Catchment area of upstream of Chanju-II Project	263 Sq. Km.
8	Project Components	A Diversion Structure in the form of gated barrage with Full Reservoir Level (FRL) at El. 1440.0 m about 100 m d/s of confluence of Bhararu Nallah with Chanju Nallah, diverts the water through 2 Nos. 8.0 x 4.5 x 80.0 m desilting tanks, 5376.50 m of Head Race Tunnel, and 140.40 m of Penstock to generate electricity in a Surface Power House with Normal Tail Water Level (NTWL) at El 1193.43 m about 175 m u/s of Bhaled weir on Chanju stream.
9	Total Cost of Project	Rs. 295.09 Crores
10	Proposed cost of CAT Plan works	Rs. 7.38 Crores **(Annexure-II)**

CHANJU-I HEP (36 MW)

ABSTRACT OF COST OF TOTAL WORKS

(AS PER TECHNO ECONOMIC CLEARANCE ACCORDED)

S. No	Description	Amount (in Crores)
i)	Civil Works	158.21
ii)	Transmission Works	4.68
iii)	Electro Mechanical	61.74
iv)	Escalation	28.38
v)	Interest During Construction	34.62
vi)	Financial Charges	3.10
vii)	LADA	4.36
	Total	**295.09**

INTRODUCTION

The State of Himachal Pradesh is blessed with vast hydro potential, but the Northern Region as a whole is under severe power shortage and the situation in the region is likely to deteriorate further during the 11th and 12th Plan periods unless additional schemes are taken up immediately and implemented to derive timely benefits. The Govt. of Himachal Pradesh is aware of the need for accelerated development of its resources and the responsibility it shares in meeting the power needs of the region. In this context the Himachal Pradesh State Electricity Board has a significant role to play in mitigating power shortage in the Northern Region because of easy accessibility of potential sites in the state besides being located close to the load centres. Accordingly, various major and medium hydro electric projects have been identified by the State Govt/Himachal Pradesh State Electricity Board for implementation to yield benefits during 11th & 12th Five Year Plan Periods.

The Ravi is one of the major rivers of the Indus basin draining this region, originating in the Dhauladhar ranges of the Himalayas at elevation of 5800 m above Mean Sea Level (msl). The river is formed by four major tributaries in the head reaches namely Kalihan, Budhil, Tundah and Siul. A master plan for harnessing the hydro power potential of the river Ravi within its territory has been drawn by Himachal Pradesh and schemes with total installed capacity of 2398 MW have been identified. Today, hydro-electric energy has become an essential requirement for our society and is quite important for socio-economic development, not of the region but of the country. Out of this potential, about 44% has so far been exploited in the form of Holi HEP (3 MW), Chamera Stage-II (300 MW), Bhuri Singh Power House at Chamba (450 KW), Sal Stage-II (2 MW), Baira Suil HEP (198 MW) and Chamera Stage-I (540 MW). Construction works of Hibra (231 MW) renamed as Chamera Stage-III have also been taken up by Govt. of India through "NHPC".

Perspective Plan for Power Development in Ravi Basin

The following schemes have been identified in Himachal Pradesh for power development in Ravi basin under perspective plan.

S.No.	Name of Schemes	River/ Tributary	Installed Capacity (MW)
1.	Bara-Bhangal	Ravi	200.0
2.	Bajoli-Holi	Ravi	180.0
3.	Holi	Holi nallah	3.0
4.	Kutehr	Ravi	260.0
5.	Kugti	Budhil nallah	45.0
6.	Harsar	Budhil nallah	60.0
7.	Bharmour	Budhil nallah	45.0
8.	Budhil	Budhil nallah	70.0
9.	Hibra/Chamera-III	Ravi	231.0
10.	Chamera Stage-II	Ravi	300.0
11.	Chamba	Ravi	126.0
12.	Sal Stage-I	Sal nallah	6.5
13.	Bhuri Singh P/ House	Sal nallah	0.45
14.	Sal Stage-II	Sal nallah	2.0
15.	Devi Kothi-I	Kanjtu &Cheni Nallah	7.5
16.	Devi Kothi-II	Balsio nallah	13.5
17.	Sai-Kothi	Baira nallah	17.0
18.	Baira Bihali	Baira	15.0
19.	Chanju Stage-I	Chanju nallah	36.0
20.	Chanju Stage-II	Chanju	17.0
21.	Suil	Suil nallah	13.0
22.	Baira Siul	Baira & Siul nallahs	198.0
23.	Chamera Stage-I	Ravi	540.0
24.	Gharola	Gharola nallah	0.05
25.	Channi	Sundrali/Thaneter N.	18.0
		Total	**2398.0 MW**

Today government is encouraging private participation which could bridge the gap between demand and supply of power.

Project Proposal

Chanju (Stage-I) has been contemplated as a run- of- the river scheme on Chanju nallah, a tributary of Baira nallah and Sub-tributary of the river Ravi. It envisages utilization of water of Chanju nallah through a maximum gross head of 244.15 m for generation of 36 MW of power in a surface Power House located approximately 175 m upstream of Bhaled weir of Baira Suil HEP. The project comprises of a diversion weir across Chanju nallah at about 100 m downstream of the confluence of Chanju and Bhararu nallahs, twin intakes, twin feeder/connecting tunnels, twin desilting basins approximately 80 m long, a headrace tunnel approximately 5186 m concrete lined 190 m steel lined, a 140.4 m long surface penstock of 2.3 m diameter trifurcating near the powerhouse into 1.2 m diameter branch penstocks to feed three vertical axis Francis turbine generating units of 12 MW each to generate 36 MW of power in a power house utilizing a design head of 236.67 m and a design discharge of 16.85 m3 /s. A 422 m long construction adit, which acts as a surge gallery has been provided at Naredh nallah crossing. Tail water is proposed to be discharged into Chanju nallah through a box channel. A 132 kV surface Switchyard is proposed on the upside of the power house.

The project will be able to generate 157.85 Gwh of energy at the Power House bus bars in 90% dependable year at 95% machine availability. The power generated is proposed to be injected in to 132/33 KV proposed Sub-Station at Kurthala which shall be further connected with existing Sub-Station at Bathri through 132 KV D/C line.

Chanju (Stage-I) Hydro-electric project, located in the Northern Power Region, has thus been conceived for harnessing the power potential of Chanju nallah, a tributary of Baira nallah and sub tributary of river Ravi by using head available between about 100 m downstream of the confluence of Chanju and Bhararu nallahs and about 175 m upstream of Bhaled weir of Baira Suil HEP, which is under operation with NHPC. An underground desilting tank to exclude all silt particles down to 0.20 mm and above has been proposed. This project will have only power benefits, as the scope for irrigation is negligible in these reaches.

Location

The Chanju stage - I hydroelectric project sites are located on the Chanju nallah a sub-tributary of Suil nallah which is further a tributary of the Ravi between the longitudes 76°-14 '-52" to 76°-12'-06 East and latitudes 32°-44' 14" to 32°-45'43" North in the Chamba District of Himachal Pradesh.

Topography and Catchment

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 Zaskar 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 Zaskar.

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).

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 Suil 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.

Chanju nallah on which the project is located consists of four nallahs namely Tanger nallah, Diyothal nallah, Mehad nallah & Bhararu nallah. Tangar nallah originates at El. ± 4556 m from Dratijot, Diyothal nallah at El. ± 4892 m, Mehad nallah at El. ± 3901 m from Duga. Bhararu nallah consists of four nallahs namely Nakal nallah, Panglod nallah, Juri nallah & Ganj nallah originating from El. ± 4278m, El. ± 5238 m, El. ± 3800 m and El. ± 4774 m respectively.

Catchment

The Chanju-I HEP envisages the utilization of the flows of Chanju Nallah. The proposed diversion is about 100 m downstream of the confluence of Bhararu and Chanju Nallahs. The total catchment area of the Chanju Nallah up to the proposed diversion site is 307 sq. kms, out of which 67 km² (21.8%) area is snow bound. The catchment area of Chanju Nallah basin up to Bhaled weir is 378 km².

The basin is an elongated leaf shape. The equivalent slope of the river from its origin to the proposed diversion site is about 80.50 m/km. the catchment area of Bhararu Nallah up to diversion site is computed as 105 km² representing 34% of the total catchment area up to the diversion site.

There are a few glaciers in the upper part of the Chanju-I basin. There is good forest cover in the basin particularly on the left bank of the Chanju Nallah.

Meteorological Characteristics

Precipitation

The precipitation in the catchment takes places in the form of snow and rain. The catchment receives good rains from June/July to September due to the South-west monsoon. In this basin, little rainfall is observed during winter (No.-Feb) and spring season (March-April). The precipitation during winter falls as snow, primarily due to western disturbance that pass over the North-West part of the country during this period.

The annual rainfall records are available for the 13 non-recording rain gauges of Chamba District. The normal annual rainfall and year wise annual rainfall has been recorded in millimeters at all these stations for the period 1960-2002 by the office of Director, Land Records, Revenue Department, Govt. of Himachal Pradesh.

It is observed that out of these 13 rain gauges, no rain gauge exists in the Chanju-I basin. Tissa rain gauge is far away from the basin, but still it is relatively closer to the basin as compared to other rain gauge stations. Annual average rainfall at Tissa is available from 1960-2002, except for 4 years (1968, 1973, 1980, 2002). The annual rainfall observed at Tissa is 1050.7 mm, ranging between 32.5 and 2178.8 mm. The elevation of Tissa rain gauge is 1550 m.

About 94% of the basin lies above 2000 m altitude, which clearly shows that the major part of the basin experiences moderate to heavy snow fall during winters. However, the non-availability of records on snow precipitation at Tissa or any other station makes it difficult to assess the snow contribution from the basin.

Hydrological Characteristics

The Chanju Nallah receives runoff contribution from rain, snow and glaciers. The contribution from different sources and their temporal distribution make this nallah perennial in nature. The winter precipitation falling as snow accumulates in this basin and does not contribute to the stream flow immediately because melting does not take place in the basin during this period due to very cold climatic conditions. Moreover, there are no rains (or little rain) during this period. There is contribution only from base (ground water flow/ sub-surface flow) in the river. Consequently the discharge of the Chanju Nallah dwindles down to the lowest flows during winter months (December to February).

As spring season sets in, the melting of seasonal snow accumulated in the basin stats and flow in river also starts gradually increasing by the end of February /March. The runoff generated from the melting of snow dominates the stream flow during summer months till monsoon rains are experienced in the basin. The stream flow characteristics of the river show a high discharge

during monsoon months (June-September) due to rainfall as well as melting of glaciers located in the upper part of the basin. In general, July and August are the months when maximum discharge is observed, which is due to maximum melting from glaciers and high monsoon rainfall in the lower part of the basin.

Availability and Use of Hydrological Data

Details of available discharge data are given below:

- 10-daily mean discharge data at Kathwar (near Gheya Village) for a period of 4 years (June 2003 – May 2007) for Chanju Nallah.

This gauging site is about 2.20 Kms downstream from the proposed diversion site. The catchment area up to Kathwar gauging site is 320 km².

- Discharge data available at Bhaled;
- 10-daily mean discharge of Chanju Nallah at Bhaled for a period of 10 years between June 1964 and May 1978, with a gap for 4 years data (1968-71 and 1974-75).

CATCHMENT AREA TREATMENT PLAN

General

In case of some hydroelectric projects on Ravi basin, CAT Plans have been prepared and approved covering only the direct draining areas in the respective projects but in the absence of any specific directions on this aspect given by the Govt. of India in their guidelines issued in 1994, entire catchment area draining into proposed diversion dam on Chanju has been considered for formulation of catchment area treatment plan.

Catchment area treatment measures are essential not only for conservation of soil for maintaining and even enhancing productivity but also for reduction of sediment load flowing through Chanju Nallah. Apart from accelerated siltation of storage behind the dams, the increased silt load in rivers have adversely affected the turbines through corrosive action of silt particles as experienced in hydroelectric projects on Satluj river and its tributaries. Therefore, special attention has been focused on this aspect in the present report.

Estimate of Soil Loss Using Silt Yield Index (SYI) Method

The **Silt Yield Index** (SYI), considering sedimentation as product of erosivity erodibility and arial extent was conceptualized in the All India Soil and Land Use Survey (AISLUS) as early as 1969 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units within river valley project catchment areas.

The **Erosivity Determinants** are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the unit of the detached soil material. The relationship can be expressed as:

Soil Erosivity = f (Climate, slope, soil parameters, land use/land cover, soil management).

Silt Yield Index: The silt Yield Index (SYI) is defined as the yield per unit area and SYI value for hydrologic unit and is obtained by taking the weighted arithmetic mean over the entire area of the hydrologic unit.

Silt Observatory Post has to be established to determine and to measure the silt flow in the Chanju river. Periodical measurements have to be taken at regular intervals. Drawing of Silt Observatory Post is attached along with estimate as **Annexure- A.**

Prioritization of Watersheds/Sub watersheds

The prioritized of smaller hydroelectric units within the vast catchments are based on the Silt Yield Indices (SYI) of the smaller units. The boundary values or range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating the suitable breaking points. The watersheds/sub watersheds are subsequently rated into various categories corresponding of their respective SYI values.

The application of SYI model for prioritization of sub watershed in the catchment areas involves the evaluation of:

a) Climatic factors comprising total precipitation, its frequency and intensity.
b) Geomorphic factors comprising land forms, physiography, slope and drainage characteristics.
c) Surface cover factors governing the flow hydraulics and
d) Management factors

The data in climatic factors can be obtained for different locations in the catchment area from the meteorological stations whereas the field investigations are required for estimating the other attributes.

The various steps involved in the application of model are;

- Preparation of a framework of sub-watersheds through systematic delineation.
- Rapid reconnaissance surveys 1:50,000 scale leading to the 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/Sub 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 sub-water sheds are calculated using the following equations:
Silt Yield Index (SYI) = (Sum from i=1 to n of (A_iXW_i) X100)/Total Area considered.

The SYI values for classification of various categories of erosion intensity rates are given below:

Criteria for Erosion Intensity Rate

Priority Category	SYI Values
1. Very High	1400 and above.
2. High	1200-1399
3. Medium	1000-1199
4. Low	<1000

Source SYI Method, AISLUS
All India Soil and Land Use Survey Organization, Department of Agriculture and Cooperation, Ministry of Agriculture Govt. of India conducted rapid reconnaissance survey on delineation of priority sub watersheds for integrated watershed management in the catchment of the Ravi River valley Project above Thein Dam Punjab, J&K and Himachal Pradesh from May to July 1986.

In the total catchment area of 307 sq km, most of the remaining area is covered under the legal term "forest" including snow/glacial. This forestland is classified in different categories like Reserved Forests, Demarcated Protected Forests, Un-demarcated Protected Forests in forest records. Some of the protected forests around the habitations and full of rights of tree and grazing of cattle by local people have been recorded in revenue papers as "Charagah drakhtan" or "Charagah billa drakhtan" i.e. (grazing land with trees or grazing lands without trees). Similarly grassland in alpine zone grazed by migrated sheep and goat for a couple of months during summer is

termed as "dhars". Therefore, different nature of problems arise on varied lands depending on their locations and type of use to which they are put and thus approaches for their treatment and improvement have to be different. In this background, type of treatment required for each type of problematic categories has been described in paragraphs that follow.

A series of biological measures (including afforestation, enrichment plantations, pasture development, medicinal plant development, agriculture and horticulture) and engineering measures (gully plugging, contour cultivation, contour bunding, graded bunding, land slip stabilization and stream bank stabilization) in the regions of high erosion have been proposed as part of the catchment area treatment plan.

AFFORESTATION

General

Since this is mountainous tract with moderate to steep slopes, gully formation due to water/snow flows in the depression are bound to occur. Therefore, all afforestation works will have to be supported by anti-erosion measures like gully plugging, check dams etc. in varying extent. 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 43 ha. in a period of 3 years as detailed below: -

70

PROPOSED AREAS FOR AFFORESTTION IN CHANJU BLOCK

(UNDER CAT PLAN OF CHANJU- I HEP) IN TIKKRIGARH RANGE

I Bhagai Beat

1. **Bhagaigarh DPF (10 Ha)**

The aspect is North eastern, the slope is medium to high area is almost blank covered with grass growth. The species naturally growing around the area are Robinea, Salix and Deodar (in lower portion), Berberris, Cotoneaster. The proposed area is situated near & opposite to the area already planted in Khander DPF during the rainy season 2010-11 under 101-02. Afforestation Plan scheme at a distance of about 2.5Kms from the Bhagai nursery (Near Fgd Hut).

Bhaghai DPF 10 Ha

2. **Bhagaigarh DPF (5 Ha)**+5

The aspect is north eastern; the slope is medium to high. The area is almost blank covered with grass and scanty growth of mainly Berberris bushes. The small mixed patch of Deodar & Kail is naturally growing in the proposed area.

Bhaghai DPF 5Ha

3. **Prabha DPF (5Ha)** + 5

The area is at about 1.5 to 2 Kms from Prabha village. Southern aspect. Slope medium. Area covered with thick bushes like Berberis Principea, Cotoneaster. Tree species like Celtis, Aesculus etc also found around the area. Area was taken up for afforestation about 30 years ago but was not success. Ban & other B/Leave species can be tried in the area.

Prabha DPF 5Ha

II. **Chanju Beat**

1) **Sheru Dhar DPF (10 Ha)**

Area is grazing land for 10-12 households. Total area is about 60 Ha. Southern aspect, Slope medium. Area covered with thick bushes like Indigofera, Berberis Principea, Tree species like Abies pindro, Picea smithiana & few Robinea etc also found around the area. Kail, Deodar Robinea & other B/Leave species can be tried in the area. Nearest nursery is Dantuin at a distance of about 3 Kms.

Sheru Dhar DPF 10 Ha

2) **Mandola Dhar DPF 5 Ha:** +5

Total area available is about 10 Ha. South Eastern aspect, Slope medium to high. Proposed afforestation 5 ha) Area covered with thick bushes like Indigofera, Berberis Tree species like Abies pindro, Picea smithiana & few Robinea etc also found around the area. Deodar Robinea & Aesculus etc. species can be tried in the area. Nearest nursery is Mehla at a distance of about 3.5Km.

3) **Shuklu DPF 5Ha:** + 5

Total area available is about 10 Ha. North Western aspect, Slope medium to high. Area covered with thick bushes like Indigofera, Berberis, and Rubus & Peroshia etc. Tree species like Abies pindro, Picea smithiana & few Deodar etc also found at the ridge of the area. Deodar Robinea & Aesculus etc. species can be tried in the area. Nearest nursery is Mehla at a distance of about 3.5Km.

PROPOSED AREAS FOR ENRICHMENT OF CHANJU

1) **Banotu DPF 10 Ha:**

Total area available is about 10 Ha. South Eastern aspect, Slope medium to high. Area covered with thick bushes like Indigofera, Berberis, Rosa moschata etc. Tree species like Abies pindro, Picea smithiana & few Deodar etc also found in the area Deodar Robinea & Aesculus etc. Species can be tried in the area. Nearest nursery is Mehla at a distance of about 3 Km.

2) **Bharaduin DPF 10 Ha:**

Total area available is about 10 Ha. South Eastern aspect, Slope medium to high. Area covered with thick bushes like Indigofera, Berberis, Rosa moschata etc. Tree species like Ban, Kainth & few Deodar etc also found in the area Deodar, Ban, Robinea & Aesculus etc. species can be tried in the area. Nearest nursery is Kund at a distance of about 3 Km.

Plantation

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.

Plantation Technique Shd be part of afforestation ?

a) 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.

b) 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 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.

c) Fencing

Where necessary

All plantation areas will be effectively closed with 3-5 strands barbed wire fencing. Fence posts should be of durable species. These should be buried 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.

d) Site Clearance

The site shall then be cleared of bushes and unwanted growth only to the extent absolutely necessary. On hot aspects, staggered bushes of Dodonaea, Desmodium should be left to afford side shade to young plants. Where possible, the shrubs should be allowed sufficient time. The slash should, then be collected in small heaps and burnt in depressions, Nallas carefully so as to avoid any damage to existing patches of regeneration.

e) 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.

f) 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.

g) 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/naals. Nursery technique of various species and artificial reproduction, have been dealt in detail in technical order Nos. 3 and 4 of Punjab Forest Manual Volume-III.

Main Species to be planted are

1. Albizzia procera benth
2. Melia azedarach
3. Goon (Aesculus indica)
4. Piak (Alnus nitida)
5. Ritha (Sapindus mukrossi)
6. Robinia pseudoacacia
7. Akhrot (Juglans regia)
8. Grewia oppositifolia (Bihul, Dhaman)
9. Deodar (Cedrus deodara)
10. Banoak (Quercus leucotricophora)

ALBIZZI PROCERA BENTH

Artificial Propagation

Ripe pods are collected before they dehisce on the tree. These are dried in the sun, beaten and winnowed to get the clean seed which is dried for a few days before storage.

For raising nursery stock, the sowing is done in April-May under irrigated conditions; the seed is put in cooling boiled water and allowed to soak for 24 hours to soften the seed coat. Sowing is done in lines about 8 cm. Apart and the seedlings are spaced about 5 cm. in the lines. About 30 gm seed is sown per square metre of nursery area. The germination of the treated seed commences in about 3-4 days and takes about 2-3 weeks to complete. Weeding and watering of nursery beds are regularly done.

The seedlings raised from April-May sowing attain a height of about 5 cm by July-August when these are planted out in 30 cm pits dug during summer months. Monsoon planting is better than either summer or winter planting. The seedlings taken out from the nursery are planted out either with balls of

earth or with naked roots. In the latter case, the lateral roots of the seedlings are pruned and some lower leaves are plucked at the time of planting.

MELIA AZEDARCH

Artificial Propagation

Melia azedarach can be raised either by direct sowing or by planting out nursery raised seedlings or stumps.

Seed Collection and Storage

Fruits are collected during January-February from the trees. They are rubbed and washed to remove the outer pulp. The stones are dried and stored.

Nursery Technique

Sowing is done in nursery beds during February-March in drills 15 cm apart. Keeping the seed in liquid farm yard manure for about a week is reported to improve germination. The seeds are sown about 2 cm deep and about 5 cm apart in the drills. About 1000 gm seed is needed to sow each square metre of the nursery area. The nursery beds are irrigated after sowing and at regular intervals thereafter till germination are completed. Germination starts in about three week's time and may take about two months to complete. Each fruits may give rise to as many as four seedlings and at places the seedlings will appear in clumps and will have to be subsequently thinned. Regular weeding of the nursery beds is also necessary as the seedling are susceptible to weed competition on completion of germination, the seedlings should be thinned to a spacing of about 10 cm so as to have a spacing of 15 x 10 cms. The seedlings are transplanted in the nursery beds in July when these are about 2-3 months old. They are retained in the nursery for one more year when they are uprooted for planting out.

Planting Technique

The seedlings are planted out either in July or during winter months when these are leafless. For planting out entire plants in July, the seedlings are uprooted from the nursery with balls of earth. Planting is done in 30 cm3 pits dug in advance.

Stumps are prepared from 15 months old seedlings are planted in 30 cm3 pits in the same manner as entire plants.

GOON (Aesclus Indica)

Goon can be raised by direct sowing. Ripe fruit is collected during October-November and sown in patches during December. About 4-6 seeds are sown in a patch. Germination starts in March-April. At the end of one season, only one best frown plant be retained in patch and remaining ones be safely cut. Regular weeding of patches can be done during first year.

PIAK (Alnus Nitida)

Piak can be raised either by direct sowing or by nursery raised seedlings.

Seeds are collected during October-November rubbed and washed to get the seed which is dried in shade. Seed can also be separated by winnowing lightly.

For direct swing, the seed is mixed in fresh cow dung and then the cow dung mixed with seed and diluted with some water is broadcast over the area in thin layers during winter (December-January). This method is useful particularly in case of land slips. The seeds germinate during March-April and plants soon take possession of the ground. For nursery raised plants, the seed is mixed with some soil and sown in nursery beds in lines 22 cm apart. There is no need to further cover the seed by soil since seed is very small. Sowing is done during December. The nursery should be located in planting zone. Germination starts in March-April. Regular watering is done in dried months. Weeding too is necessary when plants become 10-15 cm high, these are spaced out about 10-15 cms. The weaklings are uprooted from lines with care and well grown seedlings are retained at a spacing of 15-20 cms. Plants become plantable when about 8-9 months old. Planting be done preferably in 45 cm pits, naked root.

RITHA (Sapindus Mukrossi)

Ritha can be grown by nursery raised transplants. It is natural to the tract. It can be grown at elevations from 800-1500 m on hot aspects.

Fruits are depulped and seed which is loose inside is taken out. Seed is sown either during August-September or March-April in sunken nursery beds. Nursery should be located in planting zone. Seed is sown at a spacing of 10 x 22 cm and a depth of 2-2.5 cm. regular watering to beds is done but flooding is to be avoided. Germination starts in about two weeks and takes 5 weeks to complete. Plants sown in August-September are pricked out in December in nursery beds at spacing 15 x 22 cm. Lines being kept 22 cm apart and plant to plant spacing is kept 15 cm. Plants of March-April sowing are pricked out in July-August. Regular watering / weeding to nursery beds is done. Pricking is done in holes made with debblers. The hole should be of sufficient depth to accommodate roots of plants. Plants become fit for planting when about 15 months old. August-September sowing is planted in next winter while March-April is planted in next monsoons. Naked root planting is done. Plant lesser than 30 cm height should be culled out in nursery and should not be planted.

Ritha can also be raised by P. Bags raised plants. For it, the nursery should be located near planting site. The P. Bag method be used for low elevation, planting (800-1200) because the plants are kept in P. Bags for a short duration (3-4 months) and may not attain plantable size (about 20 cm) at higher elevation. For monsoon planting, sowing in P. Bags is done during March-April. Sown P. Bags plants are planted during monsoon rains and planting be completed by end of July. Similarly for winter planting seed is sown in P. Bags during August/Early September sown and plants are planted during winter rains.

ROBINIA PSEUDOACACA

Artificial Propagation

Black locust can be propagated by planting out either nursery raised seedlings or root suckers.

Seed Collection and Storage

The pods are collected from October to December. These are dried in the sun, thrashed and winnowed to obtain clean seed.

Nursery Technique

The seed requires pre-sowing treatment which may consists of immersion in sulphuric acid or dipping in hot water or soaking in cold water. Hot water treatment, which is normally adopted, consists in soaking the seed in cooling boiled water for 2 to 5 minutes and allowed to soak at room temperature for 8 to 10 hours.

Sowing is done in the nursery beds in lines about 20 cm. apart. The spacing between the seeds in the lines is about 5 cm. and depth of sowing is about 1.5 cm. Sowing is normally done in March in irrigated nurseries.

Germination starts in about 7 days and takes about 10 days to complete.

Planting Technique

The plants from March sowings become fit of planting in the following December-January months when they attain height of about 1-2 m.

Planting is done in pits of 30 cm^3 in advance. Spacing adopted is generally 2.5x2.5 m for compact block planting. Space of 2x2 m is adopted for comparatively poorer sites. Bush cutting is done at the time of planting. Naked root plants are planted out. Sometimes root suckers are also used for planting. The tap root is cut and the lateral roots are pruned so as to accommodate the root system of the plants in 30 cm^3 pits. The plants are bundled and the roots wrapped in gunny bags during transport.

AKHROT (Juglans Regia)

Seeds are collected during October-November and sown in nursery beds either during December before snow fall or during March just after snow melting. Spacing is kept 10 cm. between seed to seed and 22 cm. from line to line. Seeds germinate after snow melting and germination completes within a month. Regular watering is done to beds. Weeding too is necessary but care be taken not to disturb the plant. Plants are planted naked root in field during next winter when these are about twenty one months old. In case plants develop long taproot, then the taproot portion is cut to size so as to accommodate it in 45 cm. size pit. Planting should not be done during monsoon rains.

GREWIA OPPOSITIFOLIA (Bihul Dhaman)

Artificial propagation is done by planting out either nursery raised seedlings of stumps.

Seed Collection and Storage

The fruits ripen from October to December depending upon the locality. The flesh of fruits is sweet and as such these are devoured by birds. A substantial quantity of the fruit crop may be eaten away by birds if seed collection is delayed. The fruits are not borne on current year shoots. Trees lopped completely do not, therefore, bear fruits. The trees reserved for seed production should either not be lopped at all or should be lopped only partially.

The fruits are rubbed and washed in water to remove the flesh. Each fruit contains 2-4 seeds. The seeds have hard testa and store well for at least a year without any appreciable drop in vitality.

Nursery Technique

Sowing in the nursery is done in March. Pre-sowing seed treatment is necessary to hasten and improve germination as the seed testa is hard. The seed is sown in 2 cm. deep in lines 15 cm. apart. About 250 g. Seed is required to sow each square metre of nursery area. The nursery beds are irrigated after sowing and regularly thereafter till germination is over. Germination starts in about 10 days and takes about a month to complete. Regular weeding is also necessary. At the time of weeding, the seedlings are spaced about 10cm. apart in lines. The seedlings grow fairly fast and attain plant able size by July. For stump planting, seedlings of 15 months age are normally used.

Planting Technique

Planting is done in July. Late planting usually results in poor survival. The seedlings are uprooted from the nursery with balls of earth and wrapped in moist gunny bags. Planting is done in pits of 30 cm^3 dug during summers or with the beginning of rainy season.

DEODAR (Cedrus Deodara)

Preparation of Nursery

The nursery should be located in low elevation in deodar zone. Natural blanks, frost holes, badly drained pockets and exposed ridges should be avoided. Soil should be deep fertile and well drained. Loamy soil be preferred. Regular water supply is very essential particularly in drier months. It is estimated that for 1000, plants about $40m^2$ nursery area is required.

Seed Collection and Storage

Seed be collected from healthy, middle aged, self pruned trees of good form and quality. It is desirable to select good quantity forests stand to manage them as seed stands. Cones are collected and during October-November and dried in sun. After these have opened, the seed is separated by winnowing. Sufficient quantity of seed be stored in sealed tins in cool/dry place.

Sowing in Nursery

Sowing is done in raised nursery beds before first snowfall in November-December. Seedlings should be sown in line 10 cm. apart. Germination will take place in March-April when snow melts. Beds may be watered in May-June, if dry weather prevails. Weeding in nursery but care be taken not to disturb the roots of seedlings.

Transplanting

During July when seedlings are about 4 months old, these are transplanted in nursery at a spacing of 15x22 cms. In raised beds. Lines being 22 cm. apart and plants in lines 15 cm. apart. For transplanting, holes be made with dibblers. Regular weeding is necessary. Light watering is done in drier months. The plants are to remain in nursery till 2 years after transplanting.

Planting

Pits should be dug in March-April after slash clearance in the area is over so as to allow sufficient time for weathering of the soil and to complete the planting work in time when the rains set in. Pits should be 30 cms deep and 30 cms in diameter at the escapement of 2.5m x 2.5m approximately. Planting shall be done with the onset of rains and should be completed by the first

week of August at the latest. Plants should be culled from the nursery beds with great care and this work should not be left to the labourers. In case the plants are to be carried for long distances they should be wrapped in moist gunny bags. While carrying out these operations, it is absolutely necessary to ensure that the root system does not get damaged even in the least. Grading of nursery stock is absolutely essential and all unhealthy or weakly growing stock is required to be discarded. While planting out special care is required to avoid the curling of the top of the seedlings root.

BANOAK (Quercus ~~Incana~~) Leucotrichophora

Propagation and Protection

The ban is best propagated by direct sowing in situ in March under cover. The growth of young seedlings is exceedingly slow under natural conditions. Working of the soil, weeding and watering assist their establishment and accelerate their growth. Coppice shoots can be depended upon from trees only up to three feet in girth. As the Ban is of low economic importance, the nursery technique is seldom resorted to. Dry, hot, southern slopes should be avoided for raising Ban plantations.

The Ban suffers most at the hands of graziers; its leaves are avidity sought out for leaf fodder. Continuous lopping of oak forests around human habitations in the tract has led to their deterioration and therefore its growing stock is on decline. The technique adopted for artificial reproduction is as under:-

Seed Collection

Fruit, acorns are collected in November-December while still on trees. Collection is done either by plucking individual acorns which is very costly or by light lopping of the trees bearing good fruit because the fallen seed is immediately attacked by some worm/insects creating holes in the seed which renders it unfit for germination.

Seed Storage

The acorns should be dried in the shade and kept in cool place. Storage of oak acorns is difficult and efforts should be made to sow them immediately after collection.

ALLANTHUS EXCELSA (Maha Rukh)

Maha Rukh can be raised artificially from seed or from cuttings. Large cutting give the best results. It coppices well and produces root suckers. It required light porous well and avoids coming up naturally.

Seed Collection

Seed is collected during May-June when it ripens.

Sowing

Seed is sown during May or June in well raised beds in drills about 9" apart. Watering is done sparingly but regularly. Germination completes within 1-2 weeks.

Planting

Seedlings can be planted out during rains of second season in 45 cm^3 pits at the spacing of 3mx3m. In badly eroded areas it should be planted at the aspacement of 1.5m x 1.5m.

Plantation Records

i) Plantation journal will be maintained for each plantation area on the standard from prescribed for the purpose. A location map on 1:50, 000 scales should also be prepared and prefixed to the journal.

ii) Plantation board should be put at prominent places, and written in Hindi, giving name of plantation, areas and year of commencement, and other detail of work

iii) Notes on germination, establishment, causalities etc. be given regularly by the Range Officer, and inspection notes of visiting officers be incorporated in the journal

iv) A detailed map showing various species and its extent should be prepared on 1:15000 scales and placed in Plantation Journal.

Year-wise phasing of physical and financial projection for each component of proposals with the total budget provision of 29.24 lacs is given in **Annexure-B.**

CONSERVATION AND DEVELOPMENT OF MEDICINAL PLANT

The higher slopes in the Chanju catchment, especially those around Kundi Marali lake, form habitat for a number of high value Himalayan herbs viz. Dhoop (*Jurinea macrocephala*), Patish (*Aconitum heterophyllum*), Salam panja (*Dactylorhiza hatageria*), Karu (*Picrorhiza kurroa*) etc. The forests along the left bank of Chanju Nala and those at the higher slopes also are home to Gucchi (*Morchela esculenta*), a source of good cash income to the local people. The valley forms one of the few areas where the *Pistacia* leaf galls (Kakkar singi) still forms. A list of major medicinal plants harvested from the area is given as Table-I.

The local people collect medicinal herbs for their own use and as a source of cash income. The increasing harvesting pressure has brought wild populations of many of these species under stress. Since the medicinal plants form an integral part of the local bio-diversity and contribute towards soil conservation and moisture regulation regimes their conservation becomes an important intervention for longevity of the project. There is a need to make an assessment of the medicinal plant scenario in the valley. The major objectives of this intervention would be as follows:

- To assess the status of major medicinal plants in the project area catchment through research wing of HPFD.
- To shortlist sites for concerted interventions for conservation and development of priority medicinal plants species, viz. dhoop, karu, kakar singi etc.
- To develop and raise nursery of important medicinal plants of the area for strengthening of wild populations of these species.
- To work out and put in place sustainable harvest mechanism like rotational harvests, organized collections, good post-harvest practices etc. with the help of research wing and local civil society organizations.

A provision of Rs. 23.63 lakhs has been made under this CAT Plan for conservation and development of medicinal plants in the Chanju Catchment.

This amount will be placed at the disposal of HP Medicinal Plants Society (HPMPS), constituted under the aegis of HP Forest Department for conservation and development of medicinal plants in the state. The HPMPS would prepare a detailed work plan for conservation and development of medicinal plants after carrying out reconnaissance of the area.

A list of commonly used or economically extracted medicinal plants and herbs occurring naturally are given in Table -I below:

Table-1 Commonly Harvested Medicinal Plants

Sl. No.	Botanical Name	Common Name	Habit	Habit	Part used
i	*Aconitum heterophyllum*	Patis	Herb	Sub-alpine region	Root tuber
ii	*Dioscoria detoidea*	Kins	Climber	Temperate	Roots
iii	*Jurinea macrocephala*	Dhoop	Herb	Sub alpine region	Root
iv	*Berberis aristata*	Kasmal	Shrub	Temperate	Whole plant
v	*Cinnamomum tamala*	Tejpatta	Tree	Sub–tropical	Leaves
vi	*Picrorhiza kurroa*	Kaur	Herb	Sub-alpine to alpine	Root/rhizomes
vii	*Podophyllum hexandrum*	Bankakru	Herb	Sub-alpine	Root & rhizome
viii	*Pistacia integerrima*	Kakkar singi	Tree	Sub-tropical	leaf galls
ix	*Viola pilosa*	Banafsa	Herb	1000-3000	Flower

Kasmal

Banafsa

Patis

Kaur

Kins

Tejpatta

Bankakru

Dhoop

PASTURE DEVELOPMENT

General

There are two types of pastures. One type constitutes depleted forest areas around habitations in the lower altitudinal zone which are grazed by domestic animals all the time. Trees generally of Ban Oak and Kahu, existing these areas which are heavily lopped in spite of proper lopping rules. Overgrazed over longer periods without any rest, these areas are now merely exercising grounds for cattle as these are now practically devoid of even grass. These areas need rest and replenishment. The second type constitutes alpine and sub alpine pastures mainly grazed by buffaloes, migratory sheep and goat. Due to altitudinal variations, these pastures are differently placed due to vegetation and need different approach for improvement. The total budget provision of 20 lacs is given in **Annexure-C.**

DETAIL OF PASTURE AREAS IN CHANJU BLOCK

(UNDER CAT PLAN OF CHANJU I HEP) IN TIKKRIGARH RANGE

S.No	BEAT	NAME OF DHAR	Area in Hact.	Area pure Pasture (approx.)	No. of Grazier passes Through	No. of Grazier (local)	REM ARKS
1.	Bhagai	Nalha	164.79	164.79	4	16	
2.		Sansarpatta	1149.60	930.00	16	24	
3.		Prabha	158.85	85.00	4	15	
		Jawara	348.62	250.00	12	18	
4.		Milgu	9337.24	3200.00	2	5	
5.		Juri	104.32	40.00	18	35	
6.	Chanju	Pukhara	935.10	350.00		32	
7.		Sheru	3652.46	2350.00		27	
8.		Badoth	112.47	30.00		13	
9.		Mandola	80.78	50.00		26	
10.	Dantuin	Deothal	4829.39	2800.00		35	

1) **DHAR SANSARPATTA (10 Ha):** - Proposed area for pasture improvement in CAT there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high; altitude is about 2500 to 3630 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

2) **DHAR NALHA (10 Ha):** - Proposed area for pasture improvement in draft CAT, plan, there is sowing of grass and planting of grass tufts is to be required. The slope of the area is medium to high, altitude is about 2200 to 2800 mtr.

3) **DHAR JAWARA (10 Ha):** - Proposed area for pasture improvement in CAT there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high; altitude is about 2800 to 3840 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

4) **DHAR PRABHA (10 Ha):** - Proposed area for pasture improvement in CAT there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2500 to 2850 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

5) **DHAR MILGU (10 Ha):** - Proposed area for pasture improvement in CAT, there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2500 to 4230 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully pluging work in some patches supported with sowing and planting of grass tufts can improve the area.

6) **DHAR JURI (10 Ha):** - Proposed area for pasture improvement in CAT, there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2300 to 3280 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

7) **DHAR PUKHARA (10 Ha):** - Proposed area for pasture improvement in CAT there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2600 to 3280 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

8) **DHAR SHERU (10 Ha):** - Proposed area for pasture improvement in CAT, there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2400 to 3500 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

9) **DHAR BADOTH (10 Ha):-** Proposed area for pasture improvement in CAT, there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2180 to 3200 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

10) **DHAR MANDOLA (5 Ha):** - Proposed area for pasture improvement in CAT there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2040 to 2270 mtr. There

is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

11) **DHAR DEOTHAL (5 Ha):** - Proposed area for pasture improvement in CAT there is sowing of grass and planting of grass tufts is to be required. The slop of the area is medium to high, altitude is about 2600 to 4250 mtr. There is small gullies are developing in the pasture area due to movement of migratory cattle grazer. Gully plugging work in some patches supported with sowing and planting of grass tufts can improve the area.

REPLENISHMENT/ENRICHMENT PLANTATION

Work

There are some forests in the catchment area where in patches density of crop is poor and devoid of overhead shade where planting could be done. In such areas planting of 800 seedlings per hectare is expected to result in full density forests. Extent of such areas is estimated to be 20 Ha which will be planted in 2 years. Areas suggested for enrichment plantations, in consultation with local forest officers, are given below:-

BHAGAI BEAT:

Masrot (10 Ha) near GHS Charda:

Total area available is about 10 Ha. South Eastern aspect, Slope medium to high. Area covered with thick bushes like Indigofera, Berberis, Rosa moschata etc. Tree species like Ban, Kainth & few Deodar etc also found in the area Deodar, Ban, Robinea & Aesculus etc. species can be tried in the area. Nearest nursery is Kund at a distance of about 3 Km.

CHANJU BEAT:

Mehlang (10 Ha) near Sumra Village:

Total area available is about 10 Ha. Souththh Eastern aspect, Slope medium to high. Area covered with thick bushes like Indigofera, Berberis, Rosa moschata etc. Tree species like Abies pindro, Picea smithiana & few Deodar etc also found in the area Deodar Robinea & Aesculus etc. species can be tried in the area. Nearest nursery is Mehla at a distance of about 3 Km.

Plantations over these 20 hectares are proposed to be completed in 2 years and maintenance is to be continued for 5 years after planting. Sequence of forests for planting in table is merely suggestive and not binding. Due to any administrative exigencies, Divisional Forest Officer, Chamba may make any adjustment in the yearly sequence. Specifications and guidelines for works will be the same as for afforestation and are appended as **Annexure-B**. A budget provision of Rs. 5.20 lacs for Enrichment plantation in Tikri Range of Chamba Forest Division has been kept as per details given in **Annexure-D.**

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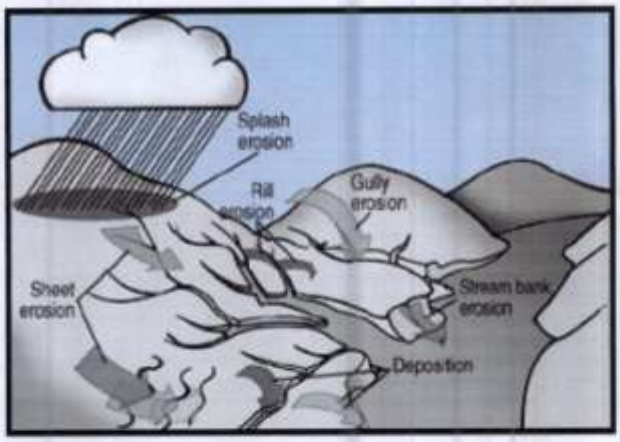
SOIL EROSION

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 (fingering 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 which 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 vegetational 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. 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.

Solid Check Dams

In bouldery nallas, 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.

A total budget provision of Rs. 89.63 lacs has been made towards these Soil Stabilization and Engineering measures. The details of different protection measures are given in **Annexure-E**.

It has been observed that the main nallahs have solid stable banks, rocky beds with lot of loose stones and boulders. The nallahs are perennial with heavy water flow. Some of the nallahs have already been taken up for treatment as such the main nallahs do not require much treatment. However side branches of these nallahs require treatment as under.

The details of various areas observed and recommended for soil & moisture conservation works is as under.

Bharadwin Nallah – Approximate length of the nallah is about 4.5 km. Length of nallah below the road side is approx.1200 RMT totally stabilized, rocky base, good vegetation, thick bushes and trees along the nallah on both sides. Nallah perennial with heavy flow of water. Trees along the nallah are Rhododendron, Ban, poplar, Neolitsea (Chirindi), Corylus (Thangi), Chandrah, etc. Bushes- Berbaries, Principia, Ariesma, Rosa moschata, Daphne, Sarcococca, Debrigaesia, Dhatura etc .Side retaining walls constructed in some portion of nallah under NAREGA. Walls at the distance of 20 mtrs from the nallah on left side. Some portion of the nala about 500Metres length at14 (N 32^0-45.874 E 076^0-16.248 hieght 2185 mtr) affected by soil erosion along the bank and needs side stabilization (Bioengineering measures are required for the protection of the nallah) Some slides in small patches found in different portions of the nala which can be treated with check walls, Cribbed structure with species like Eucalipitus, Salix & bushes like Barberries etc. Upper portion of nala rocky and narrow. The flow of water increases during the rainy season, presently almost no flow of water in this portion of nalla. Some loose boulder structures/checkdams with vegetative support can be useful.Some crate wire check walls have been

constructed on the sides under NAREGA by the Block/Panchayat near the gharat of Sh. Parza Ram s/o Dharu R/o village Banoula.

SLIDING AREA ON LEFT BANK OF CHARDA NALA:-Sliding area falls under MWS Tf 3d on the left bank of Charda nalla in Jured RF. Crate wire spurs, Protection wall and vegetative crib structure along with Bio Engineering Spps. Neolitsea (Chirindi) cuttings, Eucalyptus, Robinia, H.C.Nut etc.Willow cutting for Cribe str. Stone pitching can also be done for slide stabilization.

Kharew Nallah- It is tributary (Side branch) of Keimli nalla, total length from top of Amrotha to Bottom village Bharni Aprox. Length 6.500 Kmt. There are big exposed soil &slips spot on the right side of the nala. The nalla

passes from the area near NAG TEMPLE in village MOUHA. Crate walls (N 32^0- 46.039 E 076^0-17.651 Altitude 2344 mtr.) along the right side of nalla for the side stabilization, and Cribbed vegetative C/walls and Bio Eng. Spps.can are planted for the stabilization of the slips. Side tributary of the Keimli nalla portion near village Bharni (N 32^0-45.907 E 076^0-17.901 Altitude 2074 mtr.) at about 100 mtr. From base of the nalla requires side stabilization work like Creat C/walls, side spurs etc. and Bio Eng. Spps. Side of the nalla.

NAKOL /NAKAI NALLAH- Length of the nalla from base of Keimly nalla is about aprox.4.500 Kms. Base of the nalla is mostly rocky and bouldery almost all along its length. Nakal nalla is on the right bank of the Keimly nalla. Two side branches of the Nakal nalla on the left bank side of the nalla are at an Altitude of 2208 mtr.(N 32^0-46.477 E076^0-18.690 point between the two branches.) Approx. length of the 1st side branch of the Nakal nalla is about 1300 mtr. Most of the portion of this branch is rocky and stable. Only 200-250 mtr. Length starting from the base is affected by soil erosion/slip. This area can be treated by constructing C/walls, Cribbed vegetative C/dams and planting of bio Engineering species.

Approx. length of the 2nd side branch of the Nakal nalla is about 800 mtr. Most of the portion of this branch is also rocky and stable. Only 100 mtr. Length starting from the base is affected by soil erosion/slip and can be given same treatment as is proposed for first branch. The water flows mostly during the rainy season in these branches of Nakal nala.

KAIMLY NALLAH- The approx. length of Kaimly nalla is about 2.5 Kmtr.There is heavy flow of water through this nalla, the portion between Chhilrehi to village Salera is named as Keimly nalla. There are some slides along the left bank of the Keimly Nala which need treatment. One slide is near Juri village in the DPF Juri due to which the area is sinking The side of the nala can be stabilized by the side protection wall, spur, supported by vegetative crib structure and planting of bio engineering species on the left bank of nala .Construction of diversion channel (Approx. 1000 Rmt long) at the top in the area adjoining the private land of village Juri.

CHARDA NALA- The slide along right side of Charda nalla above the barrage side required to be treated with crib vegetative structure supported with Bio engineering species, creat wire protection check walls for side protection and loose boulder stone check walls/ check dams. The land slide is in Bhagaigarh DPF.

SAWALA NALLAH:- The length of the nallha is approximately 6-7 Km. the sides of nallah are unstable with lot of loose soil and slips. Mainly crate wire structures for side stabilization supported with vegetative measures and plantation of bio engineering species along the sides of nallah and around the nallah is required. Some crate wire check walls has been constructed by the Block Development Department under NREGA by Panchyat Pradhan Chanju. But very few structures are intact at present. Area needs treatment.There is heavy flow of water in nallah during the rainy season. Crate wire check dam, side walls are required at appropriate places and loose boulders stone, check walls are required at the narrow and dry potion of the nallah. Nallah has not been treated under any scheme by Forest Department. Area falls under MWS Tf 3k. There are heavy slides near village Cheeh below the Bhaghai Chanju road. The slope of the affected area is medium, aspect is south eastern and the area is adjoining the private land of the village Cheeh. Ban, Eucalyptus and bushes of Berberris Principea etc. are growing in the area.

PANIHARKA NALLAH: - Total length of the nalla is about 2 km. This is side branch of Chanju nalla, lower 100 mtr. are heavily affected with slips. The nalla requires treatment with check walls, gabion walls for side protection, crib structure and bio engineering species plants along the side of the nalla. Presently flow of water is very less in the nalla. Heavy flow of water during the rainy season. Upper portion of the nalla is rocky and stable. Mainly bushes and shrubs are there along the nalla in the stabilized portion.

MORA NALLAH: - The total length of the nalla is about 2.5 km. Nala is stabilized along the most of its length, rocky with bouldery, sides are almost stable with vegetation. Some small eroded patches along the nalla can be treated with planting of local species plants along the side of the nalla. The vegetation around the nalla shrubs like Kathi, Kasmal, Barbaries, Kareri etc.

GUDIARA NALLAH: - The length of the nalla is about 1 kmtr. base covered with boulder stone, sides of the nalla is unstable at some points with loose sliding soil along the nalla. Upper portion above the road almost stable. Middle and lower portion required side stabilization with crate wire check walls supported with Bio engineering species along the sides of the structure. Nalla not treated under any departmental scheme. Nalla destabilized due to construction of Bhagai-Chanju road.

MEHAD NALLAH:- Approx. length of the nalla is about 4.5 kmtr. Almost completely stabilized, densely vegetated, mostly rocky base, one or two slips near the top, cribbed structure check walls, side protection wall to be required to retain the slip as says by Forest Guard incharge Sundri beat. Nalla falls in between Jammu Kalwali RF & Topi RF of Chanju beat and Sundri beat.

SAKTOONI NALLAH:- Approx. length of the nalla is about 3.5 kmtr . Nalla falls in Sundri beat. Almost stabilized along most of its length densely vegetated, but big slip about 2 hact. at about 1000 Metres from the base of Chanju nalla on the left bank of the Chanju nalla. Cribed structures, check walls, supported with bio engineering species are required for stabilization. Vegetation around the area is Fir, Spruce, Deodar, Khirak, Ban,Badda and Chirindi etc.

BHASBHED NALLAH: - Approx. length of the nalla is about 4 kmtr. Completely stabilized, densely vegetated, rocky base needs no treatment. Most of the base of the nalla is rocky with boulders, sides are almost stable. Nalla is situated on the left bank of Chanju nalla. Nalla already treated under RVP/FPR in Tf 2b.

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BIOENGINEERING MEASURES till p. 63.

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. The total budget provision of 49.66 lacs is given in **Annexure-F.**

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.

The methods for seeding are dry-seeding and hydroseeding. The seed will be protected with straw in combination with bitumin or meshes of jute and wire on exposed areas. The stabilisation can be increased through transplanting stump sprout deciduous trees after revegetation with seeding.

Loose rock slopes can be stabilized with different types of brush layering. The applications with rooted plants are known as hedge layer. The unrooted 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.

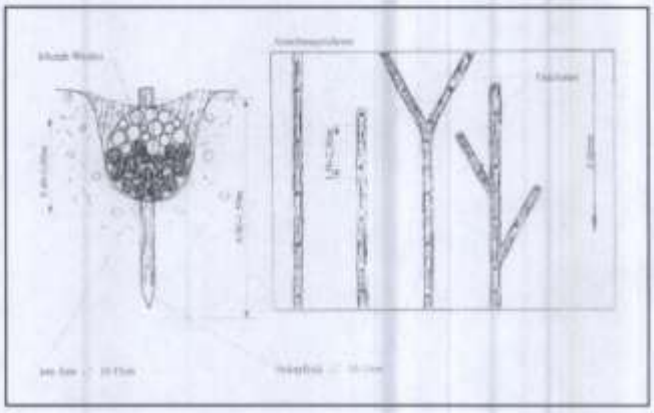
The construction is started at the toe of slope. Benches are excavated horizontally, on the contour, or slightly down the slope, if needed to aid the drainage. The surface of the bench slope should be constructed in such a manner that the outside edge is higher than the inside part. The live branch cuttings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

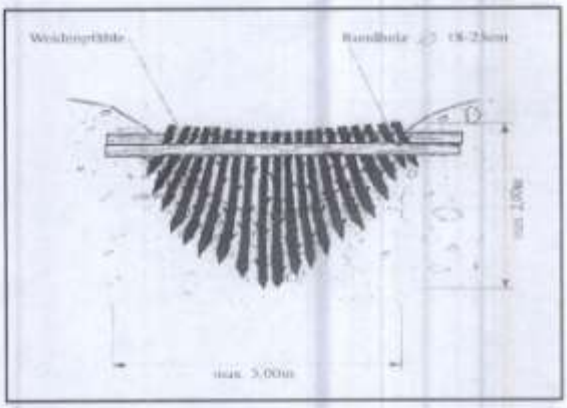
The bundles are tied together with 1.5 to 2.0 mm wire every 1 m and fixed into the ground every meter by wooden pegs or live stacks with a minimum length of about 80-100 cm. For the lower third of the fascine green branches

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 m^2 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.

FOREST PROTECTION

Construction and 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 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 of due care and should be constructed with cement mortar. A sum of Rs. 10.00 lacs is kept under this component as shown in **Annexure-G.**

Infrastructure Development

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 become outlived. These are required to be reconstructed. The existing Forest rest houses are very poorly furnished. An amount of Rs. **20 lacs** 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 makes final selection.

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. **5 lacs** 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 is as per **Annexure-H.**

Fires Watch Tower & Fire Protection

Fire is a good servant but a bad master. Man is responsible for fires in the forests. Controlled use of fire results in increase in bacterial activity with the result that nitrate production is augmented. It reduces the weed growth,

provides a clean seed bed, and makes condition suitable for natural regeneration. Fire is also used in cleaning planting site of weeds, grasses, shrubs and a felling refuse. Controlled use of fire burns most of the inflammable material and thus reduces the damage that may occur from an accidental summer fire. On the other hand uncontrolled fires cause a considerable damage to the forests. The quantum of damage done to trees by fires varies with species, age of trees and the season. In the tract dealt with, Chil forests are susceptible to fires. An enormous damage due to fire is seen in Chil crop every year especially in summer season, however, damage to deodar, Kail, Fir/Spruce, Oaks forests is rare. The worst sufferer is the young regeneration. Repeated fires destroy the regeneration completely. Even pole crop is sometimes engulfed by the flames. In case of crown fire, mature trees also dry out at a steady pace. Year after year, an uncontrolled fire burn down the organic matter and reduces the fertility of soil. Fire makes soil compact, impervious and its effect on clay is extremely bad. Besides above, fires, seriously affect productive capacity of the forests. Repeated fires degenerate a valuable forests into inferior forest. Density and increment of forest are reduced and thus affect the yield. The animal life of the forest is destroyed due to fires and therefore, natural eco balance is seriously affected.

Deodar and kail are fairly susceptible to fires; all the forests allotted to this working circle will be strictly protected from fires. Young Deodar plantations and regeneration areas require special care and complete protection from fires. Special precautions are necessary in the areas adjoining Chil Forests. To keep the fire out of these forests it is suggested that the forest floor is swept clean of the debris and other combustible material. The fire lines, inspection and bridal paths should be kept clean of needles, especially in hot weather. Adequate number of fire watchers should be appointed during the fire season. Above all, public co-operation is very necessary to keep fire out of these areas.

Fire Preventive Measures

Fires have far reaching effects on the forest. But the far reaching effecting can be both constructive and destructive. Controlled fires are of the greater use in the forestry whereas uncontrolled fires can lead to destruction of forests. Chil

is fire resistant but still needs protection in seedling stage and is destroyed by incendiary fires in hot weather. Chil trees have resin ducts and as such they catch fire easily. On the other hand deodar and still more so, blue pine, spruce and silver fir are not fire resistant and silver fir is killed merely by heat from burning pile of slash. As the proverb goes "Prevention is better than cure". It is thus of utmost significance to prevent fire accident and if it occurs-to check it from spreading. The causes of forest fires have been enumerated above and to prevent occurrence of forest fire all these causes will have to be eliminated by suitable action. A study of how fire started in each case is the key to remove or prevent ignition causes and focus attention on things that should and should not be done, particularly in case of accidental fires or those caused due to negligence's. On the other hand, the study of location and timing of the forest fires may prove useful in identifying the actual cause of fires, through the process of elimination apart from planning the prevention and extinguishing strategy. Detailed information about the causes and thorough understanding of motives behind the forest fire, provide the background for fire prevention work. There are two types of measures for risk reduction and fire prevention which are discussed below.

Fire Prevention Education

The main objective of fire prevention education is to create keen awareness in the public about damages caused by fire and the necessity of the fire prevention safe ways of performing certain operations without causing forest fires. An educated public opinion may help to create strong social pressure for need to preserve/conserve forest resources. The ways and means that can be used for fire prevention education are as under;

a. **Training** - Formal training in five prevention and control is necessary for preparing a nucleus of people for guiding fire prevention and control programmes. Short courses on fire prevention may be organized for not only the forestry personnel but also extension workers, voluntary organization, Gram panchayat members, and in schools. Such programme may be organized preferably in those areas which are subjected to fire every year.

b. **Control Burning** -Controlled use of fire has many advantages. It reduces the fire hazards resulting in diminishing the danger of fire especially in summer, special measures of fire protection in the Chil forests.

c. **Control Burning of Areas Under Regeneration** - All regeneration areas must be isolated by fire traces until they are sufficiently advanced to be fired departmentally. Interior fire lines must be cleared of grass in order to enable fires to be localized. The chill seedling develops bark by the time it is one to one and half meter in heights which enables it to resist the effect of a slow fire during the winter. The foundations of fires protection are laid with the first seeding fallings which must extend evenly over the whole compartment under regeneration, apart from compact groups of poles which are left intact.

d. **Fire Watchers** - Sufficient number of fire watchers must be engaged for chil area in fire season. They should be provided a set of instructions for keeping fire lines, paths, and roads clear of inflammable material and watching the forests from strategic points and informing promptly the concerned forest guards and others.

e. **Organization For Fighting Fire** - During the fire season and particularly where the season has been very dry, the forest should be frequently patrolled by the whole of the forest staff; occasionally the night patrolling should also be organized and everyone found moving in the forest should be questioned. Every Forest Guard should look in his beat as his own property and should be considered personally responsible for its safety. Frequent visit to forests should be made by the Range Officers, Divisional Forest Officers and occasional visits by the Conservator of Forests during the fire season.

When a fire is observed, Forest Guards and Fire Watchers at 'lookout' points should at once send a message to the Forest Range and the nearest officer. They should immediately inform the President and members of the local panchayat as well as the staff and institution stationed near the vicinity to lend necessary help in the fire fighting operation. The senior officer present will immediately take command of the operation. He should know the local

geography. Should a fire get beyond control, it is necessary to localize it by counter-firing or back firing. Counter firing should only be done under orders of the senior officer in-charge of operation and should only be attempted from a definite line such as road path or ridge or a fire line. A line is formed along a ridge by clearing the soil covering and cutting bushes from which a fire is started so as to consume the fuel in advance of the oncoming forest fire.

Successful counter firing calls for the highest degree of fire behavior knowledge and accurate appraisal of fuel and burning conditions. The fire and its potential must be considered as a whole. Counter firing also requires a high degree of skill, timing and coordination in its execution. Inaptly applied, it may be disastrous and serve only to spread fire, discourage and demoralize the staff and in general makes a bad situation worse. After fire has been brought under control, a patrol is to be kept on duty until all danger of the fire spreading has been removed.

Fire Fighting Equipments

Shovel,	Fire Raker	Brush Hook
Double bit axe	McLeod	Fire Tender
Fire resistance clothings.		Wireless sets.

Besides above, the arrangement for transport, food, and water are essential.

Fuel Wood for Project Labour and Administrative Staff

Administrative staff with a proposed strength of about 72 is adequately paid and is accepted to purchase kerosene and cooking gas which is readily available from existing outlets at Bhajhraru and Chamba

During the construction of the project, it is estimated that a peak labour force of 350 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. During the 42 months of planned period of construction, the labour force will be increased / decreased as under: -

This is to be provided by the project. What do.

Period	Labour Force
1 Year	300
II Year	350
III Year	250
Last 6 months	150

What fire wood provision will the project make?

Though adequate steps are taken to see that the contractor's labour force is provided proper fuel to cook food and meet other household requirements. However, in this temperate zone area the labour force even then may indulgent to use of fuel wood due to its easy availability.

Fuel wood is very scarce and promotes pollution. Kerosene oil is easily available or even can be available as the area is well connected. Moreover, it has been experienced that laboures find it more expedient to use kerosene oil for household cooking. Fuel wood takes longer time to produce energy, is wasteful and pollutant, therefore, it is proposed to encourage the labour to utilize only 25% of the fuel wood requirement and meet the balance of energy requirements from use of kerosene oil and use stoves and pressure cookers for cooking. It is proposed to provide firewood/kerosene from depots t these workers so that no pressure is generated on local forests. In fact trees falling within various components of the project to be transferred with land User Agency are mainly of fuel wood species and could also be used to supplement fuel wood requirements of labour. There will be no deficiency of kerosene oil.

Impact on Socio-Economic Environment

This construction phase will last for about 3 to 5 years. The peak labour force and technical staff required is estimated at about 450. The total number of persons inhabiting the area including the service population will be about 1,300. The adverse impacts on ecosystem due to such a congregation during the construction phase have been detailed in the respective sections dealing with various disciplines of the environment. The construction phase of any project is rather an unsettled stage characterized by uncertainties and often disorders. The basic problem relates to management of large population, which migr+95ate to the construction area in search of jobs. Those who would migrate to this area are likely to come from various parts of the country mainly having different cultural, ethnic and social background. Such a

mixture of population has its own advantages and disadvantages. The advantages include exchange of ideas and cultures between various groups of people that would not have been possible otherwise. Due to longer residence of this population in one place, a new culture, having distinct socio-economic similarity would develop which will have its own entity.

The benefits however, are always not a certainty and depend on several factors. Often they are directly related to the way construction phase is handled by the project authorities and their sensitivity to various socio-economic problems that could develop during this phase.

The availability of infrastructure is generally a problem during the initial construction phase. Though the construction workers can be subsidized for certain facilities like health, education, etc., the facilities of desired quality are often not made available in the initial stages. The adequacy of water supply, sewage treatment, housing, etc. should therefore, be ensure before and adequate measures would be taken at the very start of the project.

A budget provision for infrastructure development is as under:

Sr. No	Particulars	Amount (Rs. In Lacs)
1	Buildings	20.00
2	Roads, Paths & Bridges	5.00
3	Fire Watch Towers & Fire Protection	12.00
4	Fire Fighting Equipments	10.00
5	Fuel Wood for Project Labour & Administrative Staff	8.00
	Total	**55.00**

OPERATIONAL SUPPORT

For an efficient management of forest resources, it is essential that operational support to the Forest Department is adequately developed. Similarly, in remote localities of the division there are no places for shelter for the staff, people and trekkers. Therefore, following provisions be made under the CAT Plan. A budget provision of Rs. 63 lacs has been kept. Component of proposals are given as below:

Sr. No.	Description	Amount (Rs. in Lacs)
1.	Field Vehicle / Inspection vehicles which includes Scorpio, Ambassador, Pickup, Motorcycles.	26,00,000/-
2.	Computers with Printer and Fax machine, Photocopy Machine, Scanner etc.	5,00,000/-
3.	GPS	2,00,000/-
4.	Misc. Office Furniture Almirahs, File Racks etc.	5,00,000/-
5.	R&M of vehicles and machinery for 5 years @ Rs. 5.00 lacs per year.	25,00,000/-
	TOTAL	**63,00,000/-**

Sr. No. 1 to 5 to be provided in kind by the User Agency.

ENERGY SAVING DEVICES

Conserving energy is otherwise also our collective responsibility for a better tomorrow. Government of India is committed to meet the growing energy needs at affordable rates required to meet the objectives of economic development. To deliver a sustained economic growth rate of 8% to 9% through 2031-32 and to meet life time energy needs of all citizens, India need to increase its primary energy supply by 3 to 4 times and electricity generation capacity about 6 times. As a result energy service demand growth rates will keep on increasing because of accelerated industrialization, urbanization, and an emerging consumer society.

Because of government encouragement in the form of subsidies and tax incentives, energy conservation efforts are also being increasingly viewed as a major function of the energy industry, as saving an amount of energy has almost identical economic benefits to generating that same amount of energy. This is compounded by the fact that the economics of delivering energy tend to be priced for capacity as opposed to average usage.

Fuel wood is very scarce and results in pollution. Though adequate steps are taken to see that the contractor's labour force is provided proper fuel to cook food and meet other household requirements. However, in this temperate zone area the labour force even then may indulge in to use of fuel wood due to its easy availability.

Fuel wood takes longer time to produce energy, is wasteful and pollutant. Therefore, on one hand labour can be encouraged to utilize kerosene instead of fuel wood by giving them subsidy on kerosene on the other hand other energy saving devices can be introduced to them to reduce the load on fuel wood hence the forests.

In fact trees falling within various components of the project to be transferred with land user agency are mainly of fuel wood species and could also be used to supplement fuel wood requirements of labour.

To reduce the load on fuel wood due to increased activity in the area it is proposed to provide other energy saving devices worth **Rs 15 lac** to the affected people in the area so that least pressure is generated on local forests. The detailed proposal is given in **Annexure-I.**

Heating our home with an active solar energy system can significantly reduce our fuel bills in the winter. A solar heating system will also reduce the amount of air pollution and greenhouse gases that result from your use of fossil fuels such as oil, propane, and natural gas for heating or that may be used to generate the electricity that you use.

The new technology pressure cookers can significantly cut the energy used for cooking. Modern pressure cookers save you money, help cut pollution and fight climate change. The new safe pressure cookers also save water. The efficient pressure cooker cooks food so quickly, your stove will be on less and generating heat for less time. Using a modern pressure cooker can reduce a stove's energy consumption by 70%. Pressure-cooking is the easiest and fastest green cooking method.

ECO-FORCE/ECO-BATALION

The concept of Eco-Task Force (ETF) scheme was initiated by the Ministry of Defense in 1980 with a view to involve ex-service men in afforestation and eco-development schemes in far flung and difficult places to under take restoration of degraded eco-systems through afforestation, soil conservation and water resource management techniques. Under the scheme the establishment and operational expenditure on Eco-Task Force or Eco-Battalion raised by the Ministry of Defence is reimbursed by Ministry while the input such as sapling, fencing etc. as also the professional and managerial guidance is provided by the concerned State Forest Departments.

ECO TASK FORCE

In order to step up the pace of expenditure on implementation of CAT Plans as well as to augment the HPFD's limited capacity to execute the approved CAT Plans, farming out of CAT Plan works to Eco Battalion/Eco Task Force is a very effective option, considering their capacity to work in difficult areas all year round and healthy survival of the plantations done by them in the past.

The state of Himachal Pradesh has also raised 133 Infantry Battalion TA (Ecological) in March 2006 with sole purpose of generation of employment opportunity for ex-servicemen of the state through afforestation and soil conservation works.

Ecological Task Forces are created to execute specific ecology related projects (afforestation & soil conservation works) in hard, rugged terrain, with a Military like work culture and commitment, with technical inputs from the Forest Department. Officers & JCOs are taken from Regular Army & Territorial Army; other ranks are recruited from ex-servicemen from the near-by areas where the unit is located. Each ETF may be composed of one or more companies depending upon the needs and scope of work.

Responsibilities of Forest Department:

- Provide land, material (fencing, seed/saplings, manure etc. including transportation)
- Establishment charges, Accommodation, water, electricity, telephone connections, other administration requirements (Bear all expenses)
- Technical advice

Responsibility of Eco-Task Force:

- Provide manpower for works (such as for planting, transportation of saplings, watering of plants, soil conservation works etc.)
- Execute all works in areas handed over to the ETF including maintenance for three years.
- Watch and ward of the plantation area.
- Organize mass awareness programmes.

Therefore, with a view to pool in resources to support ETF, a provision of Biological and Engineering measures amounting to Rs. 22 Lacs is being made on this account in the CAT Plan.

JOINT FOREST MANAGEMENT

In the process of resource management, the concept of Joint Forest Management is an intervention to evolve organized and collective thinking on the issues of forest management where all the ingredients of a sound management system i.e. scientific, professional options, social and anthropological dimensions and economic principles are synergized for drawing maximum benefits for the society keeping the sustenance of the resources in mind. It must be remembered that the sources to be managed are limited and claim over the resources are varied, no single solution or a particular practice of this management or control can satisfy the needs of all. The philosophy for JFM in essence aims at involving the people in resource generation activities through motivation, active involvement in the process of management and sharing of benefits through adequate institutional arrangements. JFM initiatives have many of the following characteristics in common:-

i) the formation of a local community based institutional to participate with the forest department in forest management decision making;
ii) rules and regulations about responsibilities and sharing decision making;
iii) involvement of NGOS particularly in documentation, training, research and community level organizing and facilitation;
iv) reorientation and training of forest department staff and locals communities;
v) the joint preparation of microplans for forest management which often form the basis of formal agreements between the forest department and the local institution;
vi) The formation of state level working groups to co-ordinate their Joint Forest Management.

Joint Forest Management in India is a concept in its infancy which is continuously evolving bases on local experience. No two states have identical forms of JFM but the collective experience of these differences is enriching the concepts in all the states. In recognition of the importance of the concept and the value of this learning process a prominent NGO the Society for the

Promotion of Water land Development has recently established a JFM network to facilitate the exchange of this experience.

Objectives of Joint Forest Management

The basic objects of Joint Forest Management are given below

1. To evolve consensus on the basic issues to conservation of soil, water and forest resources.

2. To provided an effective and immediate treatment for barren, wastelands, or degraded protected forests situated near village through protection, afforestation, pasture development, soil conservation by active participation of local people.

3. To maintain the environmental stability through preservation and wherever necessary, restoration of the ecological balance that has been adversely destroyed by depletion of the forests through involvement of local people in resource management.

4. To augment fuel wood, fodder and small timber production for use by local people.

5. To convert a hostile population living in the fringes of forests areas into friends and ultimately into resource managers and resource users.

Joint Forest Management in Himachal Pradesh

Vide H.P.Govt. Order No. Forest (C) 3-4/80-V dated 12.05.93 it was decided by the Govt. to constitute Village Forest Development Committee for JFM in the villages of Himachal Pradesh for Planning, Protection, Afforestation and judicious use for Eco. Development of the areas situated near the villages so as to arrest their further afforestation degradation and to augment fuel wood, fodder and small timber production of use by local people through their active participation.

Procedure for constitution of Forest Development Committee as per above mentioned order is laid down as under:-

1. Name of Committee: Village Forest Development Committee (V.F.D.C.)

2. Definition: A Village Forest Development Committee is a registered, non political body representing all families of a Tikka/Village.

3. Area Selection: There shall be only one Village Forest Development Committee (VFDC) in each Tikka/Village.

4. Constitution: One adult male and female member of each family will be enrolled as a member of the General House of VFDC of the village. President Mahila Mandal, President Yuvak Mandal, Members of Panchayat representing Tikka/Village will be nominated as members of the General House of the VFDC by DFO concerned.

5. Executive Body: The Executive Body will have 9 to 12 members including nominated ones. It will have President, Vice-President, Treasurer etc. who will be elected by the Executive Body itself. Two auditors will be elected in the General House.

A uniform representation shall be given to each group of 10-20 families and the executive body will have minimum 5 members from the Tikka/Village out of which 50% will be women.

Forest Guard will be ex-officio Member-Secretary of the Executive Body. One member of Gram Panchayat, one member from Antyodaya family, one woman either from Mahila Mandal or otherwise will also be nominated members of the Body.

6. Meetings: There will be two meetings of the General House and four of the Executive body in a year. DFO will convene the meeting with the President of the Executive Body of VFDC and the Range Officer concerned twice in a year to review the progress of the work. Quorum will be 50% for these meetings.

7. Registration of Committee: VFDC will formally be registered by the territorial Divisional Forest Officer.

8. Management Plan: The Ranger Officer concerned will prepare Joint Forest Management Plan with the help of Executive Body which will be discussed with General House of VFDC and finally approved by the DFO.

9. Duties of VFDC: To persuade the villagers to give the available areas for plantation. To assist the Forest Department in Planning, Protection, Afforestation, Judicious use of all existing rights and equitable sharing of usufructs and eco-development of the area as per approved Management Plan.

10. Responsibilities: It will be the responsibility of the Committee (1) to just and fair distribution of the usufructs derived and (2) to ensure the management as per prescribed norm, (3) settlement of disputes between villages, (4) honor all the commitments.

11. Powers of the Committee: Committee will make its own bye-laws with the concurrence of concerned DFO. The committee can recommend punishment to the offenders including cancellation of membership and forfeit their share in usufructs to the concerned DFO.

12. Duties & Responsibilities of Forest Department

-To explain Joint Management Plan to the villagers.
-To recognize the VFDC in letter and spirit and give weightage to its recommendations.
-To provide technical know-how, administrative and managerial skills, in order to assist the Executive Body to carry out the responsibilities.

13. Power of the Forest Department: Membership of any individual from the General House/Executive Body can be dissolved by the General House in consultation with the DFO, DFO can dissolve the Executive Body and in case it fails to fulfil its duties and responsibilities.

14. Dispute Arbitration, Termination of Agreement: Appeal of the aggrieved/Executive Body will lie with the Conservator of Forests who will communicate his decision within a month's time and will be final.

15. Usufructs Sharing: The entire quantity of usufructs will be distributed to the villagers under the supervision of Forest Guard (Member Secretary) 25% of the net sale proceeds of final harvests will be given to the VFDC out of the plantations/coppice to raised and kept in a common fund of the committee known as Village Development Fund which can be utilized of village development works with the approval of General house and in consultation with the concerned DFO. The exercise of other rights viz. timber, fuel wood etc. will be exercisable as per provisions of settlements.

Role of Women IN JFM

Women in general and those of rural areas in particulars play an important role in maintaining the family and thereby improving the village economy. It is often said that if a women is developed, the entire family is developed, because it is only women who is most intimately connected with the basic needs. Thus, the woman as a mother in the household assumes the role of efficient manager and undertakes various functions for the welfare of the family.

The entire village abutting the forests actually depends on the forests for the daily based needs in the form of small timber, fuel, fodder, green leaf manure etc., unlike the women in urban areas; the rural women are solely dependent on the forests for their fuel needs to a very large extent. It is the woman who collects fuel wood and dried sticks for cooking purposes from the forest. Many women also bring fuel wood from forests for their sustenance through wage earning as they do not have any other alternative sources of employment. The rural women take care of cattle grazing in the forests. In many parts of the country women collect potable water from perennial jungle streams passing through the forests.

The women's attitude towards forests has been changing conservation strategies at the National and State Level. In the Himalayan region, rural men are very much interested in raising pine trees so as to get quick money at the time of harvests. On the other hand, the women are interested in raising broad leaved trees like Quercus incana; Olea cuspidate, Acer species, Alnust nitida, Grewia oppositifolia, Pistacia integerrima, Albizzia stipuplata etc which improves the diversity and result in perennial flow of water in mountain streams in the region and the woman have succeeded in this sphere of activity.

In short, women can play a dominant role in the implementation of J.F.M. because of their intimate association with forests. They depend on forest for various livelihood security services, they must get equal representation in the Village Forest Councils and have a choice in the decision making viz. In the selection of species and other silvicultural measures for upgrading the degraded forests vegetative cover and bio-diversity.

Scope of Joint Forest Management in Catchment Area

Large chunks of Demarcated Protected Forests and Un-demarcated Protected Forests are blank near the habitations. They support generally inferior and bushy type of vegetation. Pasture lands are deteriorating speedily due to excessive grazing. Local people are mostly interested in raising Banoak, Kahu, Siris, Dhaman and other broad leaved to fulfill their requirements for

fuel wood, small timber and fodder. In higher altitude, people are also accustomed to collect and sell non timber forest produce to middle traders to earn their livelihood. The concept of JFM would play an important role in protection, conservation of forests, thereby improving the economic conditions of local people. Forests in the tract dealt with occur between the elevations 680 M to 4882 M. They stretch from the banks of Ravi River to the top of lofty mountains. They are found in all type of slopes, aspects, and are rich in flora and fauna. There is a great diversity in the vegetation of the tract starting from river in species like Dalbergia sissoo, Mallotus philippinesis and ending with Abies pindrow, Juniperus macropoda and alpine pastures. The most important conifers are Deodar, Kail, Spruce, Fir and Chil and amongst broad leaved are Quercus species, Alnus nitidia, Aesculus, Celtis australis, Acer species, Corylus colurna, Juglans regia, olea cuspidate, Pistacia integerrima, Populas ciliate, Rhododendron arboretum, Fraxinus floribunda etc. The tract has a variety of valuable medicinal herbs like Patis, Chora, Kaur, Bankakri, Kuth, Gucchie, Veleriana species (Smak), Banafsha, Dhool etc.

Implementation of J.F.M.

The concepts of J.F.M., can be implemented in the tract for afforestation, soil conservation works, pasture improvement and for raising N.T.F.P. It is discussed as under: -

a. Afforestation

There is a good scope of involving the people living on the outer periphery of blank, degraded forests, to carry out the massive afforestation, supplemented soil conservation thereby improving their economic conditions. While carrying out afforestation works, due care be given to improve the low-lying pasture areas, also choice of species is left to village councils.

b. Non Timber Forest Produce

The value of non timber forest produce cannot be under-rated since they constitute an important raw material for the various industries which are the

focal points of economic development in the state. The importance of non timber forest produce is to be adjusted not only by the money they fetch but also by the source they render to the society at large. The Ayurvedic and Unani System of medicines more or less fall both on these products. People living in interiors largely depend on collect of N.T.F.P. to earn their livelihood. They usually collect the various medicinal herbs and sell it to middle man who further sells in the market. The various Non Timber Forest Products that are found or can be introduced in the tract, their method of cultivation, Collection. Harvesting and marketing etc. need to be discussed. Joint Forest Management can play a dominant in enriching the forests with this nature heritage and at the same time to improve the economy of local people. The choice of species to be raised is left to Village Forest Council.

Assessment of Positive Impacts

General

The positive impacts that are anticipated from the completion of this project are in the sphere of electricity generation, recreation, job creation and other socio-economical benefits.

Power Generation

Additional generation of 36 MW of electric energy to local grid will increase the scope of industrial development in the areas based on wool and medicinal herbs.

Socio-Economic Benefits

- For transport of machinery road will be widened. This will facilitate faster speed and easy negotiability on these mountain roads.
- Tele-communications will improve.
- Due to concentration of labour and administrative staff of the project, local small time shopkeepers will have scope for accelerating their turn over.

- Easy availability of electric power will facilitate establishment of small scale industries based on wool, fruits and medicinal herbs.
- Educational and health facilities are likely to develop further.
- Implementation of catchment areas treatment measures which from the essential part of the project will:
  (i) Reduce erosion and increase fertility of land.
  (ii) Improve forest resources as also of medicinal plants.
  (iii) Increase job availability and additional labour employment.

A budget provision of Rs. 10 lacs has been kept. Component of proposals are given in **Annexure-J.**

FORESTRY RESEARCH

The mainstay of the hydro-electric projects is continuous supply of silt free water. It calls for management of the catchment in a way that enhances the water percolation and reduces run off. The catchment of Chanju project has been subject to disturbance on account of removal of biomass for firewood, use of slopes for grazing of livestock, bringing the slopes under plough for agriculture, and for construction of roads and paths, etc. These processes have caused change in the ecological regime and landscape structure in the valley. Even though this plan provides for addressing the immediate needs for rehabilitation of Chanju catchment through afforestation, rehabilitation of degraded areas, stabilization of road sides & land slides, etc. there is a need to undertake focused research, studies in respect of:

- Floristic composition of various micro habitats.
- Ecological studies, especially in erosion prone areas & selection of species for stabilization efforts.
- Social structure and likely pressures on the forestry resources in the valley.
- Standardization of nursery techniques of species for soil stabilization.

The research wing of the HPFD will be responsible for carrying out these studies. A provision of **Rs. 8.00 lacs** has been made in the plan for forestry research pertaining to this catchment. The areas for undertaking research trials will be short listed & selected on the basis of results of research studies.

DEVELOPMENT OF CHANJU VALLEY AS ECO-TOURISM

Introduction

Ecotourism has come to be regarded as a type of responsible tourism where tourists, as individuals or in small groups, venture into lesser known destinations to enjoy the nature in its pristine form along with gaining understanding of local cultures and customs in such a way as to cause minimum impact on the nature and the local culture. Since ecotourism entails understanding of local culture, it involves local communities living in their usual lifestyles and provides them a livelihood option. Subscription to ecotourism does not envisage large scale investments on the part of local communities and it remains a low cost low impact operation. As ecotourism is essentially based on Nature and managed by the local communities, it provides an incentive to the local communities to protect and sustainably manage the landscape.

Himachal Pradesh, a paradise of scenic beauty with very hospitable local communities, forms an ideal ecotourism destination. As the word is spreading, more and more eco-tourists are thronging the State to enjoy Himalayan landscape and the variety of local cuisine and folk dances. The Government of Himachal Pradesh, realizing the potential of ecotourism in the State, has already enunciated a Policy on Development of Eco-tourism in Himachal Pradesh (2005), wherein blueprint for development of ecotourism in the State has been provided.

Ecotourism Potential in Chanju Valley

Chanju valley, lying in the lap of Pir Panjal mountain range, has an excellent potential from ecotourism point of view. The seemingly narrow valley at the point of entry suddenly opens up beyond the confluence of Chanju and Bhararu khads to offer a panoramic view of the vast tracts of lush green Oak and Conifer forests and snow clad alpine slopes. One also stands a good chance of sightings of rare temperate Himalayan wild animals in this valley.

For the trekkers, the area offers challenging treks over high altitude passes to mystic Pangi Valley. Khundi Marali, a lake located at about 3600 m msl in

the upper Chanju catchment along Tangar nala, attracts a number of pilgrims every year and forms the site of an annual fair. Similarly, the upper Bhararu catchment, along Malen ka Gharat khad, offers a view of more than 100 m high waterfalls.

The valley located in the interior Chamba district, still has many a remote villages that are not connected with road or other means of communication. As such the people have only limited livelihood options, the major vocation being farming and livestock rearing. The general lifestyle of the local people still remains traditional, that suits the needs of ecotourism. The houses are still constructed in the typical pahari style, the cuisine remains traditional and the people enjoy their folk dances. Promotion of ecotourism in this area would provide the local communities with an additional livelihood option as hosts, guides, porters, cooks, etc., besides strengthening their bond with Nature.

Strategy for Developing Ecotourism in Chanju Valley

Development of Infrastructure: The upper Chanju valley has an old Forest Rest House that can be repaired and developed as a base station for promoting ecotourism in the area. This Forest Rest House is strategically located on the

In the first two years of the project a study would be commissioned to assess the ET potential & Requirements of the area & to suggest a modus operandi for undertaking ET here. Thereafter the earmarked funds of Rs 7.50 L

Khundi Marali lake route, the eco-circuit that could be developed and promoted during phase-1 of this ecotourism development plan. This eco-circuit has been identified as it is widely known in the area as a pilgrimage site and is visited by a large number of local people every year. The area is moderate on gradient and services of local guides are available.

There is also a good possibility of developing and promoting *home-stays* near habitations, where enterprising host families can accommodate tourists on payment basis. Some initial professional and financial support to enterprising local people will be provided to help kick start the activity.

The area also holds good promise of developing *camping facilities* at interior locations. Strategically located sites will be identified for the purpose and camping facilities developed in association with enterprising local people.

Capacity Building of Local Entrepreneurs: Ecotourism is an activity where the local people have to deal with eco-tourists coming from different parts of the world. It is, therefore, imperative that the local people are trained in the globally appreciated basic minimum courtesies and cleanliness regimes. It is envisaged to build capacity of the selected local entrepreneurs in managing

eco-tourists in collaboration with professional agencies. Some local CSO will be identified to steer the program till it establishes.

Liaison and Advertisement: The most difficult part in developing and sustaining ecotourism is advertisement of new ecotourism destinations and establishing linkages with local communities. Under this plan, the local communities will be assisted in developing an ecotourism website to be managed by local youth. The communities will also be assisted in establishing liaison with HP Tourism Development Corporation and other mainline tourism agencies for including Chanju ecotourism circuit in their brochures. Appropriate literature on the highlights of ecotourism circuit will be developed in the form of brochures to be given to eco-tourists for their guidance and non-formal advertisement.

Budgetary Provisions: A Lump Sum provision of **Rs. 7.50 Lacs** (Rupees Seven Lac Fifty Thousand only) has been made under this plan towards promotion of ecotourism in the Chanju valley CAT Plan area. Plan of proposed activities and cost estimates are given here under

Plan and Cost Estimates

S. No.	Activity	Budget Provision (Rs. in Lacs)	Scheduling of Activities			
			1st Year	2nd Year	3rd Year	4th Year
1	Repair of Gwari-Kaunda FRH as base station for developing ecotourism in the area	1.50				
2	Incentive towards developing 5 local houses for home stays as demonstration	1.50				
3	Developing two camping sites – one each in Chanju and Bhararu catchments.	1.50				
4	Capacity building of local people as hosts, guides, porters and cooks.	1.50				
5	Development of Chanju Valley Eco-circuit Web Site	1.00				
6	Development and preparation of ecotourism brochures	0.50				
	Total:	**7.50**				

ECO-SERVICES

Introduction

In the past two hundred years, economic growth fueled by industrialization has vastly increased the standard of living in industrialized nations and has contributed significantly to improved health status. But at the same time, the combination of economic growth and population growth has resulted in a dramatic increase in the consumption of natural resources, the production of wastes, and the pollution of the environment. In 1998 the World watch Institute reported that globally between 1950 and 1997 lumber use tripled, paper use increased six fold, fish catch increased nearly fivefold, grain consumption almost tripled, and fossil fuel consumption almost quadrupled. The scale of this impact is so large that human consumption is beginning to affect the global climate, global ecosystems, global resources, and the web of life itself. These constitute a global life-support system; in effect, they provide free "eco-services" to humankind.

The massive impact on the natural environment of the urban and industrialized way of life has been graphically described by Mathis Wackernagel and William Rees (1996) as the "ecological footprint." The concept is a simple one, although complex in its implementation. An attempt is made to calculate the area of biologically productive space required per person in order to maintain the person's current lifestyle through the "provision" of resources and eco-services. This requires calculating such issues as how much land is required for food production, housing, transportation, consumer goods, and services. Land categories that are included in the calculation include forest, pasture, arable land, sea space, fossil-energy land, and built-up land. However, the largest single component of the ecological footprint (roughly half) is attributable to energy consumption.

The ecological footprint can be calculated for individual households; for facilities such as hospitals, schools or businesses; for infrastructure projects such as highways, bridges or dams; for particular products (e.g., hothouse tomatoes); and for communities, for nations, and at a global level. The

impacts of different lifestyles and economic choices can be apparent. For example:

Ecosystem services

Type of ecosystem service

Humankind benefits from a multitude of resources and processes that are supplied by natural ecosystems. Collectively, these benefits are known as **ecosystem services** and include products like clean drinking water and processes such as the decomposition of wastes. While scientists and environmentalists have discussed ecosystem services for decades, these services were popularized and their definitions formalized by the United Nations 2004 Millennium Ecosystem Assessment (MA), a four-year study involving more than 1,300 scientists worldwide. This grouped ecosystem services into four broad categories: *provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits.

As human population grow, so do the resource demands imposed on ecosystems and the impacts of our global footprint. Natural resources are not invulnerable and infinitely available. The environmental impacts of

anthropogenic actions, which are processes or materials derived from human activities, are becoming more apparent – air and water quality are increasingly compromised, oceans are being over-fished, pests and diseases are extending beyond their historical boundaries, deforestation is eliminating flood control around human settlements. It has been reported that approximately 40-50% of Earth's ice-free land surface has been heavily transformed or degraded by anthropogenic activities, 66% of marine fisheries are either overexploited or at their limit, atmospheric CO_2 has increased more than 30% since the advent of industrialization, and nearly 25% of Earth's bird species have gone extinct in the last two thousand years. Consequently, society is coming to realize that ecosystem services are not only threatened and limited, but that the pressure to evaluate trade-offs between immediate and long-term human needs is urgent. To help inform decision-makers, economic value is increasingly associated with many ecosystem services and often based on the cost of replacement with anthropogenically-driven alternatives. The on-going challenge of prescribing economic value to nature, such as through processes like biodiversity banking, is prompting trans-disciplinary shifts in how we recognize and manage the environment, social responsibility, business opportunities, and our future as a species.

Brief History

The simple notion of human dependence on Earth's ecosystems probably reaches to the start of our species' existence, when we benefited from the products of nature to nourish our bodies and for shelter from harsh climates. Recognition of how ecosystems could provide more complex services to mankind date back to at least Plato (c. 400 BC) who understood that deforestation could lead to soil erosion and the drying of springs. However, modern ideas of ecosystem services probably began with Marsh in 1864 when he challenged the idea that Earth's natural resources are not infinite by pointing out changes in soil fertility in the Mediterranean. Unfortunately, his observations and cautions passed largely unnoticed at the time and it was not until the late 1940s that society's attention was again brought to the matter. During this era, three key authors – Osborn, Vogt, and Leopold– awakened and promoted recognition of human dependence on the environment with the idea of 'natural capital'. In 1956, Sears drew attention to the critical role of the ecosystem in processing wastes and recycling nutrients. An environmental

science textbook called attention to "the most subtle and dangerous threat to man's existence… the potential destruction, by man's own activities, of those ecological systems upon which the very existence of the human species depends". The term 'environmental services' was finally introduced in a report of the *Study of Critical Environmental Problems*, which listed services including insect pollination, fisheries, climate regulation and flood control. In following years, variations of the term were used, but eventually 'ecosystem services' became the standard in scientific literature.

Modern expansions of the ecosystem services concept include socio-economic and conservation objectives, which are discussed below. For a more complete history of the concepts and terminology of ecosystem services, see Daily (1997).

Ecology

Understanding of ecosystem services requires a strong foundation in ecology, which describes the underlying principles and interactions of organisms and the environment. Since the scales at which these entities interact can vary from microbes to landscapes, milliseconds to millions of years, one of the greatest remaining challenges is the descriptive characterization of energy and material flow between them. For example, the area of a forest floor, the detritus upon it, the microorganisms in the soil and characteristics of the soil itself will all contribute to the abilities of that forest for providing ecosystem services like carbon sequestration, water purification, and erosion prevention to other areas within the watershed. Note that it is often possible for multiple services to be bundled together and when benefits of targeted objectives are secured, there may also be ancillary benefits – the same forest may provide habitat for other organisms as well as human recreation, which are also ecosystem services.

The complexity of Earth's ecosystems poses a challenge for scientists as they try to understand how relationships are interwoven among organisms, processes and their surroundings. As it relates to human ecology, a suggested research agenda for the study of ecosystem services includes the following steps:

1. Identification of *ecosystem service providers* (*ESPs*) – species or populations that provide specific ecosystem services – and characterization of their functional roles and relationships;
2. Determination of community structure aspects that influence how ESPs function in their natural landscape, such as compensatory responses that stabilize function and non-random extinction sequences which can erode it;
3. Assessment of key environmental (abiotic) factors influencing the provision of services;
4. Measurement of the spatial and temporal scales ESPs and their services operate on.

Recently, a technique has been developed to improve and standardize the evaluation of ESP functionality by quantifying the relative importance of different species in terms of their efficiency and abundance. Such parameters provide indications of how species respond to changes in the environment (i.e. predators, resource availability, and climate) and are useful for identifying species that are disproportionately important at providing ecosystem services. However, a critical drawback is that the technique does not account for the effects of interactions, which are often both complex and fundamental in maintaining an ecosystem and can involve species that are not readily detected as a priority. Even so, estimating the functional structure of an ecosystem and combining it with information about individual species traits can help us understand the resilience of an ecosystem amidst environmental change.

Many ecologists also believe that the provision of ecosystem services can be stabilized with biodiversity. Increasing biodiversity also benefits the variety of ecosystem services available to society. Understanding the relationship between biodiversity and an ecosystem's stability is essential to the management of natural resources and their services.

The Redundancy Hypothesis

The concept of ecological redundancy is sometimes referred to as *functional compensation* and assumes that more than one species performs a given role within an ecosystem. More specifically, it is characterized by a particular

species increasing its efficiency at providing a service when conditions are stressed in order to maintain aggregate stability in the ecosystem. However, such increased dependence on a compensating species places additional stress on the ecosystem and often enhances its susceptibility to subsequent disturbance. The redundancy hypothesis can be summarized as "species redundancy enhances ecosystem resilience".

The Rivet Hypothesis

Another idea uses the analogy of rivets in an airplane wing to compare the exponential effect the loss of each species will have on the function of an ecosystem; this is sometimes referred to as *rivet popping*. If only one species disappears, the efficiency of the ecosystem as a whole is relatively small; however if several species are lost, the system essentially collapses as an airplane wing would, were it to lose too many rivets. The hypothesis assumes that species are relatively specialized in their roles and that their ability to compensate for one another is less than in the redundancy hypothesis. As a result, the loss of any species is critical to the performance of the ecosystem. The key difference is the rate at which the loss of species affects total ecosystem function.

The Portfolio Effect

A third explanation, known as the *portfolio effect*, compares biodiversity to stock holdings, where diversification minimizes the volatility of the investment, or in this case, the risk in stability of ecosystem services. This is related to the idea of *response diversity* where a suite of species will exhibit differential responses to a given environmental perturbation and therefore when considered together, they create a stabilizing function that preserves the integrity of a service.

Several experiments have tested these hypotheses in both the field and the lab. In ECOTRON, a laboratory in the UK where many of the biotic and abiotic factors of nature can be simulated, studies have focused on the effects of earthworms and symbiotic bacteria on plant roots. These laboratory experiments seem to favor the rivet hypothesis. However, a study on

grasslands at Cedar Creek Reserve in Minnesota seems to support the redundancy hypothesis, as have many other field studies.

Economics

Further information: environmental economics, ecological economics, environmental ethics, deep ecology

There is extensive disagreement regarding the environmental and economic values of ecosystem services. Some people may be unaware of the environment in general and humanity's interrelatedness with the natural environment, which may cause misconceptions. Although environmental awareness is rapidly improving in our contemporary world, ecosystem capital and its flow are still poorly understood, threats continue to impose, and we suffer from the so-called 'tragedy of the commons'. Many efforts to inform decision-makers of current versus future costs and benefits now involve organizing and translating scientific knowledge to economics, which articulate the consequences of our choices in comparable units of impact on human well-being. An especially challenging aspect of this process is that interpreting ecological information collected from one spatial-temporal scale does not necessarily mean it can be applied at another; understanding the dynamics of ecological processes relative to ecosystem services is essential in aiding economic decisions.[27] Weighting factors such as a service's irreplaceability or bundled services can also allocate economic value such that goal attainment becomes more efficient. Wetlands can be used to assimilate wastes.

The economic valuation of ecosystem services also involves social communication and information, areas that remain particularly challenging and are the focus of many researchers. In general, the idea is that although individuals make decisions for any variety of reasons, trends reveal the aggregative preferences of a society, from which the economic value of services can be inferred and assigned. The six major methods for valuing ecosystem services in monetary terms are:

Avoided cost

Services allow society to avoid costs that would have been incurred in the absence of those services (e.g. waste treatment by wetland habitats avoids health costs)

Replacement cost

Services could be replaced with man-made systems (e.g. restoration of the Catskill Watershed cost less than the construction of a water purification plant)

Factor income

Services provide for the enhancement of incomes (e.g. improved water quality increases the commercial take of a fishery and improves the income of fishers)

Travel cost

Service demand may require travel, whose costs can reflect the implied value of the service (e.g. value of ecotourism experience is at least what a visitor is willing to pay to get there)

77.

Hedonic pricing

Service demand may be reflected in the prices people will pay for associated goods (e.g. coastal housing prices exceed that of inland homes)

Contingent valuation

Service demand may be elicited by posing hypothetical scenarios that involve some valuation of alternatives (e.g. visitors willing to pay for increased access to national parks)

Management and Policy

Although monetary pricing continues with respect to the valuation of ecosystem services, the challenges in policy implementation and management are significant and multitudinous. The administration of common pool resources is a subject of extensive academic pursuit. From defining the problems to finding solutions that can be applied in practical and sustainable ways, there is much to overcome. Considering options must balance present and future human needs, and decision-makers must frequently work from valid but incomplete information. Existing legal policies are often considered insufficient since they typically pertain to human health-based standards that are mismatched with necessary means to protect ecosystem health and services. To improve the information available, one suggestion has involved the implementation of an *Ecosystem Services Framework* (ESF), which integrates the biophysical and socio-economic dimensions of protecting the environment and is designed to guide institutions through multidisciplinary information and jargon, helping to direct strategic choices.

Novel and expedient methods are needed to deal with managing Earth's ecosystem services. Local to regional collective management efforts might be considered appropriate for services like crop pollination or resources like water. Another approach that has become increasingly popular over the last decade is the marketing of ecosystem services protection. Payment and trading of services is an emerging world-wide small-scale solution where one can acquire credits for activities such as sponsoring the protection of carbon sequestration sources or the restoration of ecosystem service providers. In some cases, banks for handling such credits have been established and

conservation companies have even gone public on stock exchanges, defining an evermore parallel link with economic endeavors and opportunities for tying into social perceptions. However, concerns for such global transactions include inconsistent compensation for services or resources sacrificed elsewhere and misconceived warrants for irresponsible use. Another approach has been focused on protecting ecosystem service 'hotspots'. Recognition that the conservation of many ecosystem services aligns with more traditional conservation goals (i.e. biodiversity) has led to the suggested merging of objectives for maximizing their mutual success. This may be particularly strategic when employing networks that permit the flow of services across landscapes, and might also facilitate securing the financial means to protect services through a diversification of investors.

Ecosystem services and business

Ecosystem services degradation can pose a number of risks to corporate performance as well as provide business opportunities through ecosystem restoration and enhancement. Risks and opportunities include:

Operational

Risks such as higher costs for freshwater due to scarcity or lower output for hydroelectric facilities due to siltation

Opportunities such as increasing water-use efficiency or building an on-site wetland to circumvent the need for new water treatment infrastructure

Regulatory and legal

Risks such as new fines, government regulations, or lawsuits from local communities that lose ecosystem services due to corporate activities

Opportunities such as engaging governments to develop policies and incentives to protect or restore ecosystems that provide services a company needs

Reputational

Risks such as retail companies being targeted by nongovernmental organization campaigns for purchasing wood or paper from sensitive forests

Opportunities such as implementing and communicating sustainable purchasing, operating, or investment practices in order to differentiate corporate brands

Market and product

Risks such as customers switching to other suppliers that offer products with lower ecosystem impacts or governments implementing new sustainable procurement policies

Opportunities such as launching new products and services that reduce customer impacts on ecosystems or participating in emerging markets for carbon sequestration and watershed protection other products

Financing

Risks such as banks implementing more rigorous lending requirements for corporate loans.

Opportunities such as banks offering more favorable loan terms or investors taking positions in companies supplying products and services that improve resource use efficiency or restore degraded ecosystems

PRESENTATION OF THE IDEA AND THE CONTENT OF THE PROJECT

Objectives

To equip the families in the 5 villages with knowledge and technology that will make it possible for them to decide on steps to:

1. Make the families and the village self sustaining in regards to production of food, fertilizer, pesticides and energy,
2. Improve income by upgrading the traditional farming methods and by identifying and starting new farming and non-farming activities,
3. Make the households and the village a clean and healthy place to live,
4. Improve the environment by planting trees and protective fences and by limiting CO2 emission.

5. Introduce 'payment for services' in order to change a situation of demands for hand-outs to a situation of informed investment, and to make the project self sustainable over a period of 3 years.

The Project

The project will be run in following villages i.e. Tikrigarh, Jajoth, Dhalhajan, Katwad, Bhaghaigarh, Ghaiya, Charda, Jakhala, Mandola, Dehra, Dantuin, Sundary & Bhangor in Churah Tehsil, Chamba District (Himachal Pradesh). The idea is to consolidate and build on the relationship with the known villages and implement the described activities in all five villages.

The project will be working with Farmers Clubs, Women's Self Help Groups, Youth Clubs, Children's Clubs and Village Development Committees to take charge of developing their village in cooperation with nature and become independent of world market turbulence by using locally available products.

The project will revolve around the Eco Service Center. The Eco Service Center will work on two lines.

- It will provide agricultural and horticulture services to the community in order for the local farmers to get assistance to establish new ways of producing and to use new water saving, energy saving and environmental friendly technologies.

- It will investigate, test and demonstrate new low cost technologies. Examples of all the models / products we are promoting in the project will be at display at the center.

The community based groups and individual farmers will learn and use environmental friendly farming technologies, methods for conservation of water, water saving irrigation techniques and methods for recharging the water level in wells and aquifers. In this way income can be generated from increased production and quality produce. Garden farming will be introduced to secure healthy food for own consumption. And a healthy environment will be build up for the families and the villages.

The project will be working in close cooperation with Training Center for Global Development. The Development Instructors under training will participate in actions in the villages and they will learn to use and promote the technologies available at the Eco Service Center.

ECO-SERVICES SETUP

Terracing of Agri fields

The present practice of agriculture is to fill the fields along the slope. This practice results in loss of fertile soil and adds to soil erosion. Terracing of slopes with filling across the slopes or along the contours is a much better practice to conserve water and soil. The local people will be motivated & supported to adopt this better practice.

Pole Model Rope Pump

The pole model Rope pump will be provided to villager for use of Drip irrigation. It will involve building of water tanks connected with the pole model Rope pump and the Drip Irrigation system, so that the water we can use for the Drip Irrigation to irrigate fields.

Soil Testing All Component Support- Better quality, fewer cattle stuff feeding

The company proposes soil testing from the farmers' fields which will be tested in the reputed labs like Nouni University Solan, as to guide the farmers' suitability of crops that can be produced in their fields.

Centrally Sponsored Schemes in Animal Sector in Himachal Pradesh

To provide 100% coverage of Artificial Insemination to breedable cattle & buffaloes of the State and to provide door step delivery of Artificial Insemination services at farmer's premises.

Back Yard Poultry Development Scheme:

The Animal Husbandry Department has introduced Backyard Poultry Scheme under the Centrally Sponsored Scheme "Assistance to the State Poultry farms" which is a 80:20 scheme. The state share is in kind i.e. land,

infrastructure, staff, etc. Since the medium and the large poultry farms have come up of late in the state due to the efforts of the department whereby training and other help in the form of project reports and opening of the units under subsidy have been provided to the poultry farmers.

Integrated Wool Improvement Programme:

This Project has been sponsored by Central Wool Development Board Jodhpur for the period of 4 years on the 100% Central Assistance pattern. This project is being implemented in District Chamba, Kangra & Kullu. Rupees 1.25 Crores as first year installment have been received by Wool Federation and are being spent on following activities:

- Breed improvement.
- Health Care.
- Training camps for sheep breeders.
- Assistance for marketing and product development of wool.

DIVERSIFICATION IN AGRICULTURE

Agriculture is the backbone of Himachal economy. Efforts are on to diversify agricultural activities in the rural areas to increase production and productivity through improvement of inputs, transfer of appropriate technology and managerial practices. Considering the dimension of the unemployment situation in the state, particularly in the rural areas, diversification of economic activities for self-employment in rural areas has become very important Implements.

The hilly and mountainous state of Himachal Pradesh is known for its natural wealth, forest, meadows, rivers and valleys endowed with rich cultural and religious heritage. This wealth can be utilized for the benefit of the poor people, provided a scientific and technological route is taken for its conservation and judicious utilization and development.

The state has primarily an agrarian economy. The agriculture sector contributes more than half of the Gross Domestic Product. Wheat, paddy and maize are the important cereal crops, whereas potato, peas, hops are the cash crops. Horticulture has come up as an important sector in the land use

planning in the state. Animal Husbandry is one of the oldest professions of the local people.

Orchard Horticulture Support- Apple, Floriculture etc.

The company proposes to distribute good quality of apple plants. The company will provide them special training regarding plantation of apple trees and how to look after them. A team will be selected for special training at Nouni University Solan (HP).

CULTIVATION OF MEDICINAL PLANTS, AROMATIC PLANTS, FLOWERS AND ORCHIDS

Medicinal Plants

The flora of Himachal Pradesh consists of around 3300 species of plants. Of these, about 150 species (including a few introduced onto the region) are attributed with medicinal value. The number of plants of confirmed medicinal value is about 100. About 35 plants products of medicinal value are regularly supplied by the State. Most commonly exploited herbs are: Dioscorea deltoides (rhizomes), Angelica glauca (roots), Berberis Spp. (root and bark), Embilica officinalis (fruit), Cinnamomum tamala (leaf), Picrorhiza kurrooa (root), Viola serpens (flowers), Terminalia chebula (fruit), Terminalia belerica (fruit), Valeriana jatamansi (roots), Heracleum candicans (root), Artemisia maritime (herb), Ephedra (stems), Podophyllum emodi (root) etc.

Flowers and Orchids

This activity has been identified as a major thrust area by the Government of India. With the internal as well as export market for cut flowers and floriculture products like dried flower arrangement, bulbs and seeds continuing to grow a sizeable section of market remains untapped. Globally the size of the industry is estimated to be around Rs. 75000/- crores. In the industry has begun to be organized only in the last couple of years and is today classified as a sunrise industry. A number of trail blazing ventures have been up in the private sector. Since the industry is labor intensive it provides great scope of tiding over of the problem of the rural unemployment or underemployment, besides ensuring higher rates of returns to the cultivating farmers.

IBM

Eco-San Toilet

The company proposes to construct Eco-San toilets in the Eco Service Center. The people from the community will be explained about the benefits of using Eco-San.

STEPS TO BE TAKEN

1. Catch up on missing activities
2. Start Farmer Field School
3. Sanitation campaign
4. Promote Energy Efficient Stove
5. Start Spirulina production
6. Make a model Desalination system
7. Waste water Management
8. Providing Apple & Other Plants.

PLAN FOR ECO-SERVICES:

1. One monthly meeting with each farmer's club of 15
2. One common meeting for all the clubs every month
3. One monthly action in each school
4. Formation of Village Development Committees
5. One monthly meeting with each committee of 15
6. Run Farmer Field School, 1 weekly meeting over 12 weeks
7. Develop the programs to be used for the clubs with 12 meeting plans for each type of club
8. Monthly display of new products, information and entertainment on 'Open Sunday' at the Eco Service Center .
9. Film about products or best practices from the villages
10. Start up of income generating services:
    - Sale of activated EM
    - Sale of Drip irrigation
11. Train Development Instructors in use of all features

A budget provision of **Rs. 73.80** has been kept.

IMPROVEMENT AND DEVELOPMENT OF WILDLIFE & WILDLIFE HABITATS

Introduction

The Chanju valley, located in the Pir Panjal range forming boundary between Chamba sub-division and Pangi sub-division with altitude varying from 1190m above msl near power house to 5685m above msl at the highest point (see project area map at Map-1), falls in the North-West Himalaya (2A) Biotic Province of the Bio-geographic zone 'Himalaya'. The wide altitudinal range in the valley supports vegetation varying from sub-tropical to alpine type and is believed to form good habitat for a number of typically temperate animal species so characteristic to this biotic province.

No systematic survey in respect of the fauna of the area has ever been carried out and as such no check-list of the fauna of the area is available. During the process of preparing this CAT Plan, a rapid survey of the project area was, therefore, carried out to record the presence of wild animal species. Some of the mammal species recorded during the survey based on direct sightings are: *Hylopetes petaurista* (Flying Fox), *Mustela sibirica* (Himalayan Weasel), *Rhesus macaque* (Monkey), *Vulpes vulpes* (Indian Red Fox), *Semnopithecus entellus* (Langur), Bats, *Mos homourus* (Hill Mouse), Himalayan yellow throated Marten, and Jackals. However, indirect evidences and secondary information gathered during the survey suggest the presence of Common Leopard, Asiatic Black Bear, Indian Wild Boar, Common Langur, Leopard Cat, Porcupine, Barking Deer and Goral amongst other common mammals; and possibility of the presence of Serrow, Musk Deer and Himalayan Brown Bear amongst mammal species of conservation concern towards higher reaches.

In as far as birds are concerned, a total of 44 species of birds were recorded during the survey from the project area. Some of the common bird species recorded during the survey are: Common Crow, Hill Myna, Blue Rock Pigeon, Ring Dove, Slaty Headed Parakeet, Blue Throated Barbet, Kashmir Pied Woodpecker, Black Drongo, Western Yellow billed Blue Magpie, Scarlet Minivet, White cheeked Bulbul, Black Bulbul, Streaked Laughing Thrush, Leaf Warbler, Pied Bush Chat, Green Bee-eater, Kashmir Grey Tit

and Cinnamon Tree sparrows. In addition, occasional sighting of the Long-tailed Eastern Grey Wagtail, Blue Rock Thrush and Alpine Swift were also made. The Plumbeous Redstart, the Whistling Thrush, and the Brown Dipper formed the group of birds having strong association with riparian areas. Amongst the birds of prey, species like Bearded Vulture, Central Asian Hobby and Shahi Falcon were frequently encountered. The area also supports good population of Himalayan Griffon Vulture. Secondary information gathered from the local people also suggests the presence of the Western Tragopan and the Himalayan Monal, pheasant species of conservation concern, towards higher reaches in the valley.

In addition 3 species of reptiles, 3 species of amphibians and 49 species of butterflies were also recorded from the area during the survey. The Chanju Valley, in its entirety, is therefore quite rich in its faunal wealth. However, the area of influence due to the project is limited up to an altitude of 2200m amsl and supports fauna that is usually come across at the Himalayan foothills. No animal or bird species of conservation concern are found in this area of influence of the project.

The Chanju valley **does not** form part of the Protected Area Network in the State as no Wildlife Sanctuary, National Park or Conservation Reserve is located within or adjoining this valley. There is, however, a network of Protected Areas covering similar type of habitats outside the Chanju valley.

The figure below depicts the location of such Protected Areas in Chamba district.

The Chanju valley, especially the area taken up under this CAT Plan, has never been a subject of focused wildlife management. As such specific problems associated with wildlife of the area have also not been documented. This CAT Plan, therefore, provides a unique opportunity to document the wildlife of the area and initiate programs for management of wildlife habitats.

The Himalayan region is witnessing a very high and increasing biotic pressure causing degradation and fragmentation of its fragile habitats and putting the survival of many a plant and animal species under threat. Whereas much of

this biotic pressure is on account of increased incidence of grazing, both local and migratory, fuel and fodder removals, and extraction of herbs; developmental projects like construction of roads, hydroelectric projects and transmission lines are also making significant contribution to this habitat degradation.

General Concerns about Wildlife Conservation

Whereas the lower Chanju valley has sizeable population of domestic cattle grazing on the lower slopes all the year round, the upper Chanju valley supports vast alpine meadows that attract thousands of migratory livestock every year during summers. This domestic livestock provides stiff competition to the wild species of the Himalayan animals, especially in the already overgrazed alpine meadows. The presence of livestock in the meadows also drives away the shy wild animals from their natural habitats. Similarly, the fragmentation of the habitats due to developmental ventures, especially creation of water reservoirs, interferes with the free movement of wild animals restricting them to certain pockets affecting their genetic pool.

The developmental projects also bring in an influx of outside labour that is generally not concerned about the local environmental customs and traditions, causing damage to the local ecology through various acts of omission and commission including removal of biomass from forests and poaching. The wild animals become especially susceptible to poaching during winters when water sources tend to freeze at upper reaches and they descend to lower slopes in search of water and food.

The areas hitherto inaccessible used to provide safe havens to a variety of temperate Himalayan fauna. However, as more and more remote areas are getting connected with road network, even the remote habitats are coming under increased activity, causing threat to the populations of usually shy temperate Himalayan fauna. The area proposed to be brought under the present CAT Plan has also come under the road program and a road is under construction to upper Chanju valley through Bhararu nala, cutting across steep rocky slopes. It would need creating general awareness about conservation imperatives to ensure the long-term survival of Himalayan wildlife.

Aims and Objectives of Wildlife Improvement-cum-Development Plan

The long-term aim of the wildlife management in the Chanju Valley is (i) sustainable management of prime wildlife habitats in the valley, (ii) improving the degraded habitats, and (iii) creating social awareness and systems to support wildlife management in the area. As no previous data related to wildlife of the area and its status is available, the present plan primarily envisages gathering baseline data for the entire catchment so that focused wildlife management programs could be taken up under CAT Plans of the other Hydro-electric Projects proposed in the Chanju upstream.

Specific objectives of the Plan are as under:

- To undertake detailed wildlife survey of the valley through Wildlife Institute of India to document diversity and status of wildlife species and to identify critical wildlife habitats in the area.

- To document traditional and present relationship/ customs/ conflicts of the local communities with wildlife of the area and develop mitigation strategies.
- To prepare comprehensive management plan in respect of wildlife species of conservation concern and their habitats.
- To undertake habitat improvement in degraded areas in upper Chanju valley through -
  - soil stabilization works in erosion prone areas by constructing bio-engineering/ engineering structures, and
  - plantations of tree/ shrub species of fruit/ fodder value in degraded areas.
- To initiate community awareness-cum-education programs towards need and community's role in biodiversity conservation.

These objectives are in addition to the general CAT Plan strategies aimed at minimizing the dependence of local people on the natural biomass resources for firewood through subsidizing LPG and kerosene.

A Lump Sum provision of Rs 87.08 lacs has been made for implementation of this Wildlife improvement-cum-development plan.

Strategies for Implementation of the Plan

The following strategies are proposed to achieve objectives of the wildlife improvement-cum-development plan in the Chanju HEP catchment.

(a) Protection of Forest and Wildlife: A provision for formation of a street theatre of the local community may be very effective for the protection of Wildlife and Forests. Several bands of ten to twelve village youth each may go performing about Wildlife and Forest conservation (with local nature based songs and natty of the local performance (including traveling and boarding, lodging) will be about Rs. 3000 per performances. In a day two performances may be given by one band. A sum of 30.00 lacs (for Five years) may be provided for above three to five such band. A dress, musical instruments and workshops for their training, etc. will also be part of this arrangement.

Unique 11

(b) Wildlife Surveys and Research: The Wildlife research may be encouraged by engaging three to five researchers and making a provision of a Research Station. The researchers may work on surveys and natural history of endangered animals such as Brown Bear, and Musk Deer. The Wildlife research organizations located at Dehradun, Delhi, and Mysore may be invited to undertake such work. A sum of Rs. ~~22~~ 30 lacs may be used for this purpose.

(c) Unique Wildlife Habitats: The area seems to have a lot of Unique Wildlife habitats such as gorges and hidden valleys which are home to many such species which may be new to the science (such as amphibians like salamanders, etc). There is a need to identify such unique habitats and protect them from blasting, degradation, etc. The mapping of such critical and unique area need to be done. A sum of Rs. 10 lacs may be kept for surveying and mapping.

(d) Linking Community Development with Wildlife Conservation: The community living in the villages in the project area need to be made part of the Wildlife management effort. The micro-credits schemes in the area may be an effective tool to do so. Emphasis may be given on proper micro-planning and suitable measures of organic farming, education of girl child, Training of teachers in the schools, use of LPG in place of fuel wood, vermicompost, etc. There may be a need for capacity building of staff and community for this purpose. A sum of Rs. 25.08 lacs will be spent for this purpose.

(c) Operationalising Herd Insurance scheme against depredation by carnivores on line of one developed for Kibber WLS. ₹ 20/-

MONITORING AND EVALUATION

Monitoring and evaluation will be developed as in-built part of the project management. Thus, a process of self-evaluation at specified intervals of time will ensure the field worthiness and efficacy of the CAT Plan.

A sum of Rs. 36.90 lacs has been provided for monitoring and evaluation. Under this component, independent consultants or third party evaluation will be done similar to DFID/Kandi projects to make Base Line Survey, Mid-term Survey and end of project survey/evaluation to find out effectiveness of CAT Plan activities in the catchment area. Silt load and run off rate could also be monitored at strategic points through Silt Observation Posts.

More Elaborate as discussed /

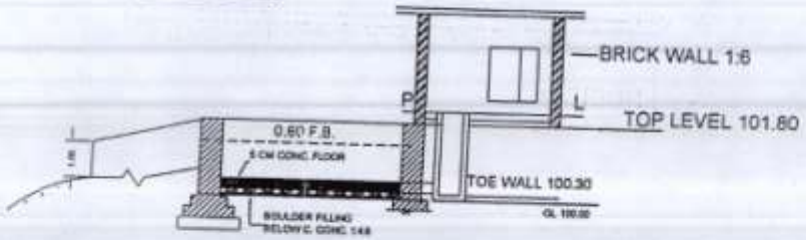
Annexure-A

Name of Work: Construction of Silt Observatory Post

Sr. No.	Particulars	Amount
1	Labour Charges	250,000.00
2	Material Cost	262,000.00
3	Cost of Carriage	185,000.00
4	S.O.P. Equipments i/c installation	500,000.00
	Total	**1,197,000.00**
	Say	**1,200,000.00**

SILT OBSERVATORY POST

PLAN



X- SECTION

ALL DIMENSIONS ARE IN MTRS
WHICHEVER NOT MENTIONED

NOT TO SCALE

Annexure-B

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS-AFFORESTATION SCHEME

Sr. No.	Description	Remarks
1.	Area in Hectare	40.00 Ha
2.	Executing Agency	Forest Department
3.	Distance from adjacent Forest	The afforestation shall be carried out in DPF itself.
4.	Name of Division	Chamba Forest Division
5.	Name of Range	Tikri Range
6.	Block	Chanju
7.	Beat	**Bhagaigarh Beat, Chanju Beat.**
8.	Legal Status	1. Bhagai DPF: 10 Ha, 2. Bhagai DPF: 5, 3. Prabha DPF: 5 Ha, 4. Sheru Dhar DPF: 10 Ha, 5. Mandola DPF: 5 Ha, 6. Shuklu DPF: 5 Ha. **Total: 40 Ha.**
9.	Average Elevation	1000 m above msl.
10.	Species to be planted	Ban / Broad Leaved Plants
11.	Estimated Cost of Afforestation including maintenance.	Rs. 27 lacs
12.	Number of years for which maintenance of afforestation provided.	Five Year

Energy Plantation (50 Ha)

(1) Bhangori DPF 10
(2) Mandola DPF = 10
(3) Shesu DPF = 10
(4) Mahunsar = 10
(5) Mashrot = 10

50

PER HECTARE COST NORM FOR MODEL PLANTATION
1500 PLANT PER HECTARE WITH R.C.C. FENCE POSTS

Sr. No	Particulars of Work	Quantity	Rate per Ha / Per Hundred	Amount
1	Survey and demarcation of plantation area.	1 Ha	67.33	67.33
2	Preparation of Wooden fence posts.	60 Nos.	863.35	518.10
3	Carriage of Wooden fence posts upto 2 mtr. Long over distance 2 Km.	60 Nos.	453.67	272.67
4	Charring and Coal tarring of the ends of Fence posts.	60 Nos.	186.33	111.79
5	Preparation / digging of holes 20-30 cm dia & 50 cm deep.	60 Nos.	604.51	362.71
6	Fixing of Wooden fence posts including strutting.	60 Nos.	477.34	286.40
7	Carriage of Barbed wire over distance 2 Km.	0.90 Qtl.	54.50 Qtl/Km	98.10
8	Streching & fixing of barbed wire in 4 stands.	720 Rmt	3.16 P. Rmt	2,275.20
9	Preparation of inspection path 60 cm width.	250 Rmt	7.24 P. Rmt	1,810.00
10	Preparation of water relention mounts /trenches.	L.S.		2,000.00
11	Inter long of throny bushes along the fence.	180 Rmt	2.74 Rmt	493.00
	TOTAL FENCING COST:			**8,295.30**
	PLANTING:			
1	Digging of pits 45x45x45 cm	600 Nos.	636.28	3,817.68
2	Digging of pits 30x30x30 cm	900 Nos.	318.22	2,863.96
3	Filling in pits 45x45x45 cm	600 Nos.	182.32	1,093.86
4	Filling in pits 30x30x30 cm	900 Nos.	127.225	1,144.98
5	Carriage of plants root plant over distance 2 Km up hills.	600 Nos.	23.49/Km	281.88
6	Carriage of plants in P/bags over distance 2 Km uphills.	900 Nos.	145.49	2,617.02
7	Planning of entire plant raised in P/bag.	900 Nos.	145.39	1,309.41

8	Planting of naked roots plants.	600 Nos.	122.66	735.96
9	Planting of grass tuts / preparation of slips including showing in strips 100 x 30 x 5 cm for grass showing along contour.	500 Strip	613.33	3,066.65
	TOTAL PLANTING COST:			**16,931.40**
	MATERIAL:			
1	Cost of barbed wire	0.90 Qtl.	7000 P Qtl	6,300.00
	NURSERY COST OF PLANTS			
1	Naked for plants	600 Nos.	6 P. Plant	3,600.00
2	Bags plant	900 Nos.	8 P. Plant	7,200.00

TOTAL COST OF PLANTS: **17,100.00**

GRAND TOTAL: **42,326.70**

Or Say Rs.: **42,500.00**

Maintenance Cost

1st Year Maintenance -30%

Mortality

S. No	Particulars of work	Quantity	Rate per Ha / Per Hundred	Amount (Rs.)
1	Re-digging of pits 45x45x45 cm.	180 Nos.	318.22	572.80
2	Re-digging of pits 30x30x30 cm.	270 Nos.	159.07	429.49
3	Filling of Pits 15x45x45 cms.	180 Nos.	182.31	328.16
4	Filling of Pits 30x30x30 cm	270 Nos.	127.22	343.49
5	Planting of P. Bag plants	270 Nos.	145.49	392.82
6	Planting of naked root plants	180 Nos.	122.66	220.79
7	Planting of grass tufs/preparation strips i/c sowing in strips 100x30x5 cms for grass sowing	200 Strips	613.13	1226.26
8	Carriage P bags plants distance 2 km uphill	270 Nos.	145.39	392.55
9	Carriage of naked roots plants over distance 2 km. uphill	180 Nos.	23.49	42.28
10	Nursery cost of plants	375 Nos.	8 to 6 per plant	3240.00
11	Repair of Fence	180 rmt	1.16 /rmt	208.80
12	repair of Inspection Path	L.S.		700.00
13	Moisture conservation works	L.S.		1000.00
			Total	**9097.44**

Or Say Rs. **9100.00**

Maintenance Cost

2nd Year Maintenance -20%

Mortality

S. No	Particulars of work	Quantity	Rate per Ha / Per Hundred	Amount (Rs)
1	Re-digging of pits 45x45x45 cm.	120 Nos.	318.22	381.86
2	Re-digging of pits 30x30x30 cm.	180 Nos.	159.07	286.32
3	Filling of Pits 15x45x45 cms.	120 Nos.	182.31	160.43
4	Filling of Pits 30x30x30 cm	180 Nos.	127.22	167.93
5	Planting of P. Bag plants	192 Nos.	145.49	279.34
6	Planting of naked root plants	108 Nos.	122.66	132.47
7	Carriage P bags plants distance 2 km uphill	192 Nos.	145.39	556.80
8	Carriage of naked roots plants over distance 2 km. uphill	108 Nos.	23.49	50.74
9	Nursery cost of plants	300 Nos.	8 to 6 per plant	2184.00
10	Repair of Fence	180 rmt.	1.16/ rmt	208.80
11	repair of Inspection Path	L.S.		500.00
12	Moisture conservation works	L.S.		800.00
			Total	**5708.69**

Or Say Rs. **5700.00**

Maintenance Cost

3rd Year Maintenance -10%

Mortality

S. No	Particulars of work	Quantity	Rate per Ha / Per Hundred	Amount (Rs)
1	Re-digging of pits 45x45x45 cm.	60 Nos.	318.22	190.93
2	Re-digging of pits 30x30x30 cm.	90 Nos.	159.07	143.16
3	Filling of Pits 15x45x45 cms.	60 Nos.	182.31	109.39
4	Filling of Pits 30x30x30 cm	90 Nos.	127.22	114.50
5	Planting of P. Bag plants	90 Nos.	145.49	130.94
6	Planting of naked root plants	60 Nos.	122.66	73.60
7	Carriage P bags plants distance 2 km uphill	90 Nos.	145.39	261.70
8	Carriage of naked roots plants over distance 2 km. uphill	60 Nos.	23.49	28.18
9	Nursery cost of plants	150 Nos	8 to 6 per plant	1080.00
10	Repair of Fence	200 rmt	1.16/rmt	232.00
11	Repair of Inspection Path	L.S.		400.00
12	Moisture conservation works	L.S.		800.00
			Total	**3564.40**

Or Say Rs. **3600.00**

Maintenance Cost

4th Year Maintenance -10%

Mortality

S. No	Particulars of work	Quantity	Rate per Ha / Per Hundred	Amount (Rs)
1	Re-digging of pits 45x45x45 cm.	60 Nos.	318.22	190.93
2	Re-digging of pits 30x30x30 cm.	90 Nos.	159.07	143.16
3	Filling of Pits 15x45x45 cms.	60 Nos.	182.31	109.39
4	Filling of Pits 30x30x30 cm	90 Nos.	127.22	114.50
5	Planting of P. Bag plants	90 Nos.	145.49	130.94
6	Planting of naked root plants	60 Nos.	122.66	73.60
7	Carriage P bags plants distance 2 km uphill	90 Nos.	145.39	261.70
8	Carriage of naked roots plants over distance 2 km. uphill	60 Nos.	23.49	28.18
9	Nursery cost of plants	150 Nos.	8 to 6 per plant	1080.00
10	Repair of Fence	200 rmt	1.16/rmt	232.00
11	Repair of Inspection Path	L.S.		300.00
12	Moisture conservation works	L.S.		700.00
			Total	**3364.40**

Or Say Rs. **3400.00**

Maintenance Cost
5th Year Maintenance -10%
Mortality

S. No	Particulars of work	Quantity	Rate per Ha / Per Hundred	Amount (Rs)
1	Re-digging of pits 45x45x45 cm.	60 Nos.	318.22	190.93
2	Re-digging of pits 30x30x30 cm.	90 Nos.	159.07	143.16
3	Filling of Pits 15x45x45 cms.	60 Nos.	182.31	109.39
4	Filling of Pits 30x30x30 cm	90 Nos.	127.22	114.50
5	Planting of P. Bag plants	90 Nos.	145.49	130.94
6	Planting of naked root plants	60 Nos.	122.66	73.60
7	Carriage P bags plants distance 2 km uphill	90 Nos.	145.39	261.70
8	Carriage of naked roots plants over distance 2 km. uphill	60 Nos.	234.90	28.18
9	Nursery cost of plants	150 Nos.	8 to 6 per plant	1080.00
10	Repair of Fence	200 rmt	1.16/ rmt	232.00
11	Repair of Inspection Path	L.S.		300.00
12	Moisture conservation works	L.S.		500.00
			Total	**3164.40**
			Or Say Rs.	**3200.00**

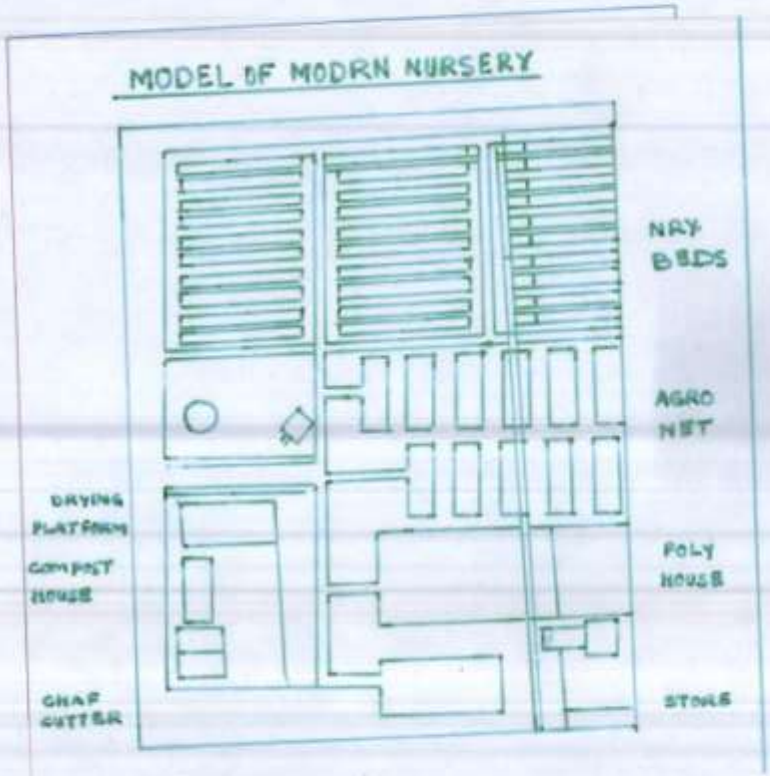
ABSTRACT

New Plantation	Rs.	42,500.00
1st Year Maintenance	Rs.	9,100.00
2nd Year Maintenance	Rs.	5,700.00
3rd Year Maintenance	Rs.	3,600.00
4th Year Maintenance	Rs.	3,400.00
5th Year Maintenance	Rs.	3,200.00
GRAND TOTAL:		**67,500.00**

MODERN NURSERY

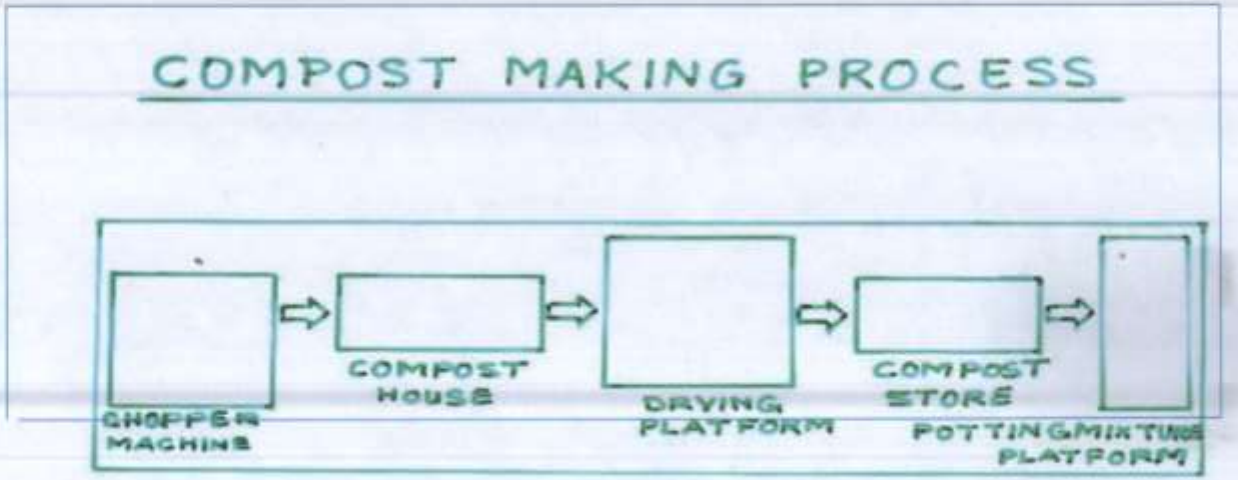
IT HAS FOLLOWING COMPONENTS:-

- 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



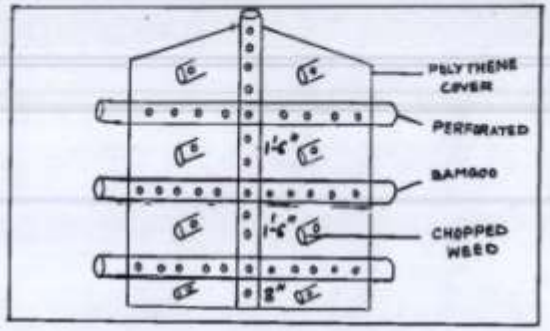
IN THE INITIAL STAGE OF PLANT LIFE, PARTICULARLY IN NURSERY STAGE, PROPER MEDIA AND NUTRITION ARE VERY IMPROTANT FACTORS WHICH DETERMINE THE FUTURE GROWTH OF PLANTS. THE COMPOST IS LIGHT, FRIABLE AND RICH IN NUTRIENTS TO SUPPORT THE YOUNG SEEDLINGS WHICH CAN BE PREPARED FROM CHOPPED WEEDS OR STRAW OR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

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

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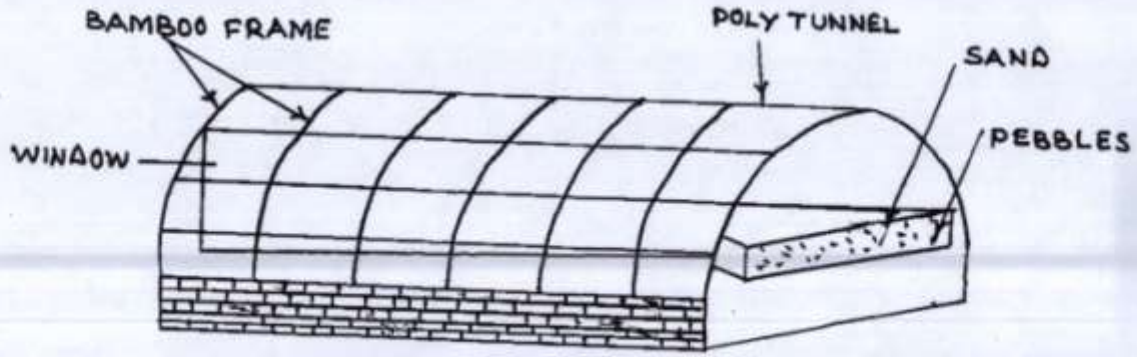


GERMINATION CHAMBER

Dr. Suresh Kumar, IFS
CF, Chamba.

Platform for drying

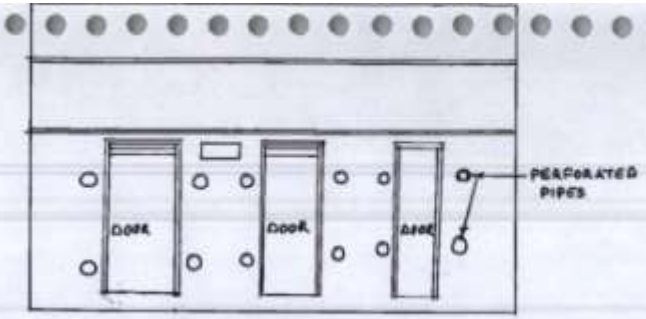
Cemented platform of 10 feet to 8 feet provided in front of composting shed.

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.

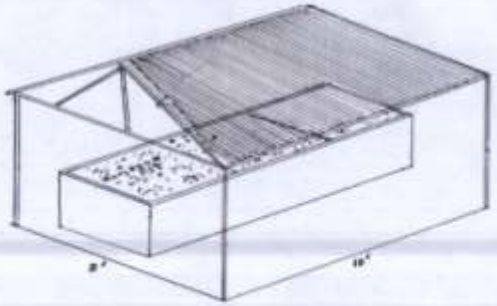
Compost so prepared is mixed with sand 1 part and compost 2 parts in route trainers, preferably the sand should be sterilized by heating before it is mixed with compost.



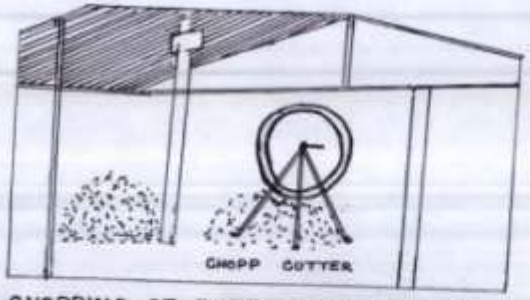
COMPOST HOUSE

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

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.

Dr. Suresh Kumar, IFS

Annexure-C

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS-PASTURE DEVELOPMENT

Sr. No.	Description	Remarks
1.	Area in Hectare	100.00 Ha
2.	Executing Agency	Forest Department
3.	Distance from adjacent Forest	The Pasture development shall be carried out in Dhars itself.
4.	Name of Division	Chamba Forest Division
5.	Name of Range	Tikri Range
6.	Block	Chanju
7.	Beat	Bhagai, Chanju & Dantuin Beats.
8.	Legal Status	1. Sansar Patta: 10 Ha, 2 Jawara:. 10 Ha, 3. Dhar Nalha: 10 Ha, 4. Dhar Milgu: 10 Ha, 5. Dhar Juri: 10 Ha, 6. Dhar Pukhara: 10 Ha, 7. Dhar Sheru: 10 Ha, 8. Dhar Badoth: 10 Ha, 9. Dhar Mandola: 5 Ha, 10. Dhar Deothal: 5 Ha, 11. Dhar Prabha: 10 Ha **Total: 100 Ha.**
9.	Average Elevation	1500 m to 2000 above msl.
10.	Grass to be planted	Grass Sowing
11.	Estimated Cost of Pasture Development.	Rs. 20 lacs
12.	Number of years for which maintenance of Pasture to be provided.	Three Year

Pasture Improvement (Low Laying Pasture)		
Sr. No	**Item of Work**	**Cost**
1	climber cutting 1/c Bushing cutting in plantation area (unwanted bush) = 1/2 ha @ 292 /- P ha	146.00
2	Digging of pits for paints45x45x45 cm = 7000 Nos. @ 324.50 P%	2,217.50
3	Filling pits 45x45x45 cm for fodder species = 700 Nos. @92.75 P%	649.25
4	@ 62.55 P%	437.85
5	Carriage of plants from nursery site to work site average lead by M/labour 5 1/2 km uphill = 700 Nos. @ 12/-	462.00
6	P Rmt.	438.00
7	Cutting and prep. Of F/post = 80 Nos. @ 440/40 P%	352.32
8	coal tarring of F/post wooden = 80 Nos. @ 95/-P%	76.00
9	Carriage of F/post from forest to work site by M/labour av lead 5 1/2 km = 80 Nos. @ 331.75 P% P km	1,019.70
10	@308.30 P%	246.64
11	Fixing offence post wooden = 80 Nos. @ 236.70 P%	189.36
12	Stretching and fixing of b/wire in 3 stands = 720 Rmt. @ 1.50 P Rmt.	1,152.00
13	Carriage of b/wire from road site to work site approxmates 5 km = 0.60 @ 57.95 P uphill	173.85
14	P.H.L	343.00
15	Prep. Of patches for grass sowing = 300 Nos. @ 166.85 P%	500.55
16	Sowing of patches for grass sowing = 300 Nos. @ 48.70 P%	146.10
	Total	**8,550.12**
	Add: 7.843% increase for S/rate	670.33
	Total	**9,220.45**
	Add: 9.09% increase on L/rate 68.75 to 75.00	838.14
	Total	**10,058.59**
17	Raising of plants in nursery = 700 Nos. @ 3/- each	2,100.00
18	collection of local grass seed = 1/2 Km @ 204/- Pkgs	102.00
	Grand Total	**12,260.59**
	Cost of Material	
1	Cost of b/wire approx = 60 kgs. @ L.S.	1,680.00
2	carriage of b/wire from market to Chamba	150.00
3	Cost of u/nail = 1 kg	50.00
4	Cost of b/Japan = 1 ltr.	45.00
	Total	**1,925.00**
	Total cost of plantation	
	Total of wages component	12,260.59
	Total of material	1,925.00
	Grand Total	**14,185.59**
	Or Say	**14,000.00**

Ist Year Maintenance of Pasture Improvement Plantation (Low Laying Pasture) per ha		
Sr. No	**Item of Work**	**Cost**
1	Weeding and hoeing of plants in colsed area = 500 Nos. @ 27.80 P %	139.00
2	Cutting and prep. Of F/post wooden = 20Nos. @440.40 P%	88.08
3	Carriage of F/post av. Lead 5 1/2km = 20 Nos. @ 231.75 P% P km	254.92
4	Digging of hole 20-30cm dia and 45cm deep 20 (new) + 10 (old) = 30 Nos. @308.30 P%	92.49
5	Fixing of plants = 30 Nos. @ 236.70 P%	71.01
6	Repair of B/wire = 270 Rmt. @0.55 p Rmt.	148.50
7	Re-digging of tailar pits 45x45x45cm = 150 Nos. @ 162.30 P %	243.45
8	Planting of pits and planting of plant 45cm3 = 150 Nos. @ 62.55 P%	93.82
9	Carriage of fodder tress plants from nursery to work site by M/labour av.lead 5 1/2 Km. = 150 Nos. @ 12/- uphill site	99.00
10	Prep. Of patches 45x45x25cm = 60 Nos. @ 166.85 P%	100.11
11	Sowing of grass seed in patches 45x45x25cm = 60Nos. @48.70 P%	29.22
12	Repair of B/wire = 120 Rmt. @1.80 p Rmt.	216.00
13	Interlacing thorny bush with b/wire = 160 H.L. @ 1.40 P.H.L.	224.00
	Total	**1,799.60**
	Add: 7.843% increase for S/rate	141.14
	Total	**1,940.74**
	Add: 9.09% increase on L/rate	176.41
	Total	**2,117.15**
14	Raising of plants in nursery = 150 Nos. @ 3/-	450.00
15	Collection of seed 250 gr @ 204/-	51.00
	Grand Total	**2,618.15**
	Or Say	**2,600.00**

IInd Year Maintenance of Pasture Improvement Plantation (Low Laying Pasture) per ha		
Sr. No	**Item of Work**	**Cost**
1	Weeding and hoeing of plants in colsed area = 550 Nos. @ 27.80 P %	152.90
2	Cutting and prep. Of F/post s/size wooden = 15Nos. @440	66.06
3	Carriage of F/post av. Lead 5 1/2km = 15 Nos. @ 231.75 P% P km	191.19
4	Digging of hole 20-30cm dia and 45cm deep 15 (new) + 15 (old) = 30 Nos. @308.30 P%	92.49
5	Fixing of plants = 30 Nos. @ 236.70 P%	71.01
6	Repair of B/wire = 270 Rmt. @0.55 p Rmt.	148.50
7	Re-digging of tailar pits 45x45x45cm = 100 Nos. @ 162.30 P %	162.30
8	Planting of plants 4545x45x45cm = 100 Nos. @ 62.55 P%	62.55
9	Carriage of fodder species plants from nursery to work site by M/labour av.lead 5 1/2 Km. = 100 Nos. @ 12/- uphill site	66.00
10	Prep. Of patches 45x45x25cm = 40 Nos. @ 166.85 P%	66.74
11	Sowing of local seed in patches 45x45x25cm = 40Nos. @48.70 P%	19.48
12	Repair of B/wire = 80 Rmt. @1.80 p Rmt.	144.00
13	Interlacing thorny bush with b/wire = 120 H.L. @ 1.40 P.H.L.	168.00
	Total	**1,411.22**
	Add: 7.843% increase for S/rate	110.68
	Total	**1,521.90**
	Add: 9.09% increase on L/rate	138.34
	Total	**1,660.24**
14	Raising of plants in nursery = 100 Nos. @ 3/-	300.00
15	Collection of seed 250 gr @ 204/-	51.00
	Grand Total	**2,011.24**
	Or Say	**2,000.00**

IIIrd Year Maintenance of Pasture Improvement Plantation (Low Laying Pasture) per ha		
Sr. No	**Item of Work**	**Cost**
1	Weeding and hoeing of plants in colsed area = 500 Nos. @ 27.80 P %	139.00
2	Cutting and prep. Of F/post wooden = 10Nos. @440.40 P%	44.04
3	Carriage of F/post from forest to work site Lead 5 1/2km = 10 Nos. @ 231.75 P% P km	127.46
4	Digging of hole and fixing of F/post 10 (new) + 10 (old) = 20 Nos. @545/- P%	109.00
5	Repair of B/wire = 180 Rmt. @0.55 p Rmt.	95.00
6	Re-digging of tailar pits = 80 Nos. @ 162.30 P %	129.84
7	Filling of pits and planting of plants = 80 Nos.@ 62.55 P%	50.04
8	Carriage of plants from nursery to work site by M/labour av lead 5 1/2 Km = 80 Nos. @12/- up hill site	52.80
9	Repair of I/path = 60 Rmt. @ 1.80 P Rmt.	108.00
10	Interlacing thorny bush with b/wire = 80 H.L. @ 1.40 P.H.L.	112.00
	Total	**967.18**
	Add: 7.843% increase for S/rate	75.86
	Total	**1,043.04**
	Add: 9.09% increase on L/rate	94.81
	Total	**1,137.85**
11	Raising of plants in nursery = 80 Nos. @ 3/-	240.00
	Grand Total	**1,377.85**
	Or say	**1,400.00**

Annexure-D

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS-REPLENISHMENT PLANTING

Sr. No.	Description	Remarks
1.	Area in Hectare	~~20~~ Ha 100 Ha.
2.	Executing Agency	Forest Department
3.	Distance from adjacent Forest	The replenishment planting shall be carried out in DPF itself.
4.	Name of Division	Chamba Forest Division
5.	Name of Range	Tikri Range
6.	Block	Chanju
7.	Beat	Bhagai & Chanju Beats.
8.	Legal Status	Bharaduin DPF: 10 Ha, Banotu DPF: 10 Ha.
9.	Average Elevation	1500 to 2000 m above msl.
10.	Grass to be planted	Grass sowing
11.	Estimated Cost of replenishment planting.	Rs. 5.20 lacs
12.	Number of years for which replenishment planting to be provided.	Two Years
13.	Number of years of maintenance.	~~Five~~ Years

Replenishment Affortation (per ha)		
Sr. No	**Item of Work**	**Cost**
1	climber cutting in palntation area = 1/2 ha @ 292 /- P ha	146.00
2	Digging of pits for palnts45x45x45 cm = 1000 Nos. @ 324.50 P%	3,245.00
3	Filling pits 45x45x45 cm = 1000 Nos. @92.75 P%	927.50
4	Planting of plants in pits in 45 m^3 = 1000 Nos. @ 62.55 P%	625.50
5	Carriage of olants from nursery site to work site average lead by M/labour 5 km uphill site (Naked Root plants) @ 12/-	600.00
6	Constrution of inspection path 60 cm wide = 140 Rmt. @ 3.65 P Rmt.	352.32
7	Cutting and prep. Of F/post = 80 Nos. @ 440.40 P%	511.00
8	Carriage of F/ post from forest to work site by M/labour AV lead 4km = 80 Nos. @ 231.75 P% P km	741.60
9	Coal tarring of F/post = 80 Nos. @ 95/- P%	76.00
10	Digging of hole 45 cm deep & 20-30 cm dia = 80 Nos. @308.30 P%	246.64
11	Fixing offence post wooden = 80 Nos. @ 236.70 P%	189.36
12	Stretching and fixing of b/wire in 3 stands = 720 Rmt. @ 1.60 P Rmt.	1,152.00
13	Carriage of b/wire from road site to work site approxmates 5 $^1/_2$ km = 0.60 @ 57.95 P P km	191.23
	Total	**9,004.15**
	Add: 7.843% increase for S/rate	706.20
	Total	**9,710.35**
	Add: 9.09% increase on L/rate 68.75 to 75.00	882.67
	Total	**10,593.02**
14	Raising of plants in nursery = 1000 Nos. @ 3/- each	3,000.00
	Grand Total	**13,593.02**
	Cost of Material	
1	Cost of b/wire approx = 60 kgs. @ L.S.	1,680.00
2	carriage of b/wire from market Chamba	150.00
3	Cost of u/nail = 1 kg	50.00
4	Cost of b/Japan = 1 ltr.	45.00
	Total	**1,925.00**
	Total cost of plantation	
	Total of wages component	13,593.02
	Total of material	1,925.00
	Grand Total	**15,518.02**
	Or Say	**15,500.00**

Ist year Maintananance of Replenishment Afforestation (per ha)		
Sr. No	**Item of Work**	**Cost**
1	Weeding and hoeing of plants in closed area = 700 Nos. @ 27.80 P %	194.60
2	Cutting and prep. Of F/post wooden = 25 Nos. @440.40 P%	110.10
3	Carriage of F/post from forest to work site by M/labour av. Lead 4km = 25 Nos. @ 231.75 P% P km	231.75
4	Digging of hole 20-30cm dia and 45cm deep 25 (new) + 15 (old) = 40 Nos. @308.30 P%	123.32
5	Fixing of plants = 40 Nos. @ 236.70 P%	94.68
6	Repair of b/wire = 360 Rmt. @0.55 p Rmt.	198.00
7	Repair of I/path = 80 Rmt. @ 1.80 P Rmt.	144.00
8	Re-digging of tailar pits 45x45x45cm = 200 Nos. @ 162.30 P %	324.60
9	Filling of pits 45x45x45cm = 200 Nos. @ 92.75 P%	185.50
10	Planting of plants in pits 45x45x45cm = 200 Nos. @ 62.55 P%	125.10
11	Carriage of plants from nursery to work site av. Lead 5 km (Naked root plants) = 200 Nos. up hill site @12/-P%	120.00
12	Thorny bush with B/wire = 180 H.L. @ 1.40 P.H.L.	252.00
	Total	**2,103.65**
	Add: 7.843% increase for S/rate	164.99
	Total	**2,268.64**
	Add: 9.09% increase on L/rate	209.22
	Total	**2,477.86**
13	Raising of plants in nursery = 200 Nos. @ 3/-	600.00
14	Cost of u/nail	30.00
	Total	630.00
	Grand Total	**3,107.86**
	Or Say	**3,100.00**

IInd year Maintananance of Replenishment Afforestation (per ha)		
Sr. No	**Item of Work**	**Cost**
1	Weeding and hoeing of plants = 800 Nos. @ 27.80 P %	222.40
2	Cutting and prep. Of F/post wooden = 20 Nos. @440.40 P%	88.08
3	Carriage of wooden F/post from forest to work site av. Lead 4km = 20 Nos. @ 231.75 P% P km	185.40
4	Digging of hole 20-30cm dia and 45cm deep 20 (new) + 10 (old) = 30 Nos. @308.30 P%	92.49
5	Fixing of F/post = 30 Nos. @ 236.70 P%	71.01
6	Repairing of B/wire = 270 Rmt. @0.55 p Rmt.	148.50
7	Repair of I/path = 80 Rmt. @ 1.80 P Rmt.	144.00
8	Re-digging of tailar pits 45x45x45cm = 160 Nos. @ 162.30 P %	259.68
9	Filling of pits 45x45x45cm = 160 Nos. @ 92.75 P%	148.40
10	Planting of plants in pits 45cm3 = 160 Nos. @ 62.55 P%	100.08
11	Carriage of plants from nursery to work site av. Lead 5 km (Naked root plants) = 160 Nos. @12/-P%	96.00
12	Thorny bush with B/wire = 120 H.L. @ 1.40 P.H.L.	168.00
	Total	**1,724.04**
	Add: 7.843% increase for S/rate	135.22
	Total	**1,859.26**
	Add: 9.09% increase on L/rate	169.01
	Total	**2,028.27**
13	Raising of plants in nursery = 160 Nos. @ 3/-	480.00
14	Cost of u/nail	30.00
	Grand Total	**2,538.27**
	Or Say	**2,600.00**

IIIrd year Maintananance of Replenishment Afforestation (per ha)		
Sr. No	**Item of Work**	**Cost**
1	Weeding and hoeing of plants = 800 Nos. @ 27.80 P %	222.40
2	Cutting and prep. Of F/post wooden = 15Nos. @440.40 P%	66.06
3	Carriage of wooden F/post from forest to work site av. Lead 4km = 15 Nos. @ 231.75 P% P km	139.05
4	Digging of hole 20-30cm dia and 45cm deep 15 (new) + 15 (old) = 30 Nos. @308.30 P%	92.49
5	Fixing of F/post = 30 Nos. @ 236.70 P%	71.01
6	Repairing of B/wire = 270 Rmt. @0.55 p Rmt.	148.50
7	Repair of I/path =60 Rmt. @ 1.80 P Rmt.	108.00
8	Re-digging of tailar pits 45x45x45cm = 130 Nos. @ 162.30 P %	210.99
9	Filling of pits 45x45x45cm = 130 Nos. @ 92.75 P%	120.57
10	Planting of plants in pits 45cm3 = 130 Nos. @ 62.55 P%	81.31
11	Carriage of plants from nursery to work site av. Lead 5 km = 130 Nos. @12/- P%	78.00
12	Interlacing thorny bush with B/wire = 80 H.L. @ 1.40 P.H.L.	112.00
	Total	**1,450.38**
	Add: 7.843% increase for S/rate	113.75
	Total	**1,564.13**
	Add: 9.09% increase on L/rate	142.18
	Total	**1,706.31**
13	Raising of plants in nursery = 130 Nos. @ 3/-	390.00
14	Cost of u/nail	30.00
	Grand Total	**2,126.31**
	Or Say	**2,100.00**

IVth & Vth year Maintananance of Replenishment Afforestation (per ha)		
Sr. No	**Item of Work**	**Cost**
1	Weeding done to colsed area plants = 500 Nos. @ 27.80 P %	139.00
2	Cutting and prep. Of F/post wooden = 10Nos. @440.40 P%	44.04
3	Carriage of F/post from forest to work site by M/labour av. Lead 4km = 10 Nos. @ 231.75 P% P km	92.70
4	Digging of hole 20-30cm dia and 45cm deep 10 (new) + 20 (old) = 30 Nos. @308.30 P%	92.49
5	Fixing of F/post = 30 Nos. @ 236.70 P%	71.01
6	Repair of B/wire = 270 Rmt. @0.55 p Rmt.	148.50
7	Repair of l/path =20 Rmt. @ 1.80 P Rmt.	36.00
8	Re-digging of pits 45x45x45cm = 80 Nos. @ 162.30 P %	129.84
9	Filling of pits 45x45x45cm = 80 Nos. @ 92.75 P%	74.20
10	Planting of plants in pits 45cm3 = 80 Nos. @ 62.55 P%	50.04
11	Carriage of plants from nursery to work site av. Lead 5 km = 80 Nos. @12/-P%	48.00
12	Interlacing thorny bush with B/wire = 10 H.L. @ 1.40 P.H.L.	14.00
	Total	**939.82**
	Add: 7.843% increase for S/rate	73.71
	Total	**1,013.53**
	Add: 9.09% increase on L/rate	92.13
	Total	**1,105.66**
13	Raising of plants in nursery = 80 Nos. @ 3/-	240.00
	Grand Total	**1,345.66**
	Or Say	**1,300.00**

Annexure-B. C

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS-SOIL & MOISTURE CONSERVATION

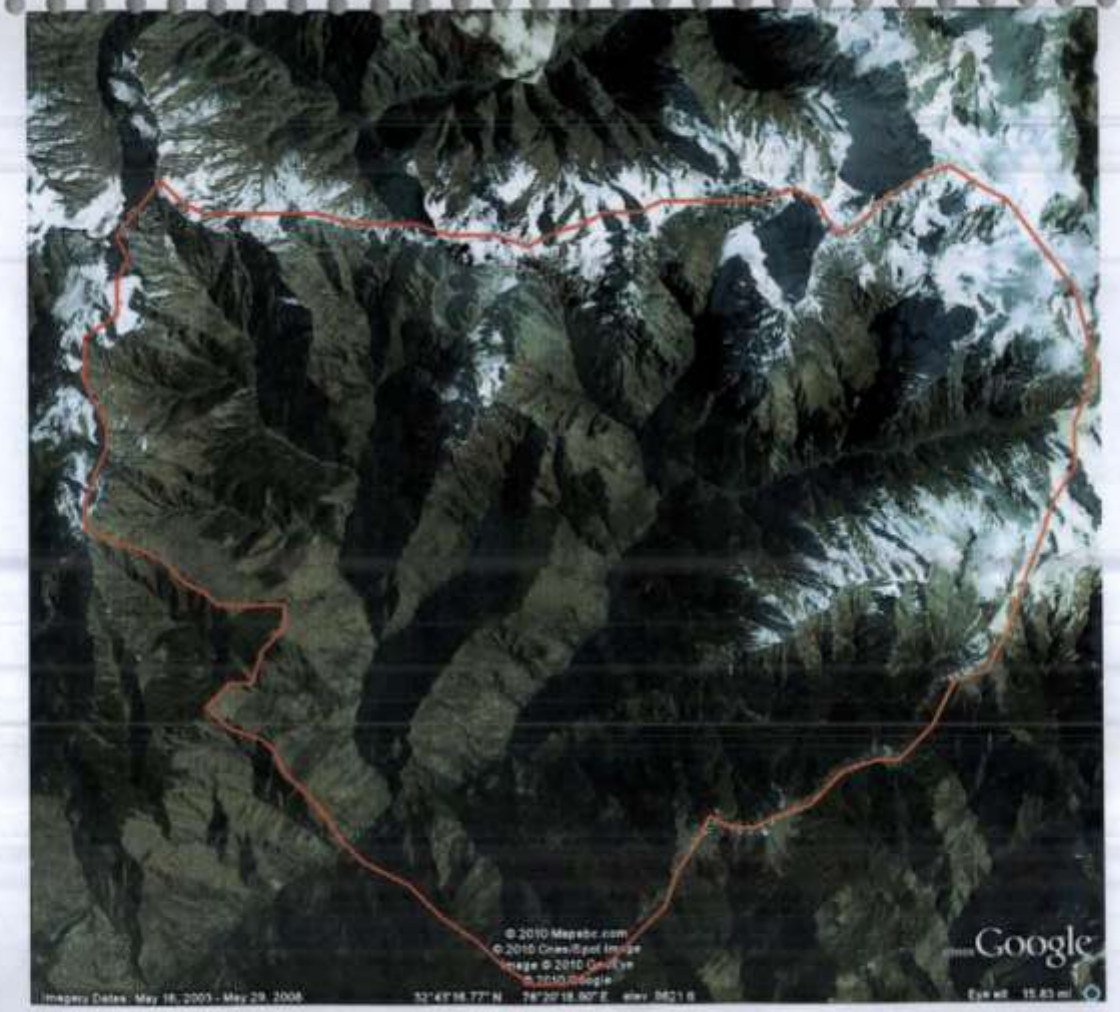
Sr. No.	Description	Remarks
1.	Executing Agency	Forest Department
2.	Distance from adjacent Forest	The SWC works shall be carried out in DPF itself.
3.	Name of Division	Chamba Forest Division
4.	Name of Range	Tikri Range
5.	Block	Chanju
6.	Beat	Bhagai, Chanju, Sundary
7.	Legal Status	Stabilization measures in terms of: a) Providing Wire Crate Work, b) Stream Bank Protection, c) Stone Masonary Check Dam, d) Gully Plugging, e) Vegetative Dam are being proposed for following nallahs in the Catchment: 1. Bharaduin Nallah, 2. Charda, 3. Kharew, 4. Nakal, 5. Kaimly, 6. Paniharka, 7. Mora, 8. Sawala, 9. Mehad, 10. Sabtuni,
8.	Average Elevation	1500 to 2400 m above msl.
9.	Estimated Cost of SWC Works including maintenance.	Rs. ~~89.63~~ lacs
10.	Works to be done	Gully Plugging, DRSM – Check Walls / Check Dams, Stream Bank Spurs, Wire Crates, & WHS / SDS.
11.	Number of years for which SWC Works provided.	Three Year

WATERSHED WISE DETAIL OF PLANTATION AND NALLAS IN RESPACT OF TIKRI FOREST RANGE FOR THE YEAR 2010-11.

W/SHED	SOWING AND	CONTOUR STG.	DEV. OF	DEV. OF SILVO	NAME OF	UPPAR REACHES		MIDDLE REACHES		LOWER REACHES			REMARKS
CODE	PLANTING	TRENCHES	PASTURE	PASTROL	NALLA	* L.B.STR.	* L.B.S. V/S	* L.V.STR.	* L.V.S. V/S	C/BUND	GABIONS	S.D.STR.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Tf 4c	0	0	0	Haragoth = 10 Hac.	Marot	0	0	0	0	5	3	0	
				Tholpadha =10 Hac.	Sahla	0	0	0	0	2	2	0	
						7	**8**	**9**	**10**	**18**	**17**	**13**	**82**
Tf 4d	0	0	0	Airwadi = 15 Hac.	Jalkani	0	0	0	0	8	0	0	
				Tobhu = 15 Hac.	Guglani	0	0	0	0	2	5	0	
					Khajwa	0	0	0	0	0	4	0	
						0	**0**	**0**	**0**	**10**	**9**	**0**	**19**
Tf 2h	0	0	0	Seri = 20 Hac.	Sidhani	7	7	6	3	4	5	0	
				Khundi = 15 Hac.	Chobu hainth	7	7	6	3	4	5	0	
				Riali = 15 Hac.	Jutnu	6	6	6	4	5	5	0	
				Spahan = 20 Hac.									
						20	**20**	**18**	**10**	**13**	**15**	**0**	**96**
Tf 3d	0	0	0	Kalalie = 15 Hac.	Jured	0	0	0	0	2	1	0	
				Jodbad = 10 Hac.	Butti	0	0	0	0	2	2	0	
						0	**0**	**0**	**0**	**4**	**3**	**0**	
Tf 3k	0	0	0	Seru =10 Hac.	Dantuin	0	0	0	3	3	3	0	
				Alias = 15 Hac.	Alias-II	0	0	0	3	3	3	0	
				Pukhara = 15 Hac.	Datie	0	0	0	3	3	3	0	
						0	**0**	**0**	**9**	**9**	**9**	**0**	**27**
Tf 3a	Kohla =10 Hac.	Kohla = 10 Hac.	0	Talgoth = 10 Hac.	Lesuin	10	6	3	2	1	1	0	
	Ladotie =10 Hac.	Ladotie = 10 Hac.		Bharadi = 10 Hac.	Behnota-II	10	6	3	2	2	1	0	
				Rainka = 10 Hac.	Daslahri	10	6	2	2	1	0	0	
					Karmund	5	6	2	2	1	1	0	
					Tikri-II	5	6	2	2	1	0	0	
						40	**30**	**12**	**10**	**6**	**3**	**0**	**101**
Tf 3b	Mandola =15 Hac.	Mandola=15 Hac.	0	Chhrotha = 20 Hac.	Dilwara	10	5	4	2	2	2	1	
	Bhagai = 5 Hac.	Bhagai = 5 Hac.		Kushan = 10 Hac.	Kunga-II	8	5	4	2	2	1	0	

	Roundi = 5 Hac.	Roundi = 5 Hac.		Trikud = 10 Hac.	Karnoth	6	8	4	2	2	2	0	
					Nared	12	7	3	2	2	2	0	
						36	**25**	**15**	**8**	**8**	**7**	**1**	**100**
Tf 4h	Ruhani = 12 Hac.	Ruhani = 12 Hac.	0	Kilontha = 20 Hac.	Malahunun	20	18	6	4	3	3	0	
	Kasrodu = 13 Hac.	Kasrodu= 13 Hac.		Dhamkan = 20 Hac.	Pindi-II	10	18	5	4	2	0	0	
					Mudiyal-II	10	6	0	0	0	0	0	
					Bloted	10	12	3	2	1	4	1	
						50	**54**	**13**	**10**	**6**	**7**	**1**	**141**
Tf 4a	0	0	0	0									
Tf 3g	Kehmali = 10 Hac.	Kehmali = 10 Hac.	Nagdehra =30 Hac.	Dhar Milgu=25Hac.	Ganj	5	5	3	3	2	2	0	
	Khadtap = 10 Hac.	Khadtap = 10 Hac.	Sensoon = 10 Hac.	Thapna =20Hac.	Sakal	5	5	4	3	2	2	1	
	Chhilrehi = 5 Hac.	Chhilrehi = 5 Hac.	Sarkund = 20 Hac.	Marhu =20Hac.	Nakol	5	4	3	3	2	2	0	
	Malan = 15 Hac.	Malan = 15 Hac.		Chipsar =25Hac.	Hainth	5	4	4	3	3	3	0	
				Kehloon =10Hac.	Malan	5	4	4	3	2	2	0	
					Taran	5	4	3	3	2	2	0	
					Gharat	5	4	4	2	2	2	0	
						35	**30**	**25**	**20**	**15**	**15**	**1**	**141**

* L.B.S. = Loose boulder structures.
* L.V.S. = Loose vegetative structures.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AREA IDENTIFIED FOR AFFORESTRATION
Bhaghaigarh DPF 5 Ha
Bhaghaigarh DPF 46 Ha
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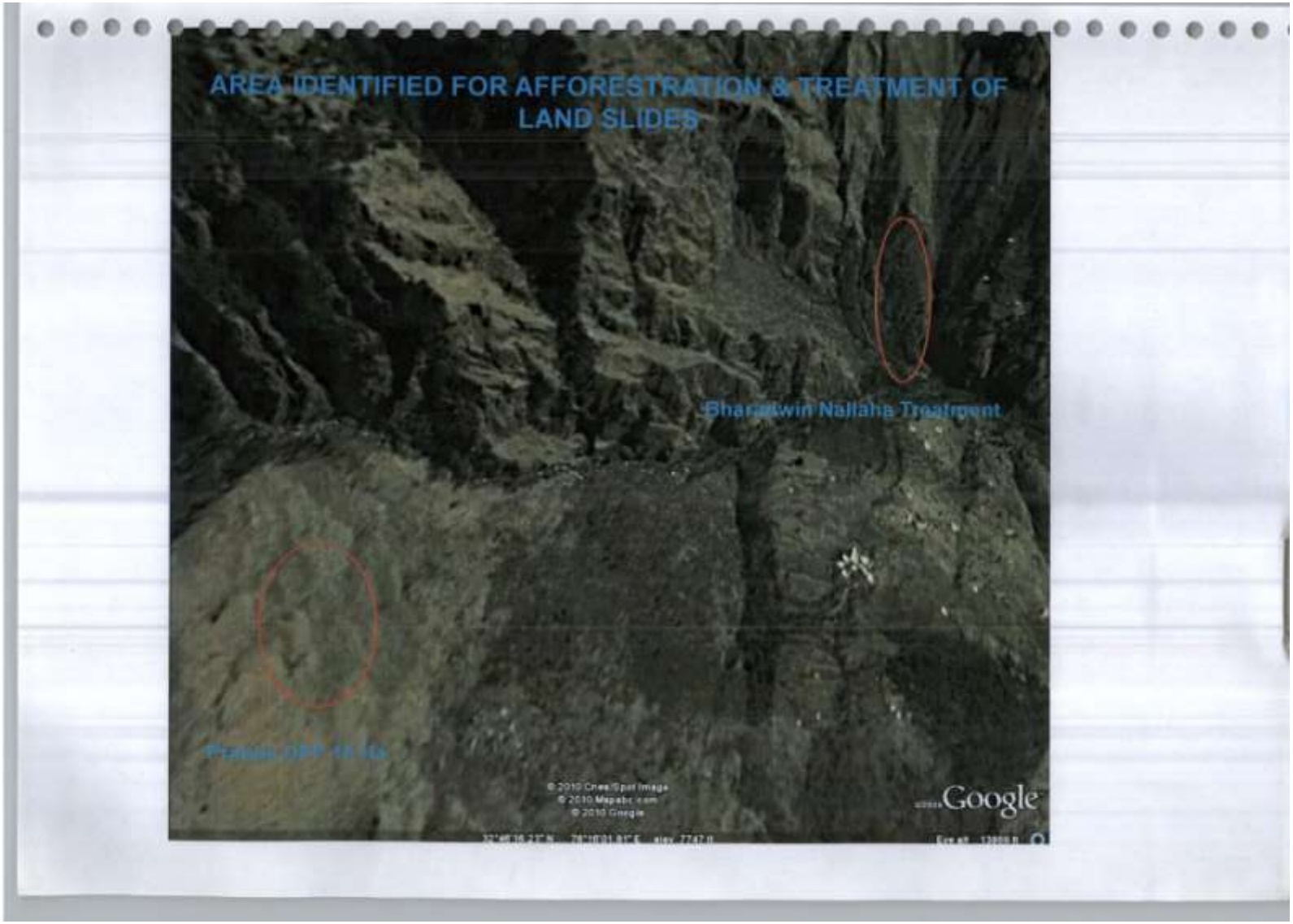
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32°46'49.23" N 76°19'16.73" E
elev 8693 ft
Google
Eye alt 18452 ft

Annexure-F

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS-BIO-ENGINEERING MEASURES

Sr. No.	Description of Item	Unit	Estimated Quantity	Amount in Rs	
				Unit Rate	Amount
1	**Collection and plantation of grass**				
1.1	Collection of grass seeds from sources.	kg	2000	80.00	1,60,000.00
1.2	Broadcasting grass seeds on slopes.	100 m²	1600	50.00	80,000
2	**Collection of grass and hardwood cuttings for vegetative propogation and plantation**				
2.1	Collection of grass clumps.	1000 slips	1500	212.17	3,18,255.00
2.2	Planting rooted grass slips on slopes.	m²	30,000	25.55	7,66,500.00
3	**Vegetative palisade construction, brush layering and fascines**				
3.1	Collection of hardwood cuttings for planting materials for palisade construction.	100 nos	20,000	112.41	22,48,200.00
3.2	Preparation and planting of live pegs of selected species.	20 nos	15,000	20.14	3,02,100.00
3.3	Site preparation for fascine laying	RM	10,000	7.11	71,100.00
3.4	Laying of live fascines, using live hardwood cuttings of selected species.	RM	10,000	20.14	2,01,400.00
4	**Crib wall construction**				
4.1	Preparing for the crib wall base.	Rm	1000	819.00	8,19,000.00
		Total			**49,66,555.00**

Annexure-C

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS – FOREST PROTECTION / REPAIR OF BOUNDARY PILLARS

Sr. No.	Description	Remarks
1.	Executing Agency	Forest Department
2.	Distance from adjacent Forest	The Forest protection including construction / Repair of boundary pillars shall be carried out in DPF itself.
3.	Name of Division	Chamba Forest Division
4.	Name of Range	Tikri Range
5.	Block	Chanju
6.	Beat	Bhagai, Chanju, Sundary & Dantuin Beats.
7.	Legal Status	**BOUNDARY PILLARS:** 1. Jammu Kalwadi RF, Large: 32 2. Jured UPF, Large -33, Small - 12 3. Banotu, Large -33, Small -4 4. Sundary RF, Large -20, Small -5 5. Topi RF, Large 22, Small -5 6. Parsiad RF, Large 18 7. Murry RF, Large -16 8. Bangord RF, Large -20 9. Sundary DPF, Large -25 10. Daliunji DPF, Large: 37
8.	Average Elevation	1200 to 2400 m above msl.
9.	Works to be done	Forest protection including construction/repair of boundary pillars.
10.	Estimated Cost of construction of boundary pillars including maintenance.	Rs. 20.00 lacs
11.	Number of years for which SWC Works provided.	Three Year

Analysis for consruction of Main Boundary Pillars Laid in cement mortar with plaster and white washing on four sides and on top and iron rod in centre.

Foundation- 100x100x25cm.(Concrete 100x100x15 cm)

Base- 80x80 cm.

Top- 40x40 cm.

Height- 100 cm.

Sr. No.	Item & Specification	Reference of scheduled Rate	Quantity	Unit	Rate	Amount (Rs.)
	1	2	3	4	5	6
1	Site Clearence	-	L.S.	L.S.	L.S.	5.00
2	Excavation of foundation in 1 pick and 1/2 jumper work 100x100x25	P.7 Item No. V A (ii) & (iii)	0.25	cum	75.75	18.94
3	Laying of charcoal, Lime and iron rod Charcoal -2 Kg., Lime - 2 Kg., Iron rod - 1 No.	...	4 1	Kg. No.	L.S.	5.00
4	Layong of Cement Concrete in foundation in 1:6:12 ratio i.e. 1 Cement, 6 Sand, 12 Stone ballast = 100x100x15 cm.	P.8 C (i)	0.15	cum	156.7	23.51
5	Random rubble stone masonary in pillar in 1:6 cement mortar in super structure =h/3 (a2+b2+ a2.b2) =h/3 (a2+b2+ab) (h=1.00m: a=0 80m: h=0.40m) =0.373	P.4 Item III (ii)	0.373	cum	307.3	114.62
6	15 mm thick cement plastering in 1:6 cement mortar Sides-4No-0.80x0.40/2 x1002=2.45 Top-1 No. 0.40x0.40 =0.16/2.61	P.34 item No. iii	2.61	Sqm	19.7	51.42
7	White washing with Lime 2 coat new including preparation of surface etc. complete	P.37	2.61	Sqm	1.5	3.92
		4 (ii)				
8	Writing of B.P No. including material cost.	L.S.	L.S.	L.S.	L.S.	10.00
9	Cost of iron rod including making of base	L.S.	1	No.	L.S.	35.00

10	Cost of lime and charcoal for linning	L.S.	4	Kg.	L.S.	30.00
11	Carriage of charcoal/lime by Manual labour (1 Km)	....	4	Kg.	L.S.	5.00
12	Cost and carriage of lime of good quality for white washing	....	0.52	....	L.S.	6.00
13	Cost of suresh neel 100 gm. Kuchi/brush.	....	L.S.	....	L.S.	20.00
14	Collection of stone 0.373 cm as in S.No5 plus (10%)	P.42	0.41	cum.	59.6	24.45
		Item No. vii				
15	Manual Carriage of stone (avergae lead 1 Km)	P.54	0.41	cum.	285	116.85
		Item No. iv				
16	Breaking of boulder stone (50%)	P.42	0.205	cum	85	17.43
		Item No. xi.				
17	Other material requried:					
	Purpose	**Quantity**	**Ratio**	**Material**		
				Stone	**Sand**	**Cement**
				Ballast40 mm(cum)	**(cum)**	**(Bag)**
i)	DSRR masonary in foundation (per cum-cement=2.2 bag, sand=0.47 cum, 40mm. Aggregate=0.94).	0.15	1:06:12	0.14	0.07	0.33
ii)	RR Stone masonary in cement mortar in pillar (cement = 1.5 Kg Sand=0.32)	0.373	1:06	....	0.12	0.56
iii)	15mm cement plaster cement .076, sand 0.016)	2.61	1:06	....	0.04	0.2
	Total			**0.14**	**0.23**	**1.09**
18	Collection of loose stone along khad for ballast	P.42	0.14	cum	59.6	8.34
		Item vii				
19	Manual Carriage of stone (avergae lead 1 Km)	P.54	0.14	cum	285	39.90
		Item v				
20	Preparation of stone ballast 40 Km.	P.42	0.14	cum	104.3	14.60
		Item xv				
21	Cost of sand	irrent market ra	0.23	cum	300	69.00

22	Manual Carriage of sand (avergae lead 1 Km)	P.54	0.23	cum	193.6	44.53
		Item v				
23	Cost and carriage of cement up to road head	....	1.09	bag	180	196.20
24	Manual carriage of cement in forest average lead 1 Km.	P.54	0.055	tonne	231.85	12.75
		Item x				
25	Cost towards METP like tins, hammers,pick axes etc.	....	L.S.	L.S.	L.S.	20.00
26	Carriage of water	L.S.	L.S.	L.S.	L.S.	20.00
	Total					**912.45**

Annexure-H

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS – FOREST PROTECTION MEASURES

Sr. No.	Description	Remarks
1.	Executing Agency	Forest Department
2.	Distance from adjacent Forest	The construction of Fire Watch, Fire Line & Paths shall be carried out in DPF itself.
3.	Name of Division	Chamba Forest Division
4.	Name of Range	Tikri Range
5.	Block	Chanju
6.	Beat	Tikri, Bhagai & Chanju Beats.
7.	Legal Status	**Fire Watch Tower:** 1. Tikri: Bathrundi, 2. Bhagai: Kathward, 3. Chanju: Pathwal **Repair of Forest Rest House:** 1. Tikri 2. Chanju 3. Deola **Repair Forest Guards Huts:** 1. Sundri 2. Khander 3. Chanju 4. FRH Chanju 5. R.R.R. Sundri

		Check Post: 1 Priya (Tikri Range) **BO Qtrs.:** 1. Chanju **Range Office cum Residence:** 1. Tikri **Control Burning:** 1. Tikri Beat 2. Bhagai Beat 3. Chanju Beat **Construction of B. Path:** 1. Maintenance of Saktiun Nallah to Lumake Gharat. 2. Basred Nallah to Trethan 3. Jasuie to Dantiun 4. Kalprya Ghar to Alias 5. Lunak Ghar to Dasdujh 6. Swala to Jured **Bridges:** 1. Targed Bridge 2. Mahead Bridge 3. Charsiun Bridge
8.	Average Elevation	1500 to 2400 m above msl.
9.	Estimated Cost.	Rs. 55.00 lacs
10.	Number of years for which Works provided.	Three Year

45
30/12

Annexure-I

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS – ENERGY SAVING DEVICES

Sr. No.	Description	Remarks
1.	Executing Agency	Forest Department
2.	Name of Division	Chamba Forest Division
3.	Name of Range	Tikri Range
4.	Block	Jassor & Chanju
5.	Beat	Bhagai, Chanju & Dantuin Beats.
6.	Legal Status	**No. of Families Members Village wise:** 1. Khander: 5 2. Charda: 5 3. Jakhla: 5 4. Swala: 5 5. Paniharka: 5 6. Mandola: 5 7. Mahala: 5 8. Dehra: 5 9. Kunda: 5 10. Dantuin: 5 11. Sundary: 5 12. Bhangor: 5
7.	Works to be done	Providing subsidizes Pressure Cookers, LPG Connection etc. & other energy saving devices reducing pressure on fuel wood.
8.	Estimated Cost.	Rs. ~~15,00,000.00~~ 35 Lacs.
9.	Number of years for which construction Works provided.	Three Year

Annexure-J

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
CAT PLAN WORKS – JOINT FOREST MANAGEMENT & MICRO PLANNING

Sr. No.	Description	Remarks
1.	Executing Agency	Forest Department
2.	Name of Division	Chamba Forest Division
3.	Name of Range	Tikri Range
4.	Block	Jassor & Chanju
5.	Beat	Tikri, Bhagai, Chanju & Dantuin Beats.
6.	Legal Status	**No. of Members Village wise:** 1. Khander: 5 2. Charda: 5 3. Jakhla: 5 4. Swala: 5 5. Paniharka: 5 6. Mandola: 5 7. Mahala: 5 8. Dehra: 5 9. Kunda: 5 10. Dantuin: 5 11. Sundary: 5 12. Bhangor: 5
7.	Average Elevation	1000 to 2000 m above msl.
8.	Works to be done	For training and awareness.
9.	Estimated Cost.	Rs. 10,00,000.00
10.	Number of years for which construction Works provided.	Three Year

Annexure- K

CHANJU-I HYDRO ELECTRIC PROJECT (36 MW)
TEHSIL CHRURAH, DISTRICT CHAMBA (HP).
CAT PLAN WORKS – ECO-TOURISM

Sr. No.	Description	Remarks
1.	Executing Agency	Forest Department
2.	Distance from adjacent Forest	The construction of Huts shall be carried out in DPF itself.
3.	Name of Division	Chamba Forest Division
4.	Name of Range	Tikri Range
5.	Block	Chanju
6.	Beat	Bhagai & Dantuin Beats.
7.	Legal Status	1. Track Eco-Hut at Juri (Bhagai), 2. Track Eco-Hut at Charda (Bhagai), 3. Track Eco-Hut at Dantuin (Dantuin)
8.	Average Elevation	1500 to 2400 m above msl.
9.	Works to be done	Construction of Track Eco-Huts.
10.	Estimated Cost of Construction of I/Huts.	Rs. 7,50,000.00
11.	Number of years for which construction Works provided.	Three Year