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Dhamwari Power Company Private Limited
New Delhi - 110044

GOYAL GROUP
Dhamwari Power

CATCHMENT AREA TREATMENT PLAN

Dhamwari Sunda Hydro Electric Project (2 x 35 MW)

Shimla District, Himachal Pradesh

AUGUST - 2010

Dhamwari Power Company Private Limited

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PREAMBLE

CATCHMENT AREA

TREATMENT PLAN

PREAMBLE

Dhamwari Power Company Private Limited (DPC), New Delhi, process to construct 2 x 35 MW "Run-of-the-River" Dhamwari Sunda Hydro Electric Project (DSHEP) on River Pabbar in Tehsil Chirgaon, District Shimla, Himachal Pradesh.

As per Pabbar Valley Master Plan there are five major Hydro Electric Projects (HEPs) (above 10 MW) on River Pabbar each of these HEPs will have effective sub-catchment area from its barriage to the barrage of immediate upstream Project. Accordingly, Dhamwari Sunda will have effective sub-catchment area of 56.48 sq.km for treatment. However, the overall catchment area of the Project at Diversion Structure is 212.48 sq.km. Out of this, 156 sq.km will be the effecive sub-catchment treatment area of upstream Tangnu Romai – I HEP.

CAT Plan estimated cost of Rs. 300.15 lacs including contigency has been provisioned, to be implemented over a period of ten (10) years commencing with financial year 2010 – 11. The CAT Plan will be implemented through State Forest Department. As per the Government of Himachal Pradesh, the involvement of the local inhabitants in the implementation of CAT Plan will ensured. This would provide them employment and generate awareness towards their environment.

The overall objective of the CAT Plan is reduction of soil erosion cum its conservations mitigation of sedimentation, land slide, afforestation, pasture developmen, re-storation of degraded area and re-generation, plantation (Timber, NTFP, Fodders etc.), Alpine pasture development, conservation and re-generation of reverine tree SPP etc. though suitable Engineering Measures and Bio-logicial Measures so as to reduce Biotic pressure on Forest and thus help improving the overall eco-system in the area.

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EXECUTIVE SUMARRY

CATCHMENT AREA

TREATMENT PLAN

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The total Hydro power potential of the five River Basins of Satluj, Beas, Ravi, Chenab & Yamuna; in Himachal Pradesh is of the order of 20,070 MW, out of which major part remains unexploited. Yamuna Basin in Himachal Pradesh has a Hydro power potential of 622.52 MW.

As per Master Plan prepared by Himachal Pradesh State Electricity Board in collaboration with M/s Swed Power, Sweden, Pabbar Valley has a Hydro power potential of 402 MW comprising 44 MW Tangnu Romai HEP-I, 6 MW Tangnu Romai HEP-II, 70 MW Dhamwari Sunda HEP, 3 MW Gumma HEP, 46 MW Chirgaon Majhgaon HEP, 24 MW Paudi Tal Lassa HEP, 17 MW Andhara HEP, 111 MW Sawra Kuddu HEP and 81 MW Tuni HEP. Out of this, 2 x 35 MW Dhamwari Sunda HEP has been allotted M/s Dhamwari Power Company Private Limited. The Project is located in the middle reach of River Pabbar; a tributary of River Tons, which itself is a tributary of River Yamuna. It is a "Run-of-the-River" scheme in Chirgaon Tehsil, Shimla district, Himachal Pradesh.

2.0 PROJECT DESCRIPTION

2.1 Location and Approach

The Project is located in Chirgaon Tehsil, Shimla District, H.P. and is 165 km from Shimla and is approachable by National Highway NH-22 up to Theog and by Theog - Rohru State Highway followed by fair weather motorable HP PWD road up to Romai. The area is located in Great Himalayan ranges and lies between Longitude 30°-15'-08" N to 31°-15'-42" N and Latitude 77°-57'-10" E to 77°-59'-20" E and is covered in the Survey of India Toposheet Nos. 53E/15, 53E/16, 53 I/3 & 53 I/4. The nearest Rail Head on Narrow gauge is Shimla and Broad gauge is Kalka. The nearest Airport is Shimla.

2.2 Project Features

The summary of the main features of the Project are as follows:

2.2.1 Catchment Area

Catchment area at Diversion Structure Site is 212.48 sq. km with a flood flow (SPF) of 1300 m^3/sec.

2.2.2 Diversion Structure

The Diversion Structure comprises a concrete Dam classified as medium size Dam of average height 28 m from the deepest foundation level with an average River bed level at El. 2160 m, FRL at El. 2180 m and MWL at El. 2185.5 m. The Diversion Structure site is in a deep gorge bounded by rocky abutments on either bank of River Pabbar. It is provided with two flushing sluice gates to flush out the sediments collected due to diurnal storage.

2.2.3 Diversion Tunnel and Coffer Dams

River Diversion has been planned through a D-shaped Diversion Tunnel, 3.7 m dia. x 230 long along with it coffer dams both on the upstream and downstream at the Diversion Structure.

2.2.4 Feeder Tunnel

D-shaped Feeder Tunnel, 3.0 m dia. x 223.85 m long on the right banks has been proposed to convey water from Intake to the De-silting Basin at a design flow rate of 19.83 m^3/sec. Its invert level at intake is El. 2167.49 m and at outlet is El. 2167.274 m.

2.2.5 De-silting Basin

Surface De-silting basin, 129 x 17.5 x 25.1 m (length x width x depth) with flushing arrangement has been proposed on right bank to eliminate particle size $\geq$ 0.20 mm. The outlet diameter is 700 mm.

2.2.6 Head Race Tunnel

The water from De-silting basin will be conveyed through D-shaped 3 m dia. x 10.14 km long Head Race Tunnel on right bank of River Pabbar for a discharge capacity 19.83 m^3/s. Its invert level at intake is El. 2164 m and at surge shaft is 2147 m. Four No. of Adits have been proposed to expedite the construction work of Head Race Tunnel.

2.2.7 Surge Shaft

An open to air restricted orifice, concrete lined surge shaft of internal 9.7 m diameter x 61 m height with an orifice of 1.5 m diameter has been provided at the end of Head Race Tunnel to accommodate the surge effect during the operation of generating units. The surge shaft has been designed for maximum upsurge level at El. 2197.50 m and minimum down surge level at El. 2153.40 m.

2.2.8 Pressure Shaft (Penstock)

Water from surge shaft will be conveyed to Power House by an underground circular steel lined, 2.10 m diameter x 451.6 m long horizontal and 492.18 m long inclined pressure shaft. Thereafter, it will bifurcate into two branches with 1.4 m diameter x 30.2 m and 24.3 m length, each branch to feed the two Pelton Wheel Turbines, 35 MW capacity each, installed vertically in the Power House.

2.2.9 Power House

Dhamwari Sunda Hydro Electric has proposed installation of 2 x 35 MW Pelton Wheel Turbines in a surface Power House located on the right bank of River Pabbar. The center line of the vertically installed turbines will be at El. 1752 m.

2.2.10 Tail Race Channel

Water from each turbine unit will be discharges back to River Pabbar through a combined open 4 m wide x 233 m long Tail Race Channel. El. of the confluence point is at El. 1748 m and the HFL is at El. 1751 m.

2.2.11 220 KV Switch Yard

Power House will be provided with a five bay switch yard complex, size 120 m x 75 m on its downstream. Both step up power transformers (11 KV / 220 KV) and step down transformers (11 KV / 440 / 220 Volts) will be installed in the switch yard.

2.2.12 Design Head

The Grass design head is 428 m and the Net design head is 397 m.

2.2.13 Diurnal Storage

The Project has been designed with a Diurnal storage of 0.214 MCM for minimum 3½ hrs. of peaking power.

2.2.14 Energy

The plant will generate 274.02 MU per annum gross energy at 90% dependable year 2000-01. Consequent to giving Royalty @ 15% for first 12 years from the Commercial Operation Date (COD) to Government of Himachal Pradesh (GoHP) and auxiliary consumption @ 1% in the plant, Net saleable energy will be 230.59 MU per annum with Plant Load Factor of 44.69%.

2.2.15 Power Evacuation

HP Power Transmission Corporation Limited (HPPTCL) will lay a Common-Corridor at 220 kV, capacity 700 MW for evacuation of power from Hydro Electric Projects in Pabbar Valley comprising 44 MW Tangnu Romai HEP-I, 6 MW Tangnu Romai HEP-II, 70 MW Dhamwari Sunda HEP, 3 MW Gumma HEP, 46 MW Chirgaon Maghgaon HEP, 24 MW Paudi Tal Lassa HEP, 17 MW Andhara HEP, 111 MW Sawra Kuddu HEP and 81 MW Tuni HEP. HPPTCL will establish two pooling stations – one adjoining Dhamwari Sunda switchyard and second at Hatkoti. Dhamwari Sunda switchyard will be LILO with the Common Corridor through the pooling station. The Common Corridor will interconnect with H.P.

State Grid at Nalagarh. The voltage will be stepped up to 400 kV at Nalagarh and interconnected to Grid Power Corporation Ltd. Sub-station Reera Majra. In this connection, letter dated April 16, 2009 has been issued by Special Secretary, (MPP & Power), Government of H.P.

2.2.16 Project Cost

The Project is estimated to cost Rs. 537.33 crore as on January 2010 price level. This includes Rs. 291.30 crore civil and hydro mechanical works, Rs. 115.80 crore for electro-mechanical works, Rs. 81.86 crore for IDC and financing costs, Rs. 40.44 crore as escalation during construction period and Rs. 7.94 crore for Local Area Development Charges (LADC). Lavellised tariff for 90% dependable year energy for 40 years operation at 9.78% discounted rate works out to Rs. 4.15 per units without considering CDM benefit.

2.2.17 Construction Schedule

The Project is programmed to be completed in a period 42 months from the day of the commencement of work.

3.0 PHYSIOGRAPHY

Catchment area of the Project falls in the Dhauladhar (North), Gobri, Khashar Dhar originating from the North-Eastern corner of Dhauladhar & Sundru Bhali Dhar ranges in the Himalayas. Of these three mountains ranges, Dhauladhar has comparative higher altitudes. The average elevation is generally around 4840 m and the highest elevations being 5145 m. The lowest altitude of 2160 m is around the Diversion Structure site about 5 km upstream of Dhamwari village. The valley is wider in upper portion and narrows to the minimum around the Diversion Structure site. The width of the valley in upper part is around 15 – 18 km whereas at Diversion Structure site is about 4 km. Slopes along the River banks are steep. However, the stretch in between the higher reaches and from level little higher than river bank has moderate slopes. This part is thickly

populated and hostly about 21 villages. However, these villagers do not depend upon River Pabbar to meet their domestic water and water needed for agriculture, animals etc. The requirement is met from nearby tributaries, streams, khads, nalahs etc.

4.0 GEOLOGY

In the uppermost reaches of the Pabbar River, around Tangnu, the bedrock consists mainly of garnetiferous gneiss and mica schist with some micaceous quartzite. Somewhat downstream, around the villages of Ambot and Romai, massive quartzite with bands and intercalations of Schist dominate. Again around Dhamwari and Tikkri villages, gneiss and mica schist occur. At Sandhasu and Chirgaon villages, thinly-bedded quartzite and mica schist predominate.

4.1 Geology of Project Components

4.1.1 Diversion Structure is in gorge bounded by rocky abutments on its either banks. The right abutment has steep slope with grey close quartzite exposed on both banks.

4.1.2 Head Race Tunnel will be excavated in formation D and E of the Pre-Cambrian Jutogh group. Both the formation contains rocks like massive quartzite, bedded quartzite, gneiss and mica schist.

4.1.3 Surge shaft will be excavated in bed load comprising inter bedded quartzite and mica schist.

4.1.4 Penstock bed rock consists of alternative beds of quartzite and mica schist.

4.1.5 Power House is situated on river terrace with its right side touching debris slope. The deposits consist of stoney gravel and has a good stability.

5.0 SEISMICITY

The Project area lies in a seismically active region where moderate to great earthquakes have occurred around the area in the past. The Diversion Structure lies in Seismic Zone - IV according to the Seismic Zoning Map of India as incorporated in Indian Standard Criteria for Earthquake Resistant Design Structures {IS:1893 (Part 1) – 2002}.

Study of the records reveals that comparatively few earthquakes have occurred in the immediate vicinity of the Project Area. Based on the study regarding the seismotectonic, regional geology, local geology and earthquake occurrence around the Project area, Indian Institute of Technology (IIT), Roorkee has recommended estimated Peak Ground Acceleration (PGA) as 0.36 g (Horizontal) and 0.18 g (Vertical). These recommendations will be used during the designing of Project components so as to make them earthquake resistant.

6.0 METEOROLOGY

6.1. Meteorology

The climate of the region is temperate and has four seasons. The area experiences severe winter from December to March, summer from April to June, monsoon from July to September and autumn during October & November.

6.2 Temperature & Humidity

The daily maximum temperature in the EIA Project study area was observed to vary from 6°C to 12°C in winter season, 28°C to 33°C in pre-monsoon season and 19°C to 25°C in monsoon season. The daily minimum temperatures ranged from -1.2°C to 2.5°C during winter reason, 9°C to 12°C during pre-monsoon season and 6°C to 8°C during monsoon season. The relative humidity ranged between 26% and 39% during winter, 32% and 48% during pre-monsoon season and 55% and 80% during monsoon season.

6.3 Rainfall

The average annual rainfall in the region is of the order of 1301 mm. Highest rainfall is observed during monsoon months of July & August.

7.0 CATCHMENT AREA AND LAND USE PATTERN

Catchment area of the Project at Diversion Structure site is 212.48 sq. km. As per the records of All India Soil and Land Use Survey report, Department of Agriculture and Corporation, Ministry of Agriculture, (Government of India), the land use is summarized in Table ES – 1.

TABLE: ES – 1

LAND USE DETAILS OF CATCHMENT AREA

S. No.	Type of Land Use	Area (Ha)	Percentage of Total Area
a)	Cultivation (Cropland)	480	2.26
b)	Orchards	42	0.20
c)	Moderately Thick Forests & Moderately Thick Forests and Grasslands	3750	17.65
d)	Grazing Land with Trees	1235	5.81
e)	Grazing land without Trees	223	1.05
f)	Thaches	300	1.41
g)	Ghasnis (Grasslands)	407	1.92
h)	Gair Mumkin	129	0.61
i)	Alpine Pastures	14654	68.97
j)	Glaciers	28	0.12
	Total	**21248**	**100.00**

(This does not quantify the area under snows or alpine pastures).

(Source: All India Soil and Land Use Survey Organizations)

7.1 Soil Quality

Soil samples were collected at 10 locations and analysed. The soils in the area varies from sandy loam to sandy clay loam. Soil test results show that pH of the soil in Project area is near to neutral; the conductivity indicates low salt content, available Nitrogen content is poor i.e. less than 0.4%. Soil has low Caution Exchange capacity and low electrical conductance thereby indicating low fertility / production potential. pH value of soil ranges between 7.0 to 8.5 and organics matter ranges between 0.37 to 1.8%. The agricultural soil of Project area showed medium to moderate fertility.

7.2 Land Required for the Project

23.3025 Ha area will be required for the Project components and all other Associated Components/activities like construction of approach & haulage roads, quarry sites, contractor area, labour camps, workshops and stores. Out of the total 23.3025 Ha, private land to be acquired is 5.1795 Ha while Government land (Classified as Unlisted Forest Land) to be taken on lease for 40 years, is 18.1230 Ha. The details are summarized in Table ES – 2.

TABLE: ES – 2

DETAILS OF LAND REQUIRED FOR THE PROJECT

S. No.	Description	Area (Ha)	
		Underground	Surface
a)	Privately Owned Land	-	5.1795
b)	Total Government Land (Classified as Unlisted Forest Land)	-	13.2578
c)	Land falling underground works such as HRT, Feeder Tunnel, Diversion Tunnel, Adits Access Tunnels, Surge Shaft Pen Stock etc	4.8652	-
	Total	4.8652	18.4373
	Grand Total		**23.3025**

7.3 Forest Types

According to the classification given by Champion and Seth, the forests in the Project catchment area fall under the following types:

- Type 12 CI/DSI/Ic : Moist – Deodar Forests (Cedrus Deodara)
- Type 12 CI/DSI/Id : Western Mixed Coniferous Forests (Spruce, Blue, Pine, Silver, Fir)
- Type 12 CI/DSI/Ie : Moist Temperate Deciduous Forests
- Type 12 CI/DSI/If : Low lever Blue Pine Forest (Pinus Wallichiana)
- Type 12 CI : Birch Rhododendron Scrub Forests

8.0 OCCUPATIONAL STRUCTURE OF THE PROJECT AREA

8.1 Population

According to 2001 census there are 2294 households with a total population of 12158 persons in the Project area. There are 953 females for every 1000 males. The average family size ranges between 5 to 6 (i.e. 5.3) persons. Similarly, the population of the six effected villages is 3142 persons with 1675 males and 1467 females in 608 households with an average family size of 5 to 6 (i.e. 5.2) persons.

8.2 Occupational Structure in the Project Area

The Project area has 6694 working population (55.06%) comprising 5066 main workers (41.66%) and 1628 marginal workers (13.39). In addition, the Project area has 5464 non-workers (44.94%). Similarly, the Project Impact area i.e. six villages has 1357 main workers (43.18%), 278 marginal workers (8.84%) and 1507 non-workers (47.96%).

The majority of population is cultivators and labourers working in the agricultural fields. Besides, inhabitant work in Government offices, schools, tourism department, construction & repair of roads, petty business like roadside hotels, repair shops, photography and other mercantile. Annual income of 50%

population range between Rs. 50,000/- to Rs. 1,00,000/- per annum and the remaining 50% earn only less than Rs. 50,000/- per annum.

8.3 Agriculture

In the Project area, agriculture is a main source of livelihood. The major crops grown in the Project area are maize, wheat and barley. Vegetables include potato, tomato, cauliflower and cabbage.

8.4 Minor Forest Produce

The local people collect medicinal plants and other valuable produce of commercial value from the forest and alpine pastures. The minor produce of the region are Bhojpatra, Mahameda, Dhoop, Goodbuch, Anjhar, Kakarsingi, Buchnag, Rvcnchini, Kakroo, Mitha Palis, Chora, Mithatelia, Mushakbala, Kunish cones, Guchhi (for whole Rohru Forest division).

8.5 Livestock

Besides, Agriculture lands livestock is another major asset of the rural population in the Project area. Livestock holding in the Project area comprising 1366 cows, 102 hours / mules, 43 bullocks, 3280 sheep, 3580 goats, 2500 poultry.

8.6 Sources of Fuel Energy

The villagers depend upon various sources to meet their requirement of fuel/energy. Locals are dependent upon their community lands and forests to a large extent for meeting their fuel requirement. About 60% of all fuel energy requirements are met from this source. They use fuel wood in their chulhas, 25% villagers use Liquefied Petroleum Gas (LPG) for cooking purposes and it, therefore stands at second place. Others use kerosene as fuel (10 – 15%) in smaller proportions.

9.0 EFFECTIVE SUB-CATCHMENT

As per Ministry of Environment & Forest (MoEF), Government of India stipulation, any Hydroelctric Project where capacity exceeds 10 MW would have its own Catchment Area Plan. As per Pabbar Valley Master Plant, there are five HEPs viz Tangnu Romai – I HEP (44 MW), Dhamwari Sunda HEP (70 MW), Chirgaon-Majhgaon (46 MW), Paudi Tal Lassa HEP (24 MW), and Sawra Kuddu HEP (111 MW) on River Pabbar. Each of these HEPs will have its effective sub-catchment area covering the area from its barrage and the extending upto barrage immediate upstream HEP. However, Tangnu Romai – I HEP would obviously have its sub-catchment area extending upto the ridge from where Pabbar River orginate. Accordingly, the effective sub-catchment area of the five HEPs is tabulated in Table CAT – ES:3.

TABLE CAT – ES:3

Effective Sub-Catchment Area of Hydro Electric Project – Pabbar Valley

Sr. No.	Description of HEP	Capacity (MW)	Effective Sub-Catchment area (sq.km.)
a)	Tangnu Romai – I	44	156.00
b)	Dhamwari Sunda	70	56.48
c)	Chirgaon-Majhgaon	46	
d)	Paudi Tal Lassa	24	
e)	Sawra Kuddu	111	197.30
	TOTAL		409.78

Sawra Kuddu effective sub-catchment area comprises 65.70 sq.km between its barrage to the barrage of immediate upstream Paudi Tal Lassa HEP and 131.60 sq.km between Sawra Kuddu HEP barrage and its immediate downstream area.

9.1 Treatable Catchment Area

Dhamwari Sunda HEP effective sub-catchment area admeasuring 56.48 sq.km will be its treatable catchment area.

10.0 SLOPE CLASS ZONES IN THE PABBAR VALLEY CATCHMENT AREA

The slope in the total Pabbar Valley catchment area in Himachal Pradesh varies greatly between 10% to 33% i.e. from very very steep to very gentle.

11.0 LAND USE IN THE PROJECT CATCHMENT AREA

The Project Catchment Area of 212.48 sq.km comprise cultivation, croplands, Orchards, moderately thick forests, degraded or scrubbed land, evergreen / semi with or without green-lands, grass land without trees, thaches, ghasnis (grass lands) gair-mumkin, alpine pastures, glaciers etc.

12.0 SOIL IN THE CATCHMENT AREA

Himachal Pradesh has a variety of soils, mainly dependent on the lithology, topography, altitude, climate and vegetation cover. Besides water, soil is another factor, which determines habitat and other settlements in this fragile region. Most of the properties related to soil morphology are inherited from the types of parent rock and their mineralogical assemblage.

The soils of the area are derived from heterogeneous parent materials i.e. gneiss, schist, sandstone and phyllite. The upper and mid mountainous portions that comprise this catchment area are characterized by shallow soils with coarse to medium texture and dark brown to very dark greyish brown colour and have a thick layer of leaf and organic matter on the surface. The soil profiles met within the area (including the catchment area) are generally well developed with clear demarcation of horizons. The soils are brown podsols and transitional podsols. They have a fine texture akin to clays and clayey loams.

Spruce and fir grow on a wide range of soil especially brown soils and podsols. Kail and Deodar generally thrive on brown soils. Large quantities of decomposing vegetative material enrich the forest soils with a good deal of humus. The following textures of soil generally of good depth are met within the area.

a) Loam or clayer loam in Jakhi, Khashdhar area.
b) Sandy loan in Kuddu and Batar forest area.
c) Loamy clays with black color as in oak bearing areas.
d) Loamy soil with a cover of humus suited for Fir and Spruce.

As in Larot, Guas and Chhachpur area, on ridges precipitous slopes and southern aspects, the soils tend to be shallow and dry. It is a common feature around villages because of frequent fires and excessive grazing.

Extracts of the Report on 'Demarcation of Priority sub-watersheds' in he catchment of upper Yamuna river by All India Soil and Land use Survey Organization, Government of India (Report No. Agri.830) indicating important physiographic units classification as per soil taxonomy together with their other important characteristics of soil of upper Yamuna catchment, which includes Pabbar Valley catchment is shown in Table CAT ES: 4.

TABLE CAT - ES: 4

DETAILS OF SOILS OF UPPER YAMUNA CATCHMENT

S. No.	Soil Type	Percentage of Catchment
a)	Sandy	20%
b)	Loamy	15%
c)	Coarse Loamy Soil	25%
d)	Sandy to Coarse Loamy Soil	35%
e)	Clay	5%
	TOTAL	100%

13.0 SOIL EROSION

Lack of proper soil and water conservation measures, coupled with anthropogenic activities cause soil erection and siltation. Such eroded sediment flow in Pabbar River through gullier and streams. Grazing pressure in the catchment area contributes soil degradation and severs run-off and soil erosion. At present, the sediment load in the catchment area of the Dhamwari Sunda Hydroelectric Project to the tune 35,960 MT per year. Catchment Area Treatment comprising Engineering Measures and Biological Measures will reduce the siltation.

13.1 Sediment Load

Based on the measurement of sediment load at hydrological stations set up at Mandlay and Andhra Khad in the past, it was obversed that the percentage of coarse aggregate is comparatively low whereas the fine particle straws a higher percentage. Dhamwari Sunda Hydro Electric Project has set up hydrological station for measurement of sedimentation load. Analysis of sediment collected over a period would help in understanding the nature of siltation and the effective corrective Engineering, Biological Measures to be adopted.

14.0 PRIORITY OF TREATMENT

All India Soil & Land Used Survey (AIS&LUS) Agriculture report No. Agri.830, Mary 1991 compiled by Department of Agriculture and co-operating Ministry of Agriculture, Government of India categorises Pabbar watershed catchment into various sub watersheds and has assigned priority of treatment for each sub watershed. This authenticated Government document would serve as an effective guide for implementation of the Catchment Area Treatment Plan.

15.0 JOINT FOREST MANAGEMENT

As per state of Forest Report 1997, published by Forest Survey of India, country has recorded forest area of 76.52 Million hectare and the actual forest cover is

estimated 63.33 Million hectare, which constitutes 19.27% of the country's geographical area.

The tribal and rural population of the country is heavily dependent on forest resources for meeting their livelyhood needs. The available forest biomass in the natural forests of the country is about 6.0 tonnes per capita only as against 82 tonnes per capita in developing countries as a result of this inbalance, Indian forests are under tremendous biotech pressure. Besides, country's forests are prone to fire very year. Such factors have lead to sever degradation and depeletion of our forest resources. The trend of degradation can be reversed only if our this precious resource is managed sustainably with the involvemnet of local communities in its protection and further development. Joint Forestry Management (JFM) has become an important tool to intervine for Sustainable Forest Management.

15.1 Joint Forest Management in Himachal Pradesh

Government of Himachal Pradesh has its own JFM programme called "*Sanghi Van Yojan – 1998*". At present these are nearly 700 villages forest committies in the State under the Scheme. The committees involve in the state under the level institutions such as Gram Panchayats, Yuvak Mandals, Mahila Mandals, Schools, Ex-Service men's bodies, Village Forest Development Socieites (VFDSs), Community Based Organisations (CBOs), NGOs etc. in sustainable management of forest resources.

The objectives include re-generation of degraded forest areas, conservation and sustainable use of better forest, creation and enhancement social, physical and financial capital of the participating communities for reducing poverties addressing problem of rural un-employment, increasing productivity of forest area, generating awareness and empowering local communities and local level

institutions to become mere pro-active in Sustainable Forest Management (SFM) etc.

The forest officer and village forest protection committees will jointly prepare micro-plan for SFM by taking into considerations, comsumption & livelyhood needs of the local communities, planning higher income, generating, produces, productive potentials of the forest commensurate with their conservation bio-diversity, need for planting multi product with more NTFP oriented approach etc.

15.2 Joint Forest Management in Dhamwari Sunda CAT Plan

VFDs will be formed for the implementation of Dhamwari Sunda CAT Plan. It would encourage participation by active Mahila Mandals, Yuvak Mandals, NGOs, besides concerned Gram Panchayat. Plantations of degraded forest land, NTFP Plantaions, Bomboo and shrub plantations etc. will form the basis for involvement of local committees in JFM. Besides this, the major thrust of the Dhamwari Sunda CAT Plan will be on Income Generation Activities (IGA) for better livelihood of inhabitants without having to enter into the forest.

16.0 OBJECTIVES OF CAT PLAN

Dhamwari Sunda Hydro Electric Project CAT Plan has been prepared in accordance with Government of Himachal Pradesh (Forest Department Notification No. FFE-B-F-(2)-72/2004-Pt-II dated September 30, 2009, endevours to improve the overall environmental conditions through treatment of degraded forest land and sever soil erosion potential areas in the effective catchment area. Various Engineering and Biological Measures will be adopted to maintain eco-system, reduce soil erosion and improve soil conservation measures, rehabilitate degraded forest areas through afforestation, treatment of pasture land and facilitate natural regeneration, demonstrate good practice in agriculture and horticulture land treatment, conserve forest based fuels, conserve & rehabitation riverine flora etc.

16.1 Engineering Measures

Various Engineering Measures will include various types of check dams, stream bank protection, contour staggered trenches, control of land slides, catch water drains, retaining walls, stepping or terracing, bench terracing etc. A silt observatory as mentioned above will be established upstream of Dhamwari Sunda Diversion Structure but downstream of Tangnu Romai barrage.

16.2 Biological Measures

Biological Measures such as restoration of degraded areas by plantation of locally useful plant species (Timber, Fodder, Fuel-wood, Medicinal Aromatic, grasses shrubs, lagumes etc.), suitable nurseries would develop in the area to facilitate treatment and raising of plantation in different pockets. Similarly, Alpine pasture developments & conservation and regreneration of riverine SPP for generation of fuel and fodder will be instituated. Biological Measurement will be undertaken both in Government land and private land.

16.3 Fuel Conservation Measures

Since the suggesed Biological Measures will take time to mature and reach harvesting stage, it is imperative that alternate measures are also adopted to reduce impact of fuel requirement on the forest. The alternate measures would include construction of improved crematoria, LPG connections and issue of pressure cooker to deserving families, installation of water heater and room heater etc. in the effective catchment area.

16.4 Forestry Research and Studies

Forestry research and studies for flora, fauna, ecological, socio-economic etc. in the Project area will be entrusted to leading organisation like IHRI, Shimla, WII, Dehradun, leading recognise universities etc.

16.5 Training of Forest Officials

Forest officers and forest officials will be imparted specialised training and study hours arranged for implementing the CAT Plan both in India and abroad so as to augment their existing skills, none their professional knowledge and capacity building.

16.6 Protection of Forests

Various measures such as controlled burning of forest debris / disposal of slashes will be taken off in dry season in dried off Nalaha, path in accordance with washing plan, rules acts, forest departmental instructions etc. The Forest Department will be equiped with necessary fire fighting kits. Such Nalaha and path will act as fire burrier. New firelines and felling of green trees will be avoided in compliance with honourable Supreme Court Order vide CWP-202/95 dated December 12, 1996 and February 14, 2000.

16.7 Eco-Tourism Development

Potential scenic beauty of the area will be developed for eco-tourism. Eco-tourism, wilderness travel, adventure travel etc. Eco-tourism will be implemented through various Eco-tourism societies, called Eco-Task Force.

16.8 Monitoring & Evaluation

Implementation of the CAT Plan will be effectively evaluated and monitored by Pabbar Valley CAT Plan society. Pending constitution of such society, a Monitoring Committee comprising Conservator of Forest, Shimla (Chairman), Assistant Conservator of Forest, Rohru, Divisional Forest Officer, Rohru (Member Secretary), representative of Panchayati Raj Institutions (i.e. Pradhans of affected Gram Panchayat), Representative of DPC and other experts / eminent personalities co-opted by Chairman of Monitoring Committee. The Committee will meet alteast once a year to assess and evaluate effectiveness

and progress of CAT Plan Implementation and institute corrective measures as required professional monitoring experts will also be engaged to supplement the monitoring efforts of Monitoring Committee.

17.0 PAYMENT FOR ENVIRONMENTAL SERVICES

Payment for Environmental Services (PES) is a new concept expected to galvanise, stake holders, Government, local communities, local institutions for the forest plantation, local irrigation, community based forest management so as to generate better livelihood of inhabitants, provide environmental services and ensure effective incentives to multiple stake holders. It will also encourage local communities to modify land use practices, evolve, control and mitigate siltation, grew and maintain vanity of plantation specially medicinal plant, help manage local forest eco-system etc. Involment of local communities and instution will ensure continuity specially when it would generate good returns for them and the experience gained will be pumed on from generation to generation.

However, PES being a new concept, it is natural and necessary that a pilot Project planned, designed, experimented and achieve results analysing for bettter results by considering scope and design of various models.

18.0 CAT PLAN COST ESTIMATE

Based on the prevailing schedule rates as per financial year 2005 – 06 as applicable in Shimla Forest Circle, Forest Department, Himachal Pradesh an estimated cost of Rs. 300.15 lacs has been provisioned for the implementation of CAT Plan in the effective Project Catchment area.

19.0 ORGANISATION STRUCTURE AND IMPLEMENTATION STRATEGY

Execution of CAT Plan will be carried out through State Forest Department under the overall administrative and financial control of the Conservator of Forest (CF), Shimla. However, the actual implementation will be affected by Divisional Forest

Officer (DFO), Rohru. DFO will compile Annual Plan of Operation (APO) recommended by CF, Shimla and approved by Principal Chief Conservator of Forest (PCCF). Any subsequent modifications / alternations / additions / deletions / to the approved APO shall be approved by PCCF.

The Implementation Agency will mainain close liaison with other Departments like Civil, Administraion, Agriculture, Horticulture, Animal Husbandry, Art & Culture, Social Welfare and Panchayati Raj participation of the local inhabitants will be ensured so as to provide them employment and create awarness towards the environment.

19.1 Placing of Implementation

CAT Plan will be implemented over a period of ten years commencing financial year 2010 – 11 to financial year 2018 – 19. Afforestation, pasture development, soil conservation activities will be implemented during first five to six years and maintained till the completion of plan period. Similarly, necessary infrastructure and establishment nurseries will be completed during the first year of plan period.

19.2 CAT Plan Implementation Staff and Its Headquarter

Exisiting Staff of DFO, Rohru and Eco-Task Force will be involved in the implementation of CAT Plan. Their headquarter will be established as per their territorial jurisdiction.

19.3 Cost Escalation

CAT Plan Projections have been computed using prevailing wage rates as indicated above. Escalation of wage rate and material cost would have corresponding effect on the computed estimates. Such differential amount will be met from the provisioned contigencies in the CAT Plan Cost Estimate.

CHAPTER – 1

GENERAL DESCRIPTION OF DHAMWARI SUNDA HYDRO ELECTRIC PROJECT AREA

CATCHMENT AREA

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CHAPTER 1

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1.0 GENERAL DESCRIPTION OF THE PROJECT AREA

1.1 INTRODUCTION

1.1.1 CATCHMENT AREA

Pabbar River is a tributary of Tons River which is a major tributary of Yamuna River. It originating at Gangdari Dhar ranges of Himalaya at an elevation of EL 5100 m in Himachal Pradesh. The total catchment area of Pabbar River in Himachal Pradesh is 1200 km^2. The Diversion Structure of the 70 MW Dhamwari Sunda Hydro Electric Power Project is proposed near village Romai down stream of Tail Race of 44 MW Tangnu Romai Hydro Electric Project. The total catchment of the Project above the Diversion Structure is 212.48 km^2.

The catchment area of 212.48 km^2 is situated in Khashdhar Forest Range, Chirgaon Tehsil, District Shimla, Himachal Pradesh. The location of the catchment area is between longitude 31°-15'-00" N to 31°-15'-42" N and latitude 77°-57'-10" E to 77°-59'-20" E. The outline of the catchment area and delineation of sub-watersheds above Romai Diversion Structure Site is shown in Fig 1.1.

Dhauladhar forming the Northern boundary of the catchment area separates it from Kinnaur Forest Division, Kinnaur District whereas along the North Western tip, the area borders Kotgarh Forest Division. On Eastern side, it is bounded by Dodra Kawar Forest Range and on the Southern and Western side by the remaining part of Khashdhar Forest of Rohru Forest Division.

Pabbar River has great power potential because of its steep bed slope and is being fed from a mountain catchment consisting of a large number of glaciers. As per the "Master Plan Studies of Pabbar River Basin" undertaken by Swedpower, Sweden in 1988-90, Pabbar River has a power potential of around 300 MW and had recommended establishing five Hydro Electric Projects on the main Pabbar River in HP. The uppermost being Tangnu-Romai (44 MW) followed by Dhamwari Sunda (70 MW), Chirgaon-Majhgaon (46 MW), Pauditai-Lassa (24 MW) and Sawra-Kuddu (111 MW).

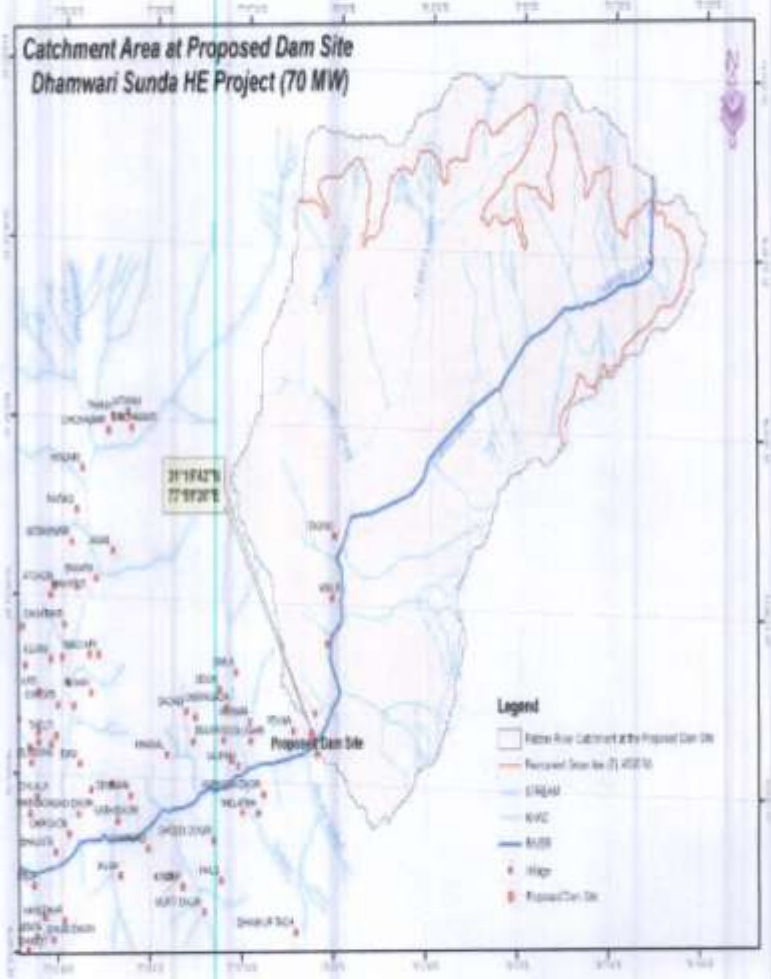


Figure 1.1 Catchment of the Pabbar River at the proposed diversion dam site

1.1.2 EFFECTIVE SUB-CATCHMENT

Since the generation capacity of each of the Hydro Electric Project captioned above exceeds 10 MW, each one of these Hydro Electric Projects would have their own Catchment Area Treatment Plan (CAT Plan) as per Government of India stipulations. Hence, the whole catchment of Pabbar in HP can be subdivided into six zones as there would be one sub-catchment for each HEP covering area from its barrage extending up to the barrage site of immediate upstream HEP, which would be its **effective sub-catchment**. Effective sub-catchment of the uppermost HEP (i.e. Tangnu Romai (44 MW) HEP at village Tangnu would obviously extend right up to the ridge from where Pabbar River originates. Total effective catchment area of Tangnu Romai HEP is 156 km^2. The sixth sub-catchment would consist of areas draining into Pabbar River below the barrage site of lower most Project (i.e. Sawra-Kuddu (111 MW) HEP at Hatkoti) in HP down to its Tail Race outlet confluence with Pabbar River. This sixth zone / sub-catchment area is 65.7 km^2. The effective sub-catchment of Dhamwari Sunda HEP accordingly, will be the area draining between the barrage site of the immediate upstream Project (i.e Tangnu Romai HEP) down to the Diversion Structure location of Dhamwari Sunda. The area of **effective sub-catchment** of this Project is (212.48 km^2 – 156 km^2) = 56.48 km^2.

1.1.3 DOWN STREAM EFFECTIVE SUB-CATCHMENT

Adopting the analogy enumerated above, the effective sub-catchment for Hydro Electric Project downstream of Dharmwari Sunda Hydro Electric Project Diversion Structure as follows:

(a) **Chirgaon-Majhgaon (46 MW)**
The Catchment area down stream of Dharmwari Sunda Hydro Electric Project Diversion Structure to its own barrage including its balancing reservoir.

(b) **Paudital-Lassa (24 MW)**
The catchment area down stream of Chirgaon-Majhgaon Barrage Structure to its own Barrage.

(c) **Sawra-Kuddu (111 MW)**
The catchment area down stream of Paudital-Lassa Barrage Structure to its own Barrage. It is understood that this area of effective sub-catchment for Sawra-Kuddu works out to 197.30 km^2.

1.1.4 TREATABLE CATCHMENT AREA

The treatable catchment of Dharmwari Sunda Hydro Electric Project is the effective sub-catchment and measuring 56.48 km^2 as enunciated under sub-section 1.1.2 above.

1.2 TRIBUTARIES OF PABBAR RIVER AND ITS GRADIENT

The gradient of the Pabbar River over the entire stretch ranges 15-40m/km, but reaches values up to 200m/km in the upper most regions. The river valley in upper region is very narrow and located between steep and high mountain ranges while along the lower stretches it is wider. The Pabbar River is joined by various Nallahs / Khads in the course from its origin to Dharmwari Sunda Hydro Electric Project Diversion Structure near village Romai, Numerous tributaries known locally as Khads / Nallahs join Pabbar River in its course in HP up to the Diversion Structure of the Project. These include Supin khad, Sundru khad, Surkhi khad, all from the right bank of the Pabbar River. Incidentally upstream of Surkhi khad, the catchment area is snow bound.

1.3 HYPSOMETRIC OF THE DHARMWARI SUNDA HYDRO ELECTRIC PROJECT CATCHMENT

Table 1.1 shows the hypsometric details of the catchment at the proposed Diversion Structure of Dharmwari Sunda Hydro Electric Project together with hypsometric covers at figure 1.2 and figure 1.3 showing elevation range (m) vs. cumulative catchment area (km^2)and relative height (h/H) vs. relative area (a/A) respectively.

TABLE 1.1

DETAILS OF HYPSOMETRIC OF THE CATCHMENT AT THE PROPOSED DIVERSION DAM SITE OF DHAMWARI SUNDA HYDRO ELECTRIC PROJECT

Sl.No.	Contour Interval (m)	Area between Contours (m^2)	Percentage of Total Area	Area (a) above EL 2100m (Km^2)	Height (h) above EL 2100m	Relative Height (h/H)	Relative Area (a/A)
1	2100 - 2200	200040.83	0.094	212.28	0	0.00	1.000
2	2200 - 2300	723302.00	0.340	211.56	90	0.03	0.997
3	2300 - 2400	1111900.25	0.523	210.45	190	0.06	0.991
4	2400 - 2500	1656674.27	0.780	208.79	290	0.09	0.984
5	2500 - 2600	2296736.52	1.081	206.49	390	0.13	0.973
6	2600 - 2700	4461695.00	2.100	202.03	490	0.16	0.952
7	2700 - 2800	4884706.27	2.299	197.15	590	0.19	0.929
8	2800 - 2900	5045402.45	2.374	192.10	690	0.22	0.905
9	2900 - 3000	6238270.93	2.936	185.86	790	0.26	0.876
10	3000 - 3100	7299232.71	3.435	178.56	890	0.29	0.841
11	3100 - 3200	7733506.42	3.640	170.83	990	0.32	0.805
12	3200 - 3300	8730193.38	4.109	162.10	1090	0.35	0.764
13	3300 - 3400	9370992.97	4.410	152.73	1190	0.39	0.719
14	3400 - 3500	10634794.60	5.005	142.10	1290	0.42	0.669
15	3500 - 3600	11397463.14	5.364	130.70	1390	0.45	0.616
16	3600 - 3700	10212241.91	4.806	120.49	1490	0.48	0.568
17	3700 - 3800	11339947.46	5.337	109.15	1590	0.51	0.514
18	3800 - 3900	10734166.75	5.052	98.41	1690	0.55	0.464
19	3900 - 4000	11347378.15	5.340	87.06	1790	0.58	0.410
20	4000 - 4100	11464190.89	5.395	75.60	1890	0.61	0.356
21	4100 - 4200	11997266.86	5.646	63.60	1990	0.64	0.300
22	4200 - 4300	12255648.41	5.768	51.35	2090	0.68	0.242
23	4300 - 4400	11999572.90	5.647	39.35	2190	0.71	0.185
24	4400 - 4500	10527529.44	4.955	28.82	2290	0.74	0.136
25	4500 - 4600	9087867.36	4.277	19.73	2390	0.77	0.093
26	4600 - 4700	8296177.35	3.904	11.44	2490	0.81	0.054
27	4700 - 4800	6056356.48	2.850	5.38	2590	0.84	0.025
28	4800 - 4900	3288649.44	1.548	2.09	2690	0.87	0.010
29	4900 - 5000	1472239.75	0.693	0.62	2790	0.90	0.003
30	5000 - 5100	524488.68	0.247	0.09	2890	0.94	0.000
31	5100 - 5200	94100.55	0.044	0.00	2990	0.97	0.000
32	5200 - 5300	13.72	0.000	0.00	3090	1.00	0.000

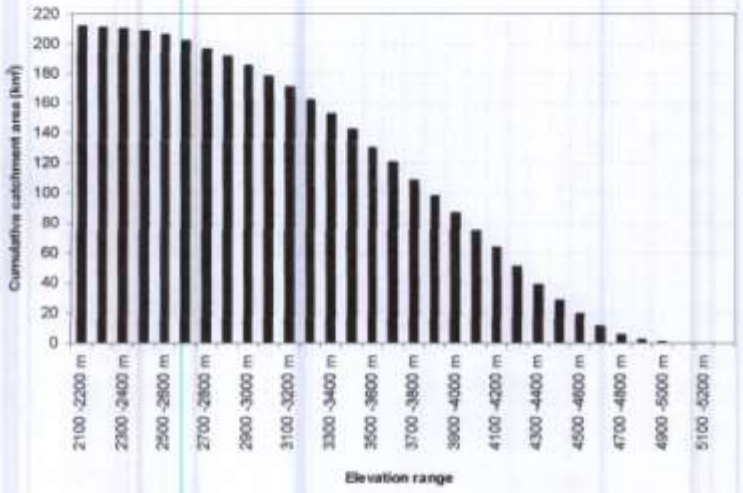


FIGURE 1.2

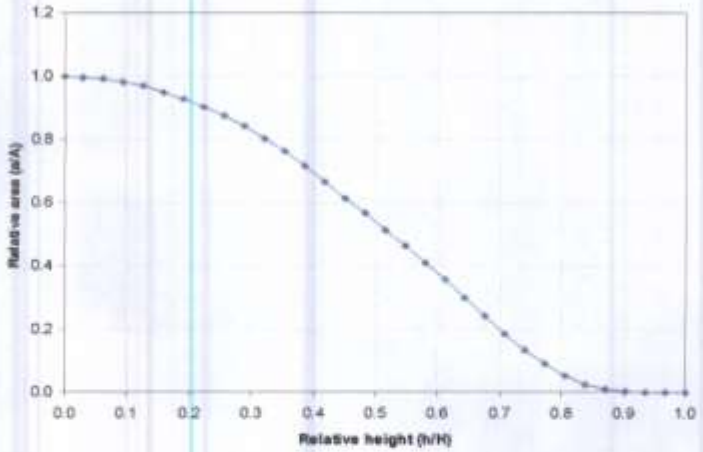


FIGURE 1.3

The catchment area of the Pabbar River at the dam site lies between latitudes 31°15'0" N to 31°25'8" N and longitudes 77°57'10" E to 78°9'40" E. The catchment area of the Pabbar River at the location of the proposed Diversion Structure site is 212.48 km^2. About 80% of this area lies above elevation 3200 meters and about 50% above EL 3800 meters. The permanent snowline encompasses about 14% of the catchment area at the proposed Diversion Structure site.

1.4 SLOPE CLASS ZONES IN THE CATCHMENT

The slope in the total Pabbar valley catchment area in Himachal Pradesh varies greatly between gentle to extreme of gradients given in Table 1.2 and depicted Figure 1.4

TABLE 1.2

GRADIENTS OF CATCHMENT AREA

S.No.	Classification of Slopes	Percentage of Catchment
a)	Very gently to gently sloping	1-10%
b)	Moderately steep to steep	15-33%
c)	Steep to very steep	15-33%
d)	Very steep to very very steep	> 33%

1.5 LAND USE IN THE PROJECT CATCHMENT AREA

The land use classification and coverage in the Project catchment area, as per the land use map (Source: Forest Department, Revenue Department, Survey of India Topo-sheet and others) cultivation (Cropland), Orchards, moderately thick forests, degraded or scrub land, evergreen / semi with and without grasslands, grazing land without trees, thaches, ghasnis (grass lands) gair-mumkin, alpine pastures, glaciers etc. are given in Table 1.3.

TABLE 1.3

LAND USE IN THE PROJECT CATCHMENT AREA

S. No.	Type of Land Use	Area (Ha)	Percentage of Total
1.	Cultivation (CroPland)	480	2.26
2.	Orchards	42	0.20
3.	Moderately Thick Forests & Moderately Thick Forests and Grasslands	3750	17.65
4.	Grazing Land with Trees	1235	5.81
5.	Grazing land without Trees	223	1.05
6.	Thaches	300	1.41
7.	Ghasnis (Grasslands)	407	1.92
8.	Gair Mumkin	129	0.61
9.	Alpine Pastures	14654	68.97
10.	Glaciers	28	0.12
	Total	**21248**	**100.00**

1.6 SOIL IN THE CATCHMENT

Himachal Pradesh has a variety of soils, mainly dependent on the lithology, topography, altitude, climate and vegetation cover. Besides water, soil is another factor, which determines habitat and other settlements in this fragile region. Most of the properties related to soil morphology are inherited from the types of parent rock and their mineralogical assemblage.

The soils of the area are derived from heterogeneous parent materials i.e. gneiss, schist, sandstone and phyllite. The upper and mid mountainous portions that comprise this catchment area are characterized by shallow soils with coarse to medium texture and dark brown to very dark greyish brown colour and have a thick layer of leaf and organic matter on the surface. The soil profiles met within the area (including the catchment area) are generally well developed with clear demarcation of horizons. The soils are brown podsols and transitional podsols. They have a fine texture akin to clays and clayey loams.

Spruce and fir grow on a wide range of soil especially brown soils and podsols. Kail and Deodar generally thrive on brown soils. Large quantities of decomposing vegetative material enrich the forest soils with a good deal of humus. The following textures of soil generally of good depth are met within the area.

a) Loam or clayer loam in Jakhi, Khashdhar area.
b) Sandy loan in Kuddu and Batar forest area.
c) Loamy clays with black color as in oak bearing areas.
d) Loamy soil with a cover of humus suited for Fir and Spruce.

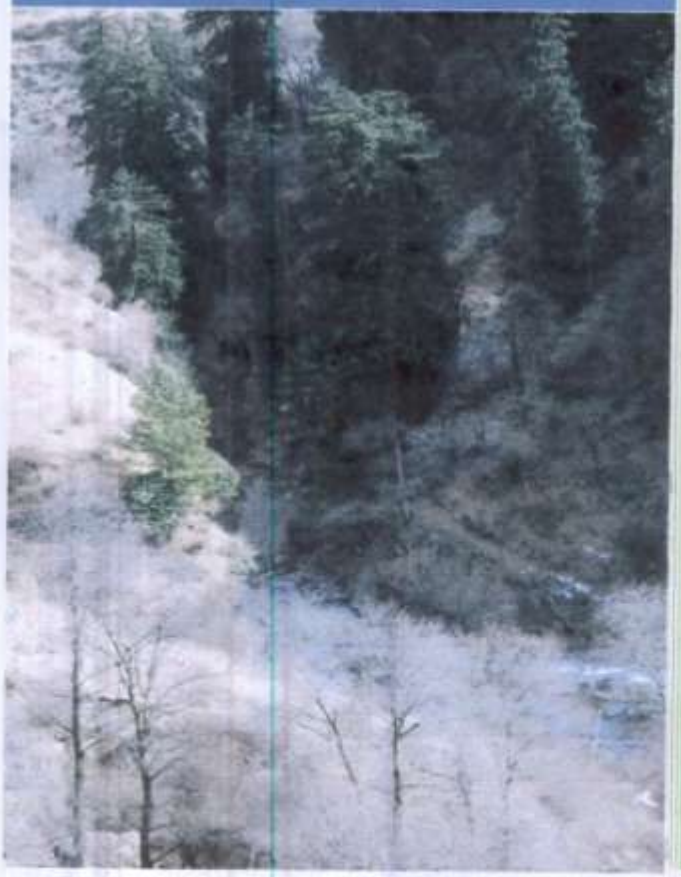
As in Larot, Guas and Chhachpur area, on ridges precipitous slopes and southern aspects, the soils tend to be shallow and dry. It is a common feature around villages because of frequent fires and excessive grazing.
Extracts of the Report on 'Demarcation of Priority sub-watersheds' in he catchment of upper Yamuna river by All India Soil and Land use Survey Organization, Govt. of India (Report No. Agri.830) indicating important physiographic units classification as per soil taxonomy together with their other important characteristics of soil of upper Yamuna catchment, which includes Pabbar Valley catchment is shown in Table 1.4.

TABLE 1.4

DETAILS OF SOILS OF UPPER YAMUNA CATCHMENT

S. No.	Soil Type	Percentage of Catchment
a)	Sandy	20%
b)	Loamy	15%
c)	Coarse Loamy Soil	25%
d)	Sandy to Coarse Loamy Soil	35%
e)	Clay	5%
	TOTAL	100%

CHAPTER – 2
PROBLEM ANALYSIS AND OBJECTIVES



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2.1 SOIL EROSION

Lack of proper soil and water conservation measures coupled with anthropogenic activities in the catchment leads to increase in silt flow in the Pabbar River. The increased run off from the denuded mountain slopes and others finds its way into the river through a network of gullies and streams carrying sediments with its flow. The most important sources of this sediment flow immediately entering into the rivers are gully and stream back erosion. Another important factor that adds to sediment load and which contributes to soil degradation is the grazing pressure. A large number of animals graze the pastures, due to this pressure – the productivity of the pasture is also declining further. The lack of proper vegetal cover is a factor to cause degradation and thereby results in severe run-off/soil erosion and subsequently premature siltation of the reservoir. The path / road construction activities frequent land slides and slips along the river also contribute to the huge debris in the beds of river and call for suitable control measures.

Thus, the soil erosion in the catchment would reduce the productivity of land, effect adversely the local water supplies, cause aridity in the climate and increase the frequency of land slides / slips beside contributing to sediment load to the reservoir. Instead of undertaking expensive and difficult de-silting operations treatment in the catchment of the River will reduce the silt inflow and require lesser efforts and expenditure.

At present the sediment output of the catchment above the Diversion Structure of Dhamwari Sunda Hydro Electric Project is to the tune of about 35960 tonnes/year as per details given in the succeeding paragraphs under sub-section 7.8. The conditions obtaining in the catchment leading to the generation of silt are not static. The catchment is a dynamic entity bustling with human and non-human activities. As such the silt generation is greatly influenced by the scale of these activities.

2.2 SEDIMENT LOAD

Measurement of suspended sediments transported by River Pabbar is a direct indication of soil erosion taking place in the catchment area. Based on the sediment load measurement hydrological station set up at Mandlay, the available sediment data collected between 1979 to 1988 is given in Table 2.1 (Monthly suspended Sediment load in terms coarse, medium and fine), Table

2.2 (Annual Sediment load tones/year and percentage) and Table 2.3 (Mean Monthly Sediment load – in tones/month and percentage).

TABLE 2.1
SUSPENDED SEDIMENT LOAD AT MANDLAY AND AT ANDHRA KHAD
(in tonnes per month)

Year /	MANDLAY				ANDHRA KHAD			
Month	Course	Med	Fine	Total	Course	Med	Fine	Total
1979								
March	6	3	172	181	-	-	-	-
April	199	174	1757	2130	11	10	379	400
May	471	417	2702	3590	85	64	552	701
June	1971	1654	3379	7004	332	270	577	1179
July	5495	3924	6066	15485	847	617	1080	2544
August	4219	3129	3593	10941	744	527	650	1921
Sept	213	154	598	965	46	24	160	230
Oct	10	4	203	217	-	-	42	42
Nov	-	-	-	-	-	-	-	-
Total	**12584**	**9459**	**18470**	**40513**	**2065**	**1512**	**3447**	**7024**
1980								
March	-	-	-	-	-	-	-	-
April	28	25	354	407	-	-	42	42
May	136	121	1109	1366	-	-	185	185
June	1940	1810	3389	7139	277	260	497	1034
July	40680	15169	7545	63394	19796	6108	1461	27365
August	39508	34458	9915	83881	10140	8394	2911	21445
Sept	402	335	1061	1798	122	79	299	500
Oct	19	11	202	232	-	-	63	63
Nov	-	-	-	-	-	-	-	-
Total	**82713**	**51929**	**23575**	**158217**	**30335**	**14841**	**5458**	**50634**
1981								
March	4	3	120	127	-	-	-	-
April	121	92	1115	1328	-	-	85	85
May	425	350	1575	2350	-	-	149	149
June	370	373	2256	3007	40	39	320	399
July	7371	6194	5246	18811	7374	6195	5239	18808
August	24374	12285	7580	44239	3756	2157	1195	7088
Sept	443	398	587	1428	114	92	145	351
Oct	24	15	158	197	-	-	36	36

Nov	-	-	-	-	-	-	-	-
Total	**33140**	**19710**	**18637**	**71487**	**11264**	**8483**	**7169**	**26916**
1982								
March	-	-	197	197	-	-	15	15
April	145	110	660	915	-	-	-	-
May	322	228	988	1538	51	32	179	262
June	543	421	1116	2080	136	117	261	514
July	3285	2765	2146	8196	-	-	-	-
August	20643	14118	5390	40150	3827	4183	1004	9014
Sept	1187	1015	798	3000	209	172	139	520
Oct	76	56	259	391	-	-	60	60
Nov	-	-	35	35	-	-	10	10
Total	**26201**	**18713**	**11589**	**56503**	-	-	-	-
1983								
March	-	-	67	67	-	-	-	-
April	117	101	368	586	29	19	117	165
May	560	514	866	1940	135	118	232	485
June	806	746	933	2485	246	225	300	771
July	4998	3962	2688	11648	1273	1036	695	3004
August	16558	12087	5181	33826	-	-	-	-
Sept	8389	5689	2759	16837	2049	1361	834	4244
Oct	762	373	485	1620	179	71	117	367
Nov	35	24	70	129	-	-	33	33
Total	**32225**	**23496**	**13417**	**69138**	-	-	-	-
1984								
March	-	-	168	168	-	-	8	8
April	64	49	316	429	-	-	74	74
May	418	366	645	1429	72	61	145	278
June	948	819	830	2597	213	190	190	593
July	5165	3054	2255	10474	1717	840	734	3291
August	13097	6989	4014	24100	3315	1733	1070	6118
Sept	4176	2127	2100	8403	1052	527	588	2167
Oct	307	232	388	927	46	32	90	168
Nov	8	6	44	58	-	-	3	3
Total	**24183**	**13642**	**10760**	**48585**	**6415**	**3383**	**2902**	**12700**
1985								
March	-	-	31	31	-	-	-	-
April	19	7	125	151	-	-	47	47
May	129	93	367	589	35	14	122	171
June	363	240	489	1092	95	53	147	295

July	9755	6527	4566	20848	1928	1248	1012	4188
August	12049	7161	5496	24706	2303	1311	1041	4655
Sept	2113	1751	1920	5784	299	253	289	841
Oct	1211	898	1464	3573	185	135	243	563
Nov	7	3	63	73	-	-	-	-
Total	**25646**	**16680**	**14521**	**56847**	**4845**	**3014**	**2901**	**10760**
1986								
March	-	-	152	152	-	-	-	-
April	39	35	328	402	-	-	68	68
May	193	163	588	944	56	31	204	291
June	685	521	1011	2217	81	54	156	191
July	12958	8362	5707	27027	1183	817	660	2660
August	27418	19157	12903	59478	3770	2770	2146	8686
Sept	1097	887	1077	3061	1097	887	1077	3060
Oct	211	172	331	714	211	172	331	714
Nov	7	6	40	53	7	6	40	53
Total	**42608**	**29303**	**22137**	**94048**	**6405**	**4737**	**4695**	**15837**
1987								
March	-	-	90	90	-	-	-	-
April	51	33	254	338	-	-	68	68
May	662	328	1194	2184	129	47	268	444
June	734	619	1273	2626	68	50	136	254
July	3166	1604	2634	7404	453	207	421	1081
August	8610	4973	4530	18113	1215	603	606	2424
Sept	2346	1155	2228	5729	291	124	303	718
Oct	316	270	507	1093	18	14	43	75
Nov	19	11	67	97	-	-	-	-
Total	**15904**	**8993**	**12777**	**37674**	**2174**	**1045**	**1845**	**5064**
1988								
March	-	-	-	-				
April	65	40	403	508				
May	247	188	778	1213				
June	699	409	1054	2162				
July	27964	19199	13772	60935				
August	15066	10340	9067	34473				
Sept	71158	51153	27851	150162				
Oct	791	605	1230	2626				
Nov	8	4	60	72				
Total	**115998**	**81938**	**54215**	**252151**				

TABLE 2.2

ANNUAL SEDIMENT LOAD AT MANDLAY
(in tonnes/year and percentage)

Year	Coarse		Medium		Fine		Total	
	Tonnes	Per-centage	Tonnes	Per-centage	Tonnes	Per-centage	Tonnes	Per-centage
1979	12584	31.1	9459	23.3	18470	45.6	40513	100.0
1980	82713	52.3	51929	23.3	23575	14.9	158217	100.0
1981	33140	46.4	19710	32.8	18637	26.0	71487	100.0
1982	26201	46.4	18713	27.6	11589	20.5	56503	100.0
1983	32255	46.6	23496	33.1	13417	19.4	69138	100.0
1984	24183	49.8	13642	34.0	10760	22.1	48585	100.0
1985	25646	45.1	16680	28.1	14521	25.6	56847	100.0
1986	42608	45.3	29303	29.3	22137	23.5	94048	100.0
1987	15904	42.2	8993	31.2	12777	33.9	37674	100.0
1988	115998	46.0	81938	23.9	54215	21.5	252151	100.0
Mean	**41120**	**46.5**	**27386**	**32.5**	**20010**	**22.6**	**88516**	**100.0**

It is observed from the table that the percentage of coarse material is comparatively low during years with low total loads, whereas fine particles show a high percentage. The reverse is true during years with high total loads. This is also what can be expected, as higher water discharges give higher water velocities, more turbulent flow, and a higher capacity for keeping coarse particles in suspension.

The same tendency is still more evident, if the months of the year are treated separately. In Table 2.3 the mean monthly sediment load is given for the 10 year period 1979-88.

TABLE 2.3

MEAN SEDIMENT LOAD AT MANDLAY FOR EACH MONTH DURING THE PERIOD 1979-88
(in tonnes/month and percentage)

Year	Coarse		Medium		Fine		Total	
	Tonnes	Per-centage	Tonnes	Per-centage	Tonnes	Per-centage	Tonnes	Per-centage
March	1	1.0	1	0.6	99	98.4	101	100.0
April	85	11.8	67	9.3	568	14.9	720	100.0
May	356	20.8	277	16.1	1081	26.0	1714	100.0
June	907	28.0	761	23.5	1573	20.5	3241	100.0
July	12084	49.5	7076	29.0	5262	19.4	24422	100.0
August	18154	48.6	12470	33.3	6767	22.1	37391	100.0
Sept	9152	46.4	6466	32.8	4098	25.6	19716	100.0
Oct	373	32.2	263	22.7	523	33.9	1159	100.0
Nov	9	16.2	5	10.4	38	21.5	52	100.0
Total	**41120**	**46.6**	**27386**	**30.9**	**20101**	**22.6**	**88516**	**100.0**

The table shows very clearly how the percentage of coarse material is very low in the beginning of the year (March, April, May). It increases continuously to a maximum in July – August. Then it decreases again until the end of the period in November, medium particle sizes show a similar trend, whereas the most fine-grained material shows a reverse trend, with high percentage in the beginning and in the end of the period and a minimum in August, just below 20%. The mean values for the 10 year period are: coarse material 46.5% medium 30.9% and fine-grained material 22.6%.

The mean annual suspended sediment load at Mandalay during 1979-88 was 88516 tonnes per annum as shown in Table 2.3. As the area of drainage basin (catchment area) of Mandlay 523 km^2, the annual suspended load amounts to 169 tonnes/km^2. Accordingly, the sediment load at Dhamwari Sunda Hydro Electric Project Diversion Structure for its catchment area of 212.48 km2 will work out to be 35960 tonnes per years.

2.3 PRIORITY OF TREATMENT

Demarcation of Priority sub-watersheds in the catchment of Upper Yamuna River (Flood Prone) which includes catchment of Pabbar River was carried by Rapid Reconnaissance survey of the area by All India Soil and Land Use Survey (AIS&LUS), Department of Agriculture and Cooperating, Ministry of Agriculture, Govt. of India from October to November 1985. Findings are given in their Report No. Agri.830, May 1991.

The All India Soil & Land Use Survey (AIS&LUS), Agriculture Report No. Agri.830, May 1991 has bee adopted for deciding the priority of area for treatment susceptibility to soil erosion. This report categorized Pabbar Watershed catchment into various sub-watersheds. Priority of treatment has been assigned to each sub-watershed based on value obtained for run-off potential as tabulated in Table 2.5 to 2.7.

The mapping units in the above Agriculture Report were indicated with symbols I1, M1, M2, M3, P1, P2, U1 & U2 and were assigned weightage values of Run-off Potential implying likely run-off percentage (relative values) from the areas of the relevant mapping units in consideration. All pro and run-off characters were taken into account. Primarily, mapping units of higher run-off potential values are donors of excessive run-off and lower RPI are the recipient units where run-off often accumulates or goes down through percolation. The donor mapping units need effective soil and water conservation measures such as terracing afforestation, engineering works etc. to check excess run-off while recipients need internal and external drainage improvement. Finally the sub-watershed areas under each mapping unit were calculated by a Planimeter. This was multiplied by run-off potential value.

The run-off product was divided by total area of the sub-watersheds which furnishes the average run-off potential index for the whole sub-watershed. The calculation is represented by the following formula:

$$RPI = \frac{\sum AR \times WR}{AS}$$

Whereas

RPI = Run-off Potential Index for the Sub-watershed.
AR = Area of Run-off Potential Mapping Units
WR = Weightage value of Run-off Potential Unit
AS = Total Area of the Sub-watershed

	vegetation; brown to very dark greyish brown, shallow to moderately deep, coarse loamy soils; 15-40% rock out crops; moderate to severe erosion with occasional land slides	
U_1	Very Steep to very very steep (more than 33% mountain slopes; snow bound for 5 to 8 months in a year; thin grassy cover; brown to dark greyish brown; very shallow to shallow, coarse loamy soils; 15-40% rock out crops; moderate to severe erosion which occasional land slides	60
U_2	Very steep to very very steep (more than 33%) mountain slopes, glacier etc; permanent snow cover	40

2.3.1 EROSION INTENSITY MAPPING UNITS

The differentiating characteristics of the erosion intensity mapping units which were followed in Agriculture Report No. Agri.830, May 1991 are given Table 2.5.

Higher the run-off potential indices, higher will be the priority. A detailed description of the erosion intensity mapping legend is given in Table 2.4.

TABLE 2.4

RUN-OFF POTENTIAL MAPPING UNIT LEGEND

Mapping Symbol	Description	Approved Run-Off Potential Value
I_1	Very gently to gently slopping (1-10% river terraces : Cultivated, brown to very dark grayish brown and dark Yellow brown, moderately deep to very deep to very deep coarse loamy soils; slight erosion	50
M_1	Moderately steep to steep (15-53%) mountain side slopes, cultivated poorly terraced; brown, shallow to moderately deep sandy to coarse loamy soils, moderate to sever erosion	65
M_2	Moderately steep to steep (15-33%) mountain side slopes; thin forest vegetation (mostly bushes) and grass lands; brown to dark greyish brown, shallow to moderately deep, sandy to coarse loamy soils; 10-25 rock out crops; moderate to severe erosion with occasional land slips	70
M_3	Moderately steep to steep (15-33%) mountain side slopes, moderately thick forest, vegetation and grasslands; brown to dark greyish brown, shallow to moderately deep, sandy to coarse loamy soils; 10-25% rock out crops; moderate to severe erosion with occasional landslips	65
P_1	Very steep to very steep (more than 33% mountain side slopes; grass lands and thin forest vegetation (mostly bushes); dark brown to dark greyish, brown and dark yellowish brown shallow to moderately deep, coarse loamy soils, 15-40% rock out crops; moderate to severe erosion with occasional land slides.	80
P_2	Very steep to very very steep (more than 33% mountain side slopes, moderately thick forest	75

TABLE 2.5
DIFFERNTIATING CHARACTERISTICS OF THE EROSION INTENSITY MAPPING UNITS

S. No.	Physio graphic Unit	Erosion Intensity Mapping Unit	Slope Gradient	Soil			Land Use	Protection Measures	Erosion Status	Run-Off Potential (%)
				Depth	Colour	Texture				
1	River terraces	I_1	1-10%	Mod. deep to very deep	Brown to very dark greyish brown & dark yellowish brown	Coarse loamy	Cultivated	Moderately conserved	Slight	50
2	Mountain side slopes	M_1	15-33%	Shallow to mod. deep	Brown to dark greyish brown	Sandy to coarse loamy	Cultivated	Poorly conserved	Moderate to severe	65
3	Mountain side slopes	M_2	15-33%	Shallow to mod. deep	Brown to dark greyish brown	Sandy to coarse loamy (10-25% R)	Thin forest and grass lands	Poorly conserved	Moderate to severe with occasional land slips	70
4	Mountain	M_3	15-33%	Shallow	Brown to dark	Sandy	Mod.	Poorly	Moderate to	65

	side slopes			to mod. deep	greyish brown	to coarse loamy (10-25% R)	thick forest and grass lands	conserved	severe with occasional land slips	
5	Mountain side slopes	P_1	> 33%	Shallow to mod. deep	Dark brown to dark greyish brown & dark yellowish brown	Coarse loamy (15-45% R)	Grass lands and thin forest	Poorly conserved	Moderate to severe with occasional land slips	80
6	Mountain side slopes	P_2	> 33%	Shallow to mod. deep	Brown to dark greyish brown	Coarse loamy (15-45% R)	Mod. thick forest	Poorly conserved	Moderate to severe with occasional land slips	75
7	Mountain slopes (snow bound for 5-8 months	U_1	> 33%	Very shallow to shallow	Brown to dark greyish brown	Coarse loamy (15-45% R)	Thin grass cover	Poorly conserved	Moderate to severe with occasional land slips	60
8	Mountain slopes (glaciers)	U_2	> 33%	--	--	--	--	--	--	40

R = Rock out crops.

The indices used in Table 2.5 above have been and are still in vogue for deciding the priority of treatment under River Valley Project (RVP) and Food Phone River (FPR), schemes of Ministry of Agriculture, Government of India. Although some of the water sheds may have been treated in the past yet as mentioned elsewhere, the situation in the catchment is dynamic and proneness to soil erosion keeps varying with time. Moreover, due to this scheme's own limitations entire watershed in many cases could not be treated as norms provided for hilly regions were kept at par or even below those of plain areas. Physical norms for number of Plants per hectare of treated land were also reduced considerably to obviate incurring expenditure beyond the cost norms. For the same reasons barbed-wire fencing was not provided to the Plantations and instead live hedge fencing was attempted. Effectiveness of live hedge fencing has been and is debatable in these regions as it was created in the same year as that of main species Planting. Owing to slow growth rates in these colder climes the fencing has by and large remained ineffective. This seriously compromised the quality of treatment provided. Relative Priority Index has been classified as per requirement of this CAT Plan and may be at variance with those followed in RVP / FPR scheme. Without passing any value judgement on the success or otherwise of the treatments done in the past, effort would again be made in this Plan to treat all sub-watersheds afresh with new initiatives to reduce silt flow which remains one of the objectives of this Plan.

The priority classes vis-à-vis run off potential index is given as under:

TABLE 2.6
RELATIVE PRIORITY INDEX CLASS

S.No.	Relative Priority Index Class	Treatment Priority
1	> 80	Critical
2	56 – 80	Very High
3	46 – 55	High
4	31 – 45	Medium
5	< 30	Low

A word of caution needs to be added here that the AIS&LUS despite being the only authentic survey ever taken to cover all the sub-watersheds may have become dated for some areas in view of fact changing conditions in and dynamics of the catchments. As such some deviations may have to be made at the time of implementation. The implementing agency would use its own observation, experience and judgement while making departure from this prioritization of sub-watersheds for treatment.

TABLE 2.7
CHARACTERISTIC OF YAMUNA BASIN – PABBAR VALLEY
PRIORITY SUB-WATERSHEDS

S.No.	Sub-Watershed Code	Symbol	Area in Ha	Run-off Potential Values	Product of Area and Run-off	Run-off Potential Index (RPI)	Relative Priority
1	Ym3m	I_1	825	50	41250		
		M_2	125	70	8750		
		P_1	475	80	38000		
		U_1	125	60	7500		
	Total		**1550**		**95500**	**66**	**III**
2	ym3n	I_1	25	50	1250		
		M_1	50	65	3250		
		P_1	1150	80	92000		
		P_2	1325	75	99375		
		U_1	400	60	24000		
	Total		**2950**		**219875**	**75**	**I**
3	ym3p	P_1	900	80	72000		
		P_2	300	75	22500		
		U_1	1425	60	85500		
	Total		**2625**		**180000**	**69**	**II**

4	ym3q	I_1	75	50	3750		
		P_1	1825	80	146000		
		P_2	500	75	375000		
		U_1	2450	60	147000		
	Total		**4850**		**671750**	**69**	**II**
5	ym3r	I_1	150	50	7500		
		M_3	50	65	3250		
		P_1	1300	80	104000		
		P_2	800	75	60000		
		U_1	1775	60	106500		
	Total		**4075**		**281250**	**69**	**II**
3	$ym3_8$	P_1	825	80	66000		
		P_2	25	75	1875		
		U_1	3200	60	192000		
	Total		**4050**		**259875**	**64**	**II**

CHAPTER – 3

JOINT FOREST MANAGEMENT IN THE CATCHMENT AREA TREATMENT

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JOINT FOREST MANAGEMENT (JFM) IN THE CAT PLAN

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3.0 JOINT FOREST MANGEMENT (JFM) IN THE CAT PLAN

3.1 INTRODUCTION

Forests play a vital role in maintaining ecological balance and in the socio-economic development of the country. Forests are an important resource base for meeting subsistence needs of millions of rural poor especially the tribals and forest dwellers. As per the State of Forest Report published by Forest Survey of India (FSI, 1997) the recorded forest area of the country is 76.52 million Ha., whereas the actual forest cover is estimated to be 63.33 million Ha., which constitutes 19.27% of the country's geographical area.

Dense forests (crown density above 40%) constitute only about 11.17% and forests with more than 70% crown density exist only over 6% of the country's land mass. Total forest cover in the tribal districts as per the 1997 assessment of Forest Survey of India is 41.72 million Ha., which constitutes about 65.86% of the total forest cover of the country.

Loss of forest cover in tribal districts of the country as compared to 1995 assessment has been noted to be 0.4899 million Ha. Growing stock has been tentatively estimated by the Forest Survey of India to be 4,740 million cum., with an average volume of 74.42 cum. per Ha. India is one of the 12 mega biodiversity countries of the world and is supports 16 major forest types.

India's human population constitutes about 16% of the world's population and its cattle population is about 18% of the world's population, whereas the geographical area is only 2.5% Per capita forest area in Indian is only 0.08 Ha. as against the world's per capita forest area of 0.64 Ha. and an average of 0.5 Ha. for the developing countries. The rural population is heavily dependent on the forest resources for meeting its livelihood needs. Per capita availability of forest resources for meeting its livelihood needs. Per capita availability of forest biomass in the natural forests of the country is only about 6 ton as against an average of 82 ton in developing countries. As a result of this imbalance Indian forests are under tremendous biotic pressure. More than 50% of country's forest area is annually prone to fires causing a loss of **Rs. 440 crore** (only replacement cost of seedlings).

These factors have led to severe degradation and depletion of our forest resources. This is turn is making the lives of rural poor very difficult besides threatening the environmental stability. The dense forests are loosing their productivity and more than 40% of country's forest cover has degraded. Main cause of degradation is use of the forest resource beyond its carrying capacity and without much consideration to its sustainability. The trend of degradation of forests can be reserved only if this precious resource is managed sustainably with the involvement of local communities in its protection and development of forest resources and JFM Programme has come out as an important management intervention for sustainable forest management.

3.2 JOINT FORESTRY MANAGEMENT IN HIMACHAL PRADESH

The Government of Himachal Pradesh its JFM Programme, *Sanjhi Van Yojan* in 1998, there are nearly. JFM Programme in the present form can be traced to the Arabari experiment initiated by foresters in the State of West Bengal. This experiment provided a strong feedback for incorporation of the system in the National Forest Policy of 1988. In many locations people's voluntary groups were engaged in protection of forests without any initiative from the Government. Subsequently, based on the experience, the process of institutionalizing people's participant in forest protection and regeneration began. This type of collective endeavour in protection and management of forests through people's involvement was later termed as JFM. At present there are nearly 700 Village Forest Committee constituted in Himachal Pradesh under this scheme. At present, the JFM Committees are being registered under different names in various States as per the provisions contained in the resolutions. Memorandum of Understanding, with clearly defined roles and responsibilities for different work or areas should be separately assigned and signed between the State Governments and the Committees. All adults of the village should be eligible to become members of the JFM Committees. It has following objectives:

a) Involvement of grass root level institutions such as gram panchayats, mahilamandals, yuvak mandals, ex-servicemen's bodies, schools, Village Development Societies (VFDSs), User groups, other Community Based Organizations (CBOs) and NGOs in Sustainable Management of forest resources.
b) Grant of 100 % income from Plantations to the VFDSs and Panchayat;
c) Grant of total usufruct rights to the VFDSs.

d) Regeneration of degraded forest areas and conservation and sustainable use of better forests through community involvement.
e) Involvement of local communities in the choice of species to be Planted under scheme.
f) Creation and enhancement of social, physical and financial capital of the participating communities for poverty reduction.
g) Special emphasis on involvement of women in the scheme.
h) Address problem of rural unemployment by utilizing degraded forest land for large scale Plantations.
i) Establish linkage between Food for Work Programme and the present scheme by making payments in the shape of food grains under the scheme.
j) Increasing productivity of the Forest areas by improvement of nursery stock and adoption of mixed Plantations.
k) Training of forest staff, VFDS members and CBOs/NGOs for facilitating and strengthening community participation.
l) Gradually empower, local communities and local level institutions to become more pro-active in Sustainable Forest Management.
m) To help VFDSs achieve financial viability and sustainability by introducing proper mix of short and long duration cropping patterns as a short and long term objective to ensure their continued participation in the scheme.

3.3 PREPARATION OF MIRCO PLAN

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

a) If the existing working Plans are in force (till their revision in future), for incorporation of micro Plans in the working Plans, a special order may be issued by the PCCFs for implementation of the micro Plan. In these areas, micro Plan should aim at ensuring a multi product and more NTFP

oriented approach. Without changing the basic principles of silviculture, deviations may be approved in the existing working Plans if necessary. To ensure this, the concerned DFO and CF should dovetail the requirement of micro Plans with working Plans.

b) The micro Plan should also take into consideration and provide suitable advice for areas Planted / to be Planted on community lands and other Government lands outside the notified forest areas including in the district council areas of North East,

c) Infrastructure / Eco-development under micro Plan should form a separate entity for funding it through concerned development agencies.

3.4 JFM AND DHAMWARI SUNDA CAT PLAN

The works specified under the CAT Plan will be executed based on this model of JFM. The various activities Planned are in consonance with the JFM. Provisions have been kept for Plantations in the degraded forest land, NTFP Plantations and Bamboo / shrubs Plantations. Besides this, the major thrust of the CAT Plan is on Income Generation Activities (IGA). So that people get their livelihood without entering in the forests. VFDC will be formed for this specific purpose besides this, the active Mahila Mandals and Yuvak Mandals and NGOs will be approached to carry out the various works of the CAT Plan. Considering the immense potential and genuine need for women's participation in JFM Programme, following guidelines are suggested for ensuring meaningful participation of women in JFM. For Plantations, however, the forest department shall continue to supply Planting material to the VFDS on demand, free of cost for three years including the year of Plantation. Therefore, for any more supply of Plants price shall be charged from the VFDS

At least 50% members of the JFM general body should be women. For the general body meeting, the presence of at least 50% women members should be a prerequisite for holding the general body meeting. Local people and committees will be engaged for the CAT Plan works such as Plantation and maintenance etc. instead of hiring the labour. The wages will be met out from the provision incorporated in the norms.

CHAPTER – 4

OBJECTIVE AND PROPOSALS FOR CATCHMENT AREA TREATMENTNT

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OBJECTIVE AND PROPOSALS FOR CATCHMENT AREA TREATMENT

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OBJECTIVES AND PROPOSALS FOR CATCHMENT AREA TREATMENT

4.0 OBJECTIVES OF THE CAT PLAN

The CAT Plan targets the overall improvement of the environmental conditions in the region. All the activities are aimed at treating the degraded forest land and potential areas of severe soil erosion in the Project effective Catchment area. The Plan provides benefits due to Biological and Engineering Measures, and its utility in maintaining the eco-system. It also aims to reduce fuel wood consumption at least during the interregnum till the time Plantations become utilizable.

In consonance with the above, this CAT Plan in the Project effective catchment area has following objectives:

a) Reduce soil erosion and land degradation by taking up adequate and effective soil conservation measures in erosion prone area (severe and very severe).

b) Rehabilitate degraded forest areas through afforestation, treatment of pasture lands and facilitating natural re-generation.

c) Reduce / control cultivation practices in the effective catchment area through suitable and appropriate alternatives acceptable to local residents.

d) Demonstrate good practices in agriculture and horticulture land treatment.

e) Save and conserve forest based fuel.

f) Conserve and rehabilitate of riverine flora, particularly in the River Pabbar stretches between Dhamwari Sunda HEP Diversion Structure (barrage) and its Tail Race Channel outlet.

As mentioned elsewhere in this document, the catchment being dynamic and always under constant pressure of activities, both anthropogenic and other than

anthropogenic, keeps generating silt of considerable proportions. A lot of silt load is found right at the point where the river and its tributaries leave the glaciers. Complete stoppage of silt is, therefore, a utopian expectation, as it would also mean complete freezing of all activities at the base level / time. Hence, Project Proponent's bottom line in this respect is stabilization of silt flow so that it does not increase any further and endeavour to mitigate it, if it cannot be completely stopped.

4.1 PROPOSED TREATMENT

Proper gully treatment and water harvesting structures are required to be provided in the effective catchment area so as to reduce runoff and sediment flow. To check siltation, it is imperative that massive afforestation programme is also taken up in the area. Thus, the catchment treatment involves both Biological and Engineering Measures for arresting the soil erosion process and controlling the sediment transfer to a certain extent. The Catchment Area Treatment (CAT) Plan envisages controlling the soil erosion process & subsequent sediment transfer to the semblance reservoir i.e. diurnal storage, enhancing forest for increasing soil holding capacity; and arresting total sediment flow in the flowing water.

4.1.1 ACTIVITIES IN THE CAT PLAN

Considering the topographic factors, soil type, climate, hill slopes and land use in the catchment area, the following Engineering and Biological Measures have been proposed to be undertaken with the aim to check and control the soil erosion.

4.1.2 ENGINEERING MEASURES

4.1.2.1 Gully Control Check Dams

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

available materials (stones) at local level and transport accessibility. State Forest Department will decide the area to be provided with Gully Control Check Dams. The types of check dam recommended for treatment are as follows:

a) Model I : Dry Rubble Stone Masonry (DRSM) where gully slope is gentle

b) Model II : Combination of DRSM and crate wire for moderate to deep gullies.

c) Model III : Combination of DRSM walls, check dams and crate wire where gully slop is very steep.

4.1.2.2 Stream Bank Protection

Stream bank erosion is caused by a variety of reasons such as destruction of vegetative cover, mass movement on unstable bank slopes, undermining of top portion of lower bank by turbulent flow and sliding of slopes when saturated with water. The stream bank protection would include wire crates and vegetative spurs. State Forest Department will decide the area to be treated with stream bank protection.

4.1.2.3 Contour Staggered Trenches

Contour staged trenches are mainly provided to trap the silt and control runoff. This is also done to prepare a fertile base for Plantation. It acts to conserve both soil and moisture in situ and also reduce run off. State Forest Department will decide the area to be provided with this type of treatment in different sub-watersheds under the Plan.

4.1.2.4 Landslides Control

Rainfall pattern of the area, water seepage coupled with geological formation results in landslides under natural conditions. Human interference may also trigger it by disturbing the slopes like by digging and by earth cutting. Water plays an important role in triggering of landslides and mass wasting processes along with other factors such as slope and nature of soil / and cover / land use. However, most of the landslides are caused by human negligence or interference. Road construction, overgrazing of hill slopes, felling of trees for timber, fuel and fodder and up slope extension of cultivation are some of main

causes of landslides. State Forest Department will decide the landslide prone areas to be taken up under the following treatments:

4.1.2.4.1 Catch Water Drains

Among the most effective, practical and least expensive measures of Landslide Hazard Management is the construction of catch water drains for run-off and surface waters in the identified hazard-prone zone so that no or little water is able to infiltrate into the ground. All the streams and minor water courses would be diverted around the crown of the slide or the potentially hazardous area through catch water drains with an adequate gradient. The catch water drain when provided avoids the run-off to pass over such vulnerable areas and water is guided through these drains located on foothill or along with Katcha / Pucca roads. The ground surface of threatened area is leveled out to eliminate all depressions where water can accumulate. State Forest Department will decide the area to be taken up under this category of treatment.

4.1.2.4.2 Check- Dams / Retaining Walls (R/W)

Brush Wood check dams are useful in arresting further erosion of depressions, channels and gullies on the denuded landslides. In addition, retaining walls would be constructed to provide support at the base of threatened slopes. State Forest Department will decide the area to be taken up under this category of treatment.

4.1.2.4.3 Slope Modification by Steeping or Terracing

To avoid rolling down of the earth mass along landslide areas and to reduce the run off speed of rainwater, the slope is modified to increases its stability considerably by grading it. The construction of steps or terraces to reduce the slope gradient is one of the measures. State Forest Department will decide the area to be taken up under this category of treatment.

4.1.2.4.4 Bench Terracing

The area under moderate to steep slopes would be subjected to bench terracing. The local people would be convinced to follow this type of terracing for comparatively better yield and with minimum threat to erosion. Moreover, in number of habitations in the catchment such practices are already visible. While making bench terraces, care will be taken not to disturb the topsoil by spreading

earth from the lower terraces to higher terraces. The vertical intervals between terraces will not be more than 1.5 m and cutting depth may be kept at 50 cm. The minimum average width of the terrace would be kept from 4 to 5 m in order to enable usage of prolong hinge. The shoulder bunds of 30 x 15 cm would also be provided. Staggered channels will drain off the excess water from the terraces. State Forest Department will decide the area to be covered under this category of treatment.

4.1.2.5 Establishment of Silt Observatory

The study area designed for the catchment area treatment is experiencing all the classic vagaries of the nature on large scale. The terrain and geology of the area is susceptible to incidence of landslides / slips / glaciers and water erosion. Bulk of soil erosion takes place due to scoring action of water running off the surface during melting of snow. The runoff water first forms localized channel which in turn form bigger gullies leading to serious Soil erosion problem. This increases the silt content in all across the rivers in Himachal Pradesh. The problem of silt is causing serious concerns in the various Projects in the state. This has caused consideration damages to machinery and power generation in Nathpa Jhakri Project. To avoid such an eventuality, establishment of a Silt Observatory upstream of Tangnu Romai Project reservoir near village Janglikh is proposed on Pabbar River throughout the year. Similarly, another Silt Observatory will be established upstream of Dhamwari Sunda Hydro Electric Project Diversion Structure but downstream of Tangnu Romai Hydro Electric Project barrage.

An amount of **Rs. 113.19 Lacs** has been kept for all the engineering measures including maintenance.

4.1.3 BIOLOGICAL MEASURES

4.1.3.1 Restoration of Degraded Areas

In critically degraded areas, Plantation of locally useful diverse and indigenous Plant species such as timber species, fodder species, fuel wood species, grasses, shrubs, legumes, medicinal and aromatic Plants would be undertaken. State Forest Department will decide the area proposed to be taken up for various Biological Measures under this component during the CAT Plan Implementation period. Suitably located nurseries would be developed in area for raising Plantation & facilitating treatment in different pockets. The Plantations

undertaken on forest land under this component shall be maintained for a period of five years.

Choice of Species:

In all the Biological Measures, suggested for the forest land and pasture land treatment, in this Plan, local indigenous species shall be preferred and Planting of exotics shall be avoided. NTFP shall also be Planted in the afforestation areas besides being introduced as ground flora in the appropriated forest areas.

4.1.3.2 Afforestation

This will include raising of multi-tier mixed vegetable of suitable local species in the steep and sensitive catchment areas of rivers / streams with the objective of keeping such areas under permanent vegetative cover. State Forest Department will decide the area under such Plantation during the Project construction period under this component. The degraded areas would also be brought under some vegetation cover by way of timber Plantation. The aim of raising afforestation need not be elaborated for it is too obvious. It would not only fulfill the purposes of silt reduction but also help the local populace to fulfill its needs. The Plantations done under this component shall be maintained for a period of seven years.

4.1.3.3 Timber Plantation

The forests in the catchment area are heavily burdened with rights of the local people including the right to concessional and free timber in the form of standing trees. With the increase in population and also increase in the incomes and living standards of the local people, demand for house construction and also for other purposes has increased manifold leading to greater pressure on forests. This in turn leads to denudation and increased silt flow. Thus a need has been felt to make special efforts for raising exclusive Plantations to meet the timber demand of local inhabitants. Accordingly, State Forest Department will decide the area to be developed as timber Plantation.

4.1.3.4 Fodder Plantation

Cattle population (that includes sheep and goats) almost equals the human population in the State and the burned due to cattle population on the catchment area is no different. Grazing and lopping for fodder are amongst the easily

identifiable causes of degradation of vegetation. To help ameliorate the situation of scarce availability of fodder, substantial area needs to be brought under fodder Plantation with suitable indigenous species. State Forest Department will decide the area to be covered under this component.

4.1.3.5 NTFP Plantation

A number of families supplement their income by collecting and selling NTFP (Non-Timber Forest Produce) including medicinal and aromatic species) besides consuming some quantities for their own use. Over a period, due to increased biotic pressure, the availability and re-generation of the species of NTFP is reducing. To sustain their growth and contribute to the economy, suitable Plantations of appropriate local species of NTFP need to be raised. State Forest Department will decide the area to be covered under this component.

4.1.3.6 Pasture Development

There are high altitude alpine pastures in the upper most parts of the catchment and temperate to sub-tropical pastures in the zones lower than Alpine zone. The second type of pastures is owned separately by private individuals / families and Government. Under this component, both alpine and lower zone pastures would be treated with suitable measures.

4.1.3.7 Alpine Pasture Development

As mentioned in sub-section 4.1.3.4, the number of cattle, sheep and goats is very high and consequently the grazing pressure is also high. This causes degradation of pasture lands. There are two types of pastures in the catchment area. One type is the permanent pasture of high altitude Alpine zone and the other is lower in altitude and is used as pasture for no other use is possible on this kind of land. The latter one is found nearer to the habitations. Both these types of pastures are subjected to grazing beyond their carrying capacities leading to varying degrees of degradation. Appropriate measures will need to be adopted to encourage development of healthy pasture areas for the use of cattle herders.

The Alpine zone pastures would need to be treated will grass sowing, grass slip / tuft plating in patches with soil and moisture conservation measures, wherever needed. Medicinal herbs and other NTFP spices that grow in this zone would

also be introduced. State Forest Department will decide the area to be developed for alpine zone pastures.

4.1.3.8 Lower Zone Pasture Development

The lower zone pastures are owned separately by both Government and private families / individuals. These pastures are nearer to the habitations and bear the brunt of excessive grazing through out the year. It is proposed to treat pastures both under private holdings also under Government ownership. In the lower zone pastures, a silvi-pasture model would need to be adopted and suitable species of grasses and tree fodder, and leguminous Plant species Planted. Effective fencing would also need to be provided for protection of saplings in the Government owned pastures. The owners of the pastures in private holdings would also need to take the protection measures of his / her own conveyance and cost.

Before any new area is taken up, eradication of weeds and unpalatable grass species is equally important. Some parts of the pastures need to be closed for seeding purpose only. State Forest Department will decide the area to be covered privately owned and Government owned pastures under this component.

4.1.3.9 Conservation and Regeneration of Riverine Tree Spp.

To raise successful Plantations, it is necessary to have a good Planting stock. It is proposed to establish nursery at UF – Barsheel. The nursery shall be raised in the first year of the Project and will be further maintained till the completion of the HEP Project. Nursery should be located in planting zone. Exposed windy ridges would be avoided. It would have adequate irrigation facility. The nursery should be located in low elevation in Deodar Zone for Planting Deodar,. Seed is collected from healthy, middle aged, self pruned trees of good form and quality. Cones are collected during October / November and dried in sun after these have been opened. Seeds would be stored in sealed polythene bags and kept in cool dry place.

In addition, it is also proposed to bring about effective closure of pasture area with the prior consent of the local people for raising of seed locally. This would help collection of seed from the closed area. The local grass spps i.e. marchunang and parchunang is available and would be consulted from the

Scientists of UHF Nauni, Solan for choice of local spps, collection of seed and Planting techniques etc. during the first two years of the Project period.

Rs. 189.51 Lacs has been provisioned for the total biological measures which also includes the maintenance of biological measures.

4.1.4 ADMINISTRATIVE / INFRASTRUCTURE SUPPORT

Implementation of CAT Plan places greater responsibility and additional work load on the State Forest Department as the Executing Agency. In case of the Compensatory Afforestation, there is a levy of 17.5% Departmental Charges and 5% as contingency charges. State Forest Department is likely to use the funds for creating necessary additional office equipment and infrastructure such as computers, photocopiers, fax machines, vehicles, etc.

An amount of **Rs. 248.00 Lacs** has been kept for Administrative/Infrastructure support.

4.1.5 PUBLICITY AND AWARENESS

Creating awareness through publicity of the works being carried out under CAT Plan is also important as it shows the correct picture to the masses. Besides, it also reflects on the environmental responsibilities being discharged by the Dhamwari Sunda Hydro Electric Project. Hence, supporting publicity and awareness about the activities of CAT Plan in particular has also been identified as one of the activities in CAT Plan.

To support monitoring (by the CAT Plan Executive Agencies), it is also proposed to provide sign boards / hoardings for each work done in the field. Cost element has been depicted under the Administrative and Infrastructure.

An amount of **Rs. 10.00 Lacs** has been kept for this purpose.

4.1.6 PRIVATE LAND TREATMENT

It has been experienced that erosion takes place from the privately owned land also. Silt contribution from the private holding is, therefore, significant. Although change of land use is not the mandate of the CAT Plans yet it can help betterment of the current land uses and attempt to encourage better land management thus help to reduce silt flow. Treatment to private holdings for

horticulture development, Agriculture development and also for pasture development need to be provided. Fencing and maintenance costs are not provided under this activity as these are to be contributed by the land owners.

4.1.6.1 Plantation for Horticultural and Agricultural Land Development

Parts of the effective catchment area are under private ownership and have the potential for development to increase land productivity and help enhance income of the individuals or families owing such lands. Under this treatment Plan, suitable horticultural crop species like apple, plum, apricot and walnut etc. shall be Planted in select areas adjacent of the villages. The species listed here are only indicative and not conclusive. The treatment would also include soil and moisture conservation measures wherever needed. State Forest Department will decide the area to be earmarked for this treatment. However, the owners will be called upon to shoulder the cost of fencing and maintenance.

4.1.6.2 Private Pasture Development

The privately owned pastures would also be treated with appropriate silvi-pasture model. Suitable species of grasses and tree fodder and leguminous Plant species shall be planted. No expenditure on account of fencing can be provided in case of private pastures, as the owners of the pastures in private holding have to undertake the protection measures at their own convenience and cost. Similarly, the maintenance costs, if any, shall be borne by the owners.

Before any new area is taken up, eradication of weeds and unpalatable grass species is equally important. Some parts of the pastures shall be closed for seeding purpose only. State Forest Department will decide the area for treatment of privately owned pastures in the CAT Plan.

An amount of **Rs. 27.80 Lacs** has been kept for this purpose.

4.1.7 FUEL CONSERVATION MEASURES

The riverine trees are locally used primarily for two purposes i.e. fuel and fodder. Since their regeneration is likely to be adversely impacted and the new plantation suggested in this Plan is going to take time to reach harvesting age, it is necessary that devices be installed to reduce their requirement for fuel purposes.

Alder is particularly used for cremation of dead bodies as it is readily available nearer the cremation grounds invariably located on riverbeds or riverbanks. Therefore, construction of improved crematoria is provided in the CAT Plan. These are simple CGI sheet covered structures having open kilns made of fire clay bricks using fire clay cement mortar and are provided with side ventilation as also an iron grill for ventilation from below to facilitate quicker burning. Their design is now standardized and is already available with the State Forest Department. State Forest Department will decide to construct crematoria at most suitable sites (suitable from all angles including from social / customary / religious angle) along the riverbanks to save them from floods.

Similarly, other fuel saving devices can also be introduced like LPG connections as non-recurring one time assistance to deserving families to reduce their dependence on forest trees besides reducing smoke and concomitant health risks. State Forest Department will decide the modus operandi and the shape of one time non-recurring assistance.

An amount of **Rs. 45.00 Lacs** has been kept for this purpose.

4.1.8 FORESTRY RESEARCH AND STUDIES

It is utmost important that waste land information about the floral diversity, ecological studies, law, policy and composition is generated to guide future conservation action. Funds will be allotted to Implementing Agency, who will determine the study areas with focus on present scenario during the Plan period. The Implementing Agency will contact most appropriate agency, institution to conduct their research activities from the institution HFRI, Shimla, Wildlife Institute of India (WII) Dehradun, and any recognized University in India. Priority will be given to undertake research studies in the following subjects:

a) Floristic studies
b) A study on distribution, relatives abundance and food habits of wildlife in the Project area.
c) Ecological studies of Pabbar River Catchment
d) Socio-Economic studies of the villages in the Project area.

First preference will be given to the in-service candidate who having a knowledge and experience on forestry management and conservation. The research and studies will be conducted through the WII Dehradun.

An amount of **Rs. 20.00 Lacs** has been kept for this purpose.

4.1.9 TRAINING OF FOREST OFFICERS/OFFICIALS IN INDIA AND ABROAD

The specialized training and study tours in India and abroad shall also be arranged for forest officials / officers who are implementing the Plan. The objective of this training component would be to provide the officers and the staff working in the Project area to augment their existing skills, professional knowledge, capacity building to share experience and ideas on different fields. The basic components of capacity building include:

a) Develop human resources through training and education
b) Generate new information for better knowledge and understanding.
c) Provide an adequate institutional framework and material support to enable acquired skills to be fully utilized.

In order to achieve overall Plan objectives by effective implementation of the CAT Plan, the training component under this Plant period is given below:

4.1.9.1 Wildlife Institute of India

Wildlife Institute of India (WII) conducts various short terms training courses for the officers of the Forest Department. The calendar of the courses is released annually.

Therefore, it is imperative that the forest officers and frontline staff in wildlife should get the opportunity to learn various skills though these courses for better management of wildlife particularly endangered and threatened species

4.1.9.2 Training in Soil and Moisture Conservation:

The training programme for a group of field staff would be organized by Central Soil and Water Conservation Research Training Institute, Chandigarh and Dehradun and also by FTI, Chail. The trainees would be exposed to the Engineering and vegetative works by way of presentation, field demonstrations and hands an experience during training programme. The trainees would be taken for visit to a nearby soil eroded area, nallahs and river bank area in Pabbar Valley and helped in identification of site problems and their solution / control method etc.

4.1.9.3 Training in JFM

Training in JFM for field staff and exposure visit in JFM area within State and other States i.e. M.P., West Bengal, Karnataka and Kerala etc.

An amount of **Rs. 50.00 Lacs** has been kept for this purpose.

4.1.10 PROTECTION OF FOREST

The Forest must be saved from forest fires. The forest fires do damage to Deodar – Kail forests during November to December and April to June. This problem has aggravated in last few years as the population has grown. Controlled burning of forest debris / disposal of slash is recommended in dry season in dried up nallahs / paths and along with cultivated private land / Govt. land in accordance with the working Plan, Rules, Acts and Departmental instructions. The nallahs and paths will act as fire barriers. No new fire lines and green felling will be carried out incompliance of the Apex Court in CWP 202/95 dated 12.12.1996 and 14.02.2000.

In order to protect the forests from fire, the following works are proposed to be undertaken along the Plan period:

a) Controlled burning of grass land and debris etc. to facilitate growth of fresh grass. Removal of vegetation, either slash and debris. Clearance and maintenance of fire lines.
b) The forest staff will be adequately equipped with the fire fighting kits which will be purchased from out of the funds provided under this sub-head.
c) Incentive to Mahila Mandals / self help groups.

An out lay of **Rs. 65.00 Lacs** has been kept for this purpose.

4.1.11 ECO-TOURISM DEVELOPMENT

The area is also known for its scenic beauty. The area has a very high potential for development of eco-tourism but poor infrastructure, low publicity, trained manpower and inadequate financial resources have been the main constraints in the proper development of eco-tourism. There is priority need to promote and develop eco-tourism, wilderness travel and adventure travel in the landscape.

The eco-tourism shall be implemented through various eco-tourism registered societies. The local people are not aware of vast eco-tourism potential and they need training and awareness / importance of the conservation of wild life along with eco-tourism.

An out lay of **Rs. 97.75 Lacs** has been kept for this purpose.

4.1.12 MONITORING AND EVALUATION

Effective monitoring of the implementation of the CAT Plan is equally important and need not be emphasized. During the interaction with local PRI representatives (some of whom were accompanied by local residents) expressed to be associated not only in the monitoring process but also in the approval of the annual Plan of activities for the CAT Plan. A separate paragraph has been devoted on the implementation mechanism as well as the monitoring aspects.

The funds being allocated under this head are meant for carrying out mid-term and end of the term appraisal by hiring professional individual / agency. However, the expenditure incurred on the meeting of two committees as prescribed in this Plan shall also be met with from the funds being provided under Monitoring and Evaluation.

An out lay of **Rs. 48.88 Lacs** has been kept for this purpose.

Income Generation Activities (IGA):

One of the major factors impacting on the effecting bio-diversity conservation is the dependence of people on the natural resources for their livelihood. Local people have a right to collect / extract of NTFP in and around area under the provision of Forest Settlement Report 1921. Although, a four year felling-cycle has been prescribed by the H.P. Forest Department and the Apex Court Order dated 14.02.2000, prohibited the removal of dead, deceased, dying and fallen trees, drift wood and grasses, but the existence of the rare and endangered species of medicinal herbs Vermi composting culture, bee keeping, are one of the alternative sources of income generation which is easy to adopt and can bring fast income returns to the local people ecologically. Forest Department and Horticulturist in Rohru Tehsil will be potential buyerd of all such vermin composting and organic farming for its vast network of forest nurseries. Women can adopt these activities as a part time without compromising with their day to day work.

Animal husbandry is an important occupation of the people of the area. Live stock practices are rather primitive in the Project area. Mostly open grazing is practiced with little stall feeding and minimum fodder cultivation. A large number of unproductive cattle are trampling the grazing land, which results in severe damage to the vegetation and soil productivity. It is, therefore, suggested that to keep large herd of unproductive cattle is reduced by demonstrating benefits of improved breed cattle to the local people and strengthening the animal husbandry infrastructure support so as to change with the passage of time.

An out lay of **Rs. 35.00 Lacs** has been kept for this purpose.

4.1.13 ECO-SERVICES TO LOCAL COMMUNITIES

It is essential to develop rural infrastructure development i.e. village paths, repair / construction of Cattle pond for the optimum conservation of natural resources. It is necessary to immunize the domestic cattle against contagious diseases like foot and mouth etc. It will prevent disease from spreading from domestic cattle to Wild animals and vice-versa.

An out lay of **Rs. 97.75 Lacs** has been kept for this purpose.

4.2 CONTINGENCIES

Outlay in the CAT Plan for various components has been worked out on the wage rates of labour, market rates and as per H.P. Forest Department schedule rates. The lump sum provision has been made in the Plan for Engineering works for soil and moisture conservation. These works are to be undertaken after preparation of detailed estimates and as per the actual work & depending upon the sites / location required to be developed. The model / design prescribed in the proposed Plan is suggestive in nature efforts has been made to restrict the expenditure but access and deficit may occur as per the allocation of funds and escalation of wage rates and cost of material etc. Since the CAT Plan is to be implemented over a period of ten years. Contingency amount of Rs. 27.29 lacs has been proposed during this Plan period to cater for escalation and other unforeseen exigencies.

An out lay of **Rs. 120.89 Lacs** has been kept for this purpose.

CHAPTER – 5

PAYMENT FOR ENVIRONMENTAL SERVICES

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5.0 PAYMENT FOR ENVIRONMENT SERVICES

Payment for Environmental Services (PES) is a new concept which is expected to galvanize all the stake holders including the Govt., local community living in the Project area as well as the various local institutions which can be involved in providing the requisite service for environmental upkeep. In order that the concept is developed in an actionable plan, it requires earmarking of funds for its evolution, planning and implementation. Accordingly, a provision of **Rs. 75.00 Lacs** has been made for implementing this novel concept of performance based PES in the CAT Plan.

5.1 PILOT PROJECT

Being a new concept, it is natural and necessary that a Pilot Project is planned, designed and experimented by considering scopes and designs for various PES models.

5.2 SUSTAINABLE INVESTMENT

A part of the fund is to be used to formulate innovative institutional and payment mechanism which would provide effective incentives to multiple stake – holders from the landed to the landless to community organizations to the State Govt. This is expected to complement regulation and help make large public investment sustainable in the fields of forest plantation, local irrigation and community based forest management. This will also result in better livelihood besides providing the environmental service.

5.3 LOCAL ECO-SYSTEM MANAGEMENT

The balance fund would be utilized to work the model, arrive at under the scoping of work in the field. This is primarily to encourage local communities to modify their land use practices. Major contribution of local stake holders is expected to control silt and help, grow & maintain a variety of plantation especially the Medicinal Plants. Another important aspect is in enhancing infiltration in forests

which is likely to reduce the water stress due to climate change. Importance of activating local community institutions in these tasks of far reaching impact and significance can not be over emphasized. Local institutions are required to help manage local forest Eco-Systems and sign and implement PES Agreements on the ground. They will naturally help reduce transaction cost and will be torch bearers for joint forest participatory management. In addition to these direct benefits, the local community and institutions will provide continuity and help in not losing track of the past learning and experience.

Under PES, there is need to create a relation and resource flow between environmental service providers and beneficiaries. Incentive based mechanism can be in cash or kind, including tenures and local deals to optimize public investments and fiscal measures. The key is to identify effective practices and local distribution options.

CHAPTER – 6

DEVELOPMENT OF DUMPING SITES FOR SOLID WASTE MANAGEMENT

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6.0 DEVELOPMENT OF DUMPING SITES

The pressure of population growth is stressing the existing system for Solid Waste management in most of the towns of our state. The Govt. of Himachal Pradesh has taken a conscious decision to cater the need of funds for this activity by making suitable provisions in the CAT plan of the Hydro Electric Projects being developed within the state. Accordingly a provision of **Rs. 45.00 Lacs** has been made in this CAT plan which will enable investment for planning and implementing the solid waste management programs of some towns in the vicinity of the Project area. Three dumping sites are proposed to be developed in the urban settlements of the state.

CHAPTER – 7

PROTECTION AND MANAGEMENT OF WILD LIFE

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7.0 PROTECTION AND MANAGEMENT OF WILDLIFE

The influx of outside labourers and project people will increase in the area. This poses a serious danger to the wildlife in the catchment area. As the habitats of wild animals may get disturbed due to heavy influx of project people and the biggest threat is poaching of wildlife in the area. To avoid these circumstances following measures are proposed for wildlife protection in the CAT Plan.

7.1 CONSTRUCTION OF WATER HOLES

The Scarcity of drinking water in the catchment area prompts the wild animals and monkeys to venture towards the habituated area and water sources of local people, this sometimes result in human wildlife conflict and damages of crops in the fields. To avoid this water holes should be constructed wherever is required. Water holes needs to be constructed at various points as per management plan. The recommended size of water ponds is 7m X 6m X 2m (with stone masonry inside) it is strongly emphasized that all this water point must be kept under vigil of patrolling staff. This is to preempt any suspected poaching attempt at the water ponds/holes.

An outlay for **Rs.6.00 Lacs** has been proposed to be incurred during the plan period.

7.2 SIGN AND SLOGAN BOARDS

It is recommended that the sign and slogan boards must be put up at selected sites. All these sign and slogan boards must be in Hindi and English languages in the form of an appeal to the local people, telling them the importance of wildlife (Protection) Act, 1972 and IFA, 1927 and FCA, 1980 etc. All such development works which are taking place in the project area must be properly displayed at the site of execution e.g. plantation work, nursery, pasture development, soil conservation works etc. therefore, an amount of **Rs.5.00 Lacs** has been proposed for this purpose during the plan period.

7.3 WILDLIFE CENSUS OPERAATION

It is proposed to carry out wild life census in the key areas to know the density of key species so that these can be further improved and developed from management point of view. During last four years no census has been carried out in the Sanctuary area due to non-availability of funds. The census should be carried out twice in an alternative year. Therefore, an amount of **Rs. 10.00 Lacs** is required for this purpose during the plan period.

For wild life census operation the whole tract is to be traversed for which camping has to be done in the forest and catchment area for which following camping equipments will be provided by the company:

Camping Equipments : Alpine Tents 10 nos., kitchen Tents 2 nos., Toilet tents 10 nos., Dinning Tents 2 nos., Sleeping Bags 10 nos., Rucksacks 10 nos., Snow boots 12 nos., trekking sticks 10 nos., Gloves 12 nos., Search lights 5 nos., Binoculars 6 no., Pedometer 1 no., Compass, altimeter, GPS (in kind).

7.4 PLANTATION OF FRUIT BEARING SPECIES FOR WILD ANIMALS SUCH AS RHESUS SPP

The monkey menace is raising serious concerns all over the state. The Government and forest department are contemplating various measured to stop the monkeys and other wild animals to venture them out of their territories. The major reason for these wild animals to trespass into other areas is the scarcity of enough food in the forests. The aim of the CAT Plan is to conserve in situ including flora along with the full range of eco-system they inhabit. As it has been under this scheme, blank area's devoid of tree growth, degraded forests area's shall be undertaken for plantations, while the choice of species will be mainly governed by the site/location, effort will be made fruit bearing species , which are helpful to wild life so far practical. The main species to be raised under this scheme are wild chulli, Bird Cherry, ban oak, Juglans regia, Pyrus spps. and other local edible fruit bearing spps. etc. Plantation must use local and indigenous species since exotics have long term negative impacts on the environment. The preference of local communities as regards the choice of species will be ascertained and given due weight age as per the requirement of site. For this propose an amount of **Rs.15.00 Lacs** has been kept, which will be spent on growing of these items with due approval from the higher authorities.

A part from above provisioned amount for the plan period an amount of **Rs. 18.00 Lacs** has been kept against the training to forest staff in animal rescue.

CHAPTER – 8

ORGANISATION STRUCTURE AND IMPLEMENTATION STRATAGEY

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8.0 Organisation Structure and Implementation Strategy

8.1 PHASING OF IMPLEMENTATION OF CAT PLAN

CAT Plan works are likely to be implemented w.e.f. financial year 2010 – 11 and likely to be completed in financial year 2019 – 20. The implementation of CAT Plan will be done by local societies and agencies under the control of State Forest Department as per the directives of Compensatory Afforestation Fund Management and Planning Authority (CAMPA), constituted as per the creation by Hon'ble Supreme Court by MoEF, Govt. of India, New Delhi.

Afforestation work will be preferably completed during first 5 to 6 years and maintenance done up to five years, therefore. Similarly, NTFP / pasture development will be completed during first 5 to 6 years of Plan period. The soil conservation activities will be completed in first six years and maintained till the completion of Plan period. Necessary infrastructure and establishment of nurseries at suitable places will be completed during the first two years of the Plan period. All the works will be carried out after the approval of Annual Plan of Operation (APO) by the Competent Authority during the Plan period.

8.2 ORGANISATIONAL STRUCTURE AND IMPLEMENTATION

Execution of CAT Plan is proposed to be carried out through H.P. Forest Department under the administrative / financial control of the Conservator of Forests (CF) Shimla. At the field level, the actual implementation will be done by the DFO, Rohru, who has territorial jurisdiction over the area covered under this CAT Plan. The area of CAT Plan will be divided into small watersheds. The APO will be prepared by DFO, Rohru and it will be approved by Principal Chief Conservator of Forests (PCCF) on the recommendation of CF Shimla. He shall be empowered to modify the activities under the Plan or include the works which are not covered in the Plan, if required during the implementation period and to resolve issues or to fulfill the objectives of CAT Plan. Any major modification, if

required with the passage of time it shall be approved from executive body through PCCF, H.P. during the Plan period. A close liaison shall be maintained with the other Departments like Civil, Administration, Agriculture, Horticulture, Animal Husbandry, Art and Culture, Social Welfare and Panchayati Raj etc. for successful achievement of CAT Plan objectives. H.P. Government strongly feels that CAT Plan should have more and more involvement of local people. Activities where local people can be engaged will be identified and implemented. This would provide them employment and create awareness towards their environment amongst the local inhabitants

8.3 CAT PLAN IMPLEMENTATION STAFF

The existing staff of District Forest Officer, Rohru Division will be involved in the implementation of CAT Plan works in addition to their existing duties. ECO Task Force will also be involved in the implementation of the CAT Plan.

8.4 HEADQUARTERS OF THE CAT PLAN IMPLEMENTATION STAFF

As the CAT Plan is to be implemented through DFO, Rohru, the headquarters of all allied staff will be as per the territorial jurisdiction and the headquarters of the ECO Task Force will be fixed according to their jurisdiction of work.

8.5 COST ESCALATION

The present CAT Plan implementation cost projections are based on the prevailing wage rates. This cost is likely to escalate as and when wage rates are hiked by the H.P. Government from time to time. In such an eventuality, cost for proportionate increase in the cost of materials and wages for funding will be submitted to the user agency by the implementing agency and differential amount will be met by the user agency during the Plan period.

CHAPTER – 9
COST ESTIMATES

CATCHMENT AREA

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CHAPTER 9

COST ESTIMATES

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CHAPTER 9

COST ESTIMATES

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CHAPTER 9

COST ESTIMATES

7.0 COST ESTIMATES

7.1 TOTAL CAT PLAN COST

Based on schedule rate for the financial year 2005 – 06, as applicable in Shimla Forest Circle, H.P. Forest Deptt., cost of the various CAT Plan components has been worked out. The details of expenditure for various components are tabulated in the Annexure, The summary of total CAT Plan cost for 10 years will be as under:

Sr. No.	Year	Period	Amount (Rs. in Lacs)
1	2010 – 11	1st Year	299.63
2	2010 – 11	2nd Year	243.87
3	2011 – 12	3rd Year	190.01
4	2012 – 13	4th Year	164.37
5	2013 – 14	5th Year	163.32
6	2014 – 15	6th Year	81.47
7	2015 – 16	7th Year	48.67
8	2016 – 17	8th Year	48.32
9	2017 – 18	9th Year	51.15
10	2018 – 19	10th Year	51.96
		TOTAL Rs.	**1342.77**

7.2 ANNUAL PHASING

The schematic planning for the execution of 2 x 35 MW Dhamwari Sunda Hydro Electric Project CAT Plan will be as enumerated in the Annexure.

ANNEXURE-I

ENGINEERING MEASURES

1. **MODEL – I**

GULLY CONTROL CHECK DAMS

Model I – Dry Rubble Stone Masonry (DRSM) Check Dams in gullies that are shallow to moderate by using locally available stone at site. Consider an area of 5 Ha. for estimating the unit cost.

No. of DRRM Dams to be constructed	= 8
Average dimension of DRRM Check Dam	= 8 m x 1.5 m x 2 m = 24 m^3
Rate for construction of DRSM Check Dam	= Rs. 325/- m^3
Amount for construction of DRSM Check Dam	= 24 x 325 = Rs. 7,800/- per No.
Total amount for 8 nos. of DRSM Check Dam	= 8 x 8700 = Rs. 62,400/-
Cost of DRSM Check Dam per Ha.	= 62400/5 = Rs. 12,480/- per Ha.
Say	**Rs. 12,500/- per Ha.**

2. **MODEL – II**

Combination of DRSM and crate work for moderate to deep gullies by using locally available stone at site, consider an area of 20 Ha. for estimating the unit cost i.e. cost per Ha.

(a) GULLY CRATE WALL

No. of Gully crates to be constructed	= 9
Average dimension of Gully crate	= 8 m x 1.5 m x 2 m = 24 m^3
Total quantity of stone required	= 24 x 9 = 216 m^3
Crate wire required	= 9 quintals
(i) Cost of crate wire	= Rs. 3,900/- x 9 = Rs. 35,100/-
(ii) Carriage from Road Head to Site	= Rs. 4,500/-
(iii) Cost of crate with local stones @ Rs. 325/- per m^3	= Rs. 325 x 216 = Rs. 70,200/-
Total cost (i) + (ii) + (iii)	= Rs. 1,09,800/-

(b) CHECK DAMS FOR SIDE NALAH

No. of Check Dams to be constructed	= 40	
Average dimension of side Nalah Check Dam	= 8 m x 1.5 m x 1 m =	12 m^3
Total quantity of stones required	= 12 x 40	= 480 m^3
Cost of Check Dam with local stones @ Rs. 325/- per m^3	= 480 x 325	= Rs.1,56,000/-

(c) CHECK DAMS FOR MAIN NALAH

No. of Check Dams to be constructed	= 9	
Average dimension of main Nalah Check Dam	= 8 m x 1.5 m x 2 m=	24 m^3
Total quantity of stones required	= 24 x 9	= 216 m^3
Cost of Check Dam with local stones @ Rs. 325/- per m^3	= 216 x 325	= Rs. 70,250/-

Total cost (a) + (b) + (c)
(i.e. Rs.109800/- + Rs. 156000/- + Rs. 70200/-) = **Rs. 3,36,000/-**

Hence, cost per Ha. for combination at DRSM and crate work = 336000/20
= **Rs.16,800/-**

3. **MODEL – II**

Combination of DRSM check walls, DSRM Check Dams and crate work in area with eroding slopes with locally available stone at site. Consider an area of 20 Ha. to estimate the unit cost i.e. cost per Ha.

(a) GULLY CRATE WALL

No. of Gully crates to be constructed	= 9
Average dimension of Gully crate	= 8 m x 1.5 m x 2 m = 24 m^3
Total quantity of stone required	= 24 x 9 = 216 m^3
Crate wire required	= 9 quintals
(iv) Cost of crate wire	= Rs. 3,900/- x 9 = Rs. 35,100/-
(v) Carriage from Road Head to Site	= Rs. 4,500/-
(vi) Cost of crate with local stones @ Rs. 325/- per m^3	= Rs. 325 x 216 = Rs. 70,200/-
Total cost (i) + (ii) + (iii)	= Rs. 1,09,800/-

(b) CHECK WALLS

No. of Check Walls to be constructed	= 50
Average dimension of Check Walls	= 10 m x 0.8 m x 0.5 m = 4 m^3
Total quantity of stones required	= 50 x 4 = 200 m^3
Cost of construction of Check Walls @ Rs. 325/- per m^3	= 200 x 325 = Rs. 65,000/-

(c) CHECK DAM

No. of Check Dams to be constructed	= 30
Average dimension of Check Dam	= 8 m x 1.5 m x 1 m = 12 m^3
Total quantity of stones required	= 12 x 30 = 360 m^3
Cost of Construction of Check Dam @ Rs. 325/- per m^3	= 360 x 325 = Rs.1,17,000/-
Total cost (a) + (b) + (c) (i.e. Rs.109800/- + Rs.65000/- + Rs. /-117000)	**=Rs. 2,91,800/-**
Hence, cost per Ha. for combination at DRSM, Walls, Check Dam and crate works	= 291800/20 **=Rs.14,590/-per Ha**

ANNEXURE-I

COST ESTIMATE FOR STREAM BANK PROTECTION

WIRE CRATE

Size of Wire Crate - 15 m x 2 m x 2 m

S. No.	Item	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Crate wire	Qtl.	2.5	3900	9750
2	Carriage charges from Road Head to Site	Man-days	10	125	1250
3	Collection of Stone, fill & tie	Cum	60	325	19500
				TOTAL	**30500**

VEGETATIVE SPUR

S. No.	Item	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Supply of brushwood material with 40 bundles in two layer	Per bundle	40	25	1000
2	Cost of Wooden Poles 6' x 6' and 6" diameter	No.	12	45	540
3	Supply	Man-days	4	125	500
				TOTAL	**2040**

NOTE :

(i) Bench terracing and contour stagger fenching rates are taken as Rs. 11,500/- and Rs.5,500/- per Ha. respectively with prior experiences which may be analysed by executing agency for execution.

(ii) Catch water drain rate is taken as Rs. 1,800/- per Ha. with prior experiences which may be analysed by executing agency for execution.

ANNEXURE-II

BIOLOGICAL MEASURES

I AFFORESTATION COST MODEL

Per Ha. Cost Model for Afforestation of degraded forest land

(Calculated at Wage Rate of Rs. 120/-)					
Assumption: Per Ha. Cost Model for afforestation of degraded land, calculation is based on average of 5 Ha. plot of dimension 250 x 200 m.					
S. No.	**Particulars of Works**	**Unit**	**Qty.**	**Rate (Rs.)**	**Amount (Rs.)**
1	Survey and demarcation of plantation area including making sections path and preparation of Map etc.	Ha.	1	82	81.89538462
2	Cutting and preparation of wooden posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	60	1036	621.81
3	Carriage of Fence post up to 2 m long and 8 to 10 cm dia over distance 1 km	% Nos./Km	60	545	327.22
4	Digging of holes 20 - 30 cm dia and 45 cm deep	% Nos.	60	726	435.35
5	fixing of fence post including strulting	% Nos.	60	557	334.12
6	Carriage of bashed wire over average distance of 1 km up hills	Qtls./km	1	136	136.4861538
7	Stretching and fixing of Bashed wire with V-stapple in each strand (3 strands)	Rm	540	4	2043.69
8	Bush cutting in the plantation site	Ha.	1	954	954.46
9	Interlacing of throng bushes in based wire fence	Rm	180	3	591.51
10	Preparation of inspection path 60 cm wide	Rm	250	9	2173.85
11	Layout of pits over 1 Ha.	Ha.	1	136	136.2830769
12	Digging of pits 45 cm x 45 cm x 45 cm (40% of total)	% Nos.	440	764	3359.704615
13	Digging of pits 30 cm x 30 cm x 30 cm (60% of total)	% Nos.	660	382	2520.387692
14	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	440	219	962.67
15	Filling of pits 30 cm x 30 cm x 30 cm	% Nos.	660	153	1007.667692
16	Carriage of naked root plants over distance 2 km uphills	% Nos./Km	400	28	225.5261538
17	Carriage of plants in polythene bage over distance 2 km uphill	% Nos./Km	700	174	2442.72
18	Planting of entire plants raised in ploythene bags	% Nos.	700	175	1222.135385
19	Planting of naked root plants	% Nos.	400	147	588.7753846
20	Nursery cost of plants	Per Plant	1100	4	4180

ANNEXURE-II

21	**Sub Total (S. No. 1 to 20)**				**24346.26**
22	Soil and moisture conservation works (up to 25% of initial planting cost at Serial No. 21)	%	1	25.00	6086.57
23	**TOTAL (S. No. 21 to 22)**				**30432.83**
26	Material cost of Barbed wire	Qtl.	1	3900.00	3900.00
27	Cost of U-Nails	Kg	1.25	45.00	56.25
28	Cost of Fence Posts	No.	100	60.00	6000.00
29	**Total Material Cost (S. No. 26 to 28)**				**9956.25**
30	**GRAND TOTAL (S. No. 25 + S. No. 29)**				**40389.08**
				SAY	**45318.00**

ANNEXURE-II

Maintenance Norms of First Year (25% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	110.00	381.88	420.06
2	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	165.00	190.89	314.97
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	110.00	218.79	240.67
4	Filling of pits 30 cm x 30 cm x 30 cm	% Nos.	165.00	152.68	251.92
5	Planting of plants raised in polythene bags including ramming	% Nos.	175.00	174.59	305.53
6	Planting of naked root plants including cramming	% Nos.	100.00	147.19	147.19
7	Carriage of plants with ploythene bags over a distance of 2 km uphill	%/Nos./km	175.00	174.48	610.68
8	Carriage of naked root plants over a distance of 2 km uphill	%/Nos./km	100.00	28.19	56.38
9	Nursery cost of plants	Per Plant	275.00	4.00	1100.00
10	Repair of Barbed wire fence	RM	180.00	1.29	232.62
11	Repair of Inspection path			L.S	300.00
12	Repair of soil and moisture conservation works			L.S	400.00
13	**TOTAL (Serial No. 1 TO 12)**				**4380.02**
				SAY	**4380.00**

ANNEXURE-II

Maintenance Norms of Second Year (20% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	88.00	381.88	336.05
2	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	132.00	190.89	251.98
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	88.00	218.79	192.53
4	Filling of pits 30 cm x 30 cm x 30 cm	% Nos.	132.00	152.68	201.53
5	Planting of plants raised in polythene bags including ramming	% Nos.	140.00	174.59	244.43
6	Planting of naked root plants including cramming	% Nos.	80.00	147.15	117.76
7	Carriage of plants with ploythene bags over a distance of 2 km uphill	%/Nos./km	140.00	174.48	488.54
8	Carriage of naked root plants over a distance of 2 km uphill	%/Nos./km	80.00	28.19	45.11
9	Nursery cost of plants	Per Plant	220.00	4.00	880.00
10	Repair of Barbed wire fence	RM	180.00	1.29	232.62
11	Repair of Inspection path			L.S	300.00
12	Repair of soil and moisture conservation works			L.S	400.00
13	**TOTAL (Serial No. 1 TO 12)**				**3690.54**
				SAY	**3691.00**

ANNEXURE-II

Maintenance Norms of Third Year (15% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	66.00	381.88	252.04
2	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	99.00	190.89	188.98
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	66.00	218.79	144.40
4	Filling of pits 30 cm x 30 cm x 30 cm	% Nos.	99.00	152.68	151.15
5	Planting of plants raised in polythene bags including ramming	% Nos.	105.00	174.59	183.32
6	Planting of naked root plants including cramming	% Nos.	60.00	147.19	88.32
7	Carriage of plants with ploythene bags over a distance of 2 km uphill	%/Nos./km	105.00	174.48	366.41
8	Carriage of naked root plants over a distance of 2 km uphill	%/Nos./km	60.00	28.19	33.83
9	Nursery cost of plants	Per Plant	165.00	4.00	660.00
10	Repair of Barbed wire fence	RM	200.00	1.29	258.46
11	Repair of Inspection path			L.S	300.00
12	Repair of soil and moisture conservation works			L.S	400.00
13	**TOTAL (Serial No. 1 TO 12)**				**3026.91**
				SAY	**3027.00**

ANNEXURE-II

Maintenance Norms of Fourth Year (15% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	66.00	381.88	252.04
2	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	99.00	190.89	188.98
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	66.00	218.79	144.40
4	Filling of pits 30 cm x 30 cm x 30 cm	% Nos.	99.00	152.68	151.15
5	Planting of plants raised in polythene bags including ramming	% Nos.	105.00	174.59	183.32
6	Planting of naked root plants including cramming	% Nos.	60.00	147.19	88.32
7	Carriage of plants with ploythene bags over a distance of 2 km uphill	%/Nos./km	105.00	174.48	366.41
8	Carriage of naked root plants over a distance of 2 km uphill	%/Nos./km	60.00	28.19	33.83
9	Nursery cost of plants	Per Plant	165.00	4.00	660.00
10	Repair of Barbed wire fence	RM	200.00	1.29	258.46
11	Repair of Inspection path			L.S	200.00
12	Repair of soil and moisture conservation works			L.S	200.00
13	**TOTAL (Serial No. 1 TO 12)**				**2726.91**
				SAY	**2727.00**

ANNEXURE-II

Maintenance Norms of Fifth Year (10% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	44.00	381.88	168.03
2	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	66.00	190.89	125.99
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	44.00	218.79	96.27
4	Filling of pits 30 cm x 30 cm x 30 cm	% Nos.	66.00	152.68	100.77
5	Planting of plants raised in polythene bags including ramming	% Nos.	70.00	174.59	122.21
6	Planting of naked root plants including cramming	% Nos.	40.00	147.19	58.88
7	Carriage of plants with ploythene bags over a distance of 2 km uphill	%/Nos./km	70.00	174.48	244.27
8	Carriage of naked root plants over a distance of 2 km uphill	%/Nos./km	40.00	28.19	22.55
9	Nursery cost of plants	Per Plant	110.00	4.00	440.00
10	Repair of Barbed wire fence	RM	200.00	1.29	258.46
11	Repair of Inspection path			L.S	200.00
12	Repair of soil and moisture conservation works			L.S	200.00
13	TOTAL (Serial No. 1 TO 12)				2037.43
				SAY	2037.00

ABSTRACT OF COST MODEL FOR AFFORESTATION OF DEGRADED FOREST LAND

S. No.	Particulars of Works	Amount (Rs.)	
1	New Norm for Plantation		45318.00
2	Maintenance Norm for 1st Year Plantation (25% Mortality)		4380.00
3	Maintenance Norm for 2nd Year Plantation (20% Mortality)		3691.00
4	Maintenance Norm for 3rd Year Plantation (15% Mortality)		3027.00
5	Maintenance Norm for 4th Year Plantation (15% Mortality)		2727.00
6	Maintenance Norm for 5th Year Plantation (10% Mortality)		2037.00
7		TOTAL	61180.00

ANNEXURE-II

BIOLOGICAL MEASURES

II TIMBER PLANTATION COST MODEL

Per Ha. Cost Model for Timber Plantation

(Calculated at Wage Rate of Rs. 120/-)					
Assumption: Per Ha. Cost Model for Timber Plantation, calculation is based on average of 5 Ha. plot of dimension 250 x 200 m.					
S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Survey and demarcation of plantation area including making sections path and preparation of Map etc.	Ha.	1	75.6	75.6
2	Layout of pits over 1 Ha.	Ha.	1	125.8153846	125.8153846
3	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	70	956.68	669.67
4	Charring and Coaltaring of the ends of Wooden Fence Posts 45 cm bottom and 15 cm conical top.	% Nos.	70	206.40	144.48
5	Carriage of Fence post up to 2 m long and 8 to 10 cm dia over distance 5 km	% Nos./Km	70	503.45	1762.06
6	Digging of holes 20 - 30 cm dia and 45 cm deep	% Nos.	70	669.78	468.85
7	Fixing of fence post including strulting	% Nos.	70	514.0615385	359.84
8	Carriage of barbed wire over average distance of 10 km up hills	Qtls./km	1	126	1260
9	Stretching and fixing of Barbed wire with V-stapple in each strand (3 strands)	Rm	720	3.507692308	2525.54
10	Preparation of inspection path 60 cm wide	Rm	150	8.03	1204.62
11	Interlacing of throng bushes in Barbed wire fence	Rm	180	3.046153846	548.31
12	Digging of pits 45 cm x 45 cm x 45 cm	% Nos.	800	704.86	5638.89
13	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	800	201.9692308	1615.75
14	Carriage of naked root plants over distance 5 km uphills	% Nos./Km	800	26.03	1041.23
15	Planting of naked root plants including ramming	% Nos.	800	135.88	1087.015385
16	Construction of stairs	Nos.	2	L.S.	450.00
17	**Total (S. No. 1 to 16)**				**18977.68**
20	Material cost of Barbed wire	Qtl.	1	3900.00	3900.00
21	Cost of U-Nails	Kg	1.25	45.00	56.25
22	Cost of Plants	Nos.	800	3.00	2400.00
23	Cost of Fence Posts			L.S.	7000.00
24	**Total Material Cost (S. No. 20 to 23)**				**13356.25**
30	**GRAND TOTAL (S. No. 19 + S. No. 24)**				**32333.93**
				SAY	**32334.00**

ANNEXURE-II

Maintenance Norms of First Year (25% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	200.00	352.52	705.05
2	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	200.00	201.97	403.94
3	Carriage of naked root plants over a distance of 6 km uphill.	%/Nos./km	200.00	26.03	312.37
4	Planting of naked root plants including cramming	% Nos.	200.00	135.88	271.75
5	Mulching/weeding of plants in planting area.	% Nos.	900.00	44.12	397.11
6	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	30.00	956.68	287.00
7	Carriage of Fence posts over a distance of 10 km uphill	%/Nos./km	30.00	503.45	1510.34
8	Digging of holes for fixing of Fence posts	% Nos.	30.00	669.78	200.94
9	Fixing of Fence posts	% Nos.	30.00	514.06	154.22
10	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
11	**TOTAL (S. No. 1 TO 10)**				**4851.94**
16	Cost of Plants	Nos.	200.00	3.00	600.00
17	Cost of U/stapples	Kg	0.50	45.00	22.50
18	**GRAND TOTAL (S. No. 15 TO 17)**				**5474.44**
				SAY	**5474.00**

ANNEXURE-II

Maintenance Norms of Second Year (20% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	160.00	352.52	564.04
2	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	160.00	201.97	323.15
3	Carriage of naked root plants over a distance of 6 km uphill.	%/Nos./km	160.00	26.03	249.90
4	Planting of naked root plants including cramming	% Nos.	160.00	135.88	217.40
5	Mulching/weeding of plants in planting area.	% Nos.	900.00	44.12	397.11
6	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	30.00	956.68	287.00
7	Carriage of Fence posts over a distance of 10 km uphill	%/Nos./km	30.00	503.45	1510.34
8	Digging of holes for fixing of Fence posts	% Nos.	30.00	669.78	200.94
9	Fixing of Fence posts	% Nos.	30.00	514.06	154.22
10	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
11	**TOTAL (S. No. 1 TO 10)**				**4513.32**
16	Cost of Plants	Nos.	160.00	3.00	480.00
17	Cost of U/stapples	Kg	0.50	45.00	22.50
18	**GRAND TOTAL (S. No. 15 TO 17)**				**5015.82**
				SAY	**5016.00**

ANNEXURE-II

Maintenance Norms of Third Year (15% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	120.00	352.52	423.03
2	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	120.00	201.97	242.36
3	Carriage of naked root plants over a distance of 6 km uphill.	%/Nos./km	120.00	26.03	187.42
4	Planting of naked root plants including cramming	% Nos.	120.00	135.88	163.05
5	Mulching/weeding of plants in planting area.	% Nos.	900.00	44.12	397.11
6	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	30.00	956.68	287.00
7	Carriage of Fence posts over a distance of 10 km uphill	%/Nos./km	30.00	503.45	1510.34
8	Digging of holes for fixing of Fence posts	% Nos.	30.00	669.78	200.94
9	Fixing of Fence posts	% Nos.	30.00	514.06	154.22
10	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
11	**TOTAL (S. No. 1 TO 10)**				**4174.70**
16	Cost of Plants	Nos.	120.00	3.00	360.00
17	Cost of U/stapples	Kg	0.50	45.00	22.50
18	**GRAND TOTAL (S. No. 15 TO 17)**				**4557.20**
				SAY	**4557.00**

ANNEXURE-II

Maintenance Norms of Fourth Year (15% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	120.00	352.52	423.03
2	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	120.00	201.97	242.36
3	Carriage of naked root plants over a distance of 6 km uphill.	%/Nos./km	120.00	26.03	187.42
4	Planting of naked root plants including cramming	% Nos.	120.00	135.88	163.05
5	Mulching/weeding of plants in planting area.	% Nos.	900.00	44.12	397.11
6	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	30.00	956.68	287.00
7	Carriage of Fence posts over a distance of 10 km uphill	%/Nos./km	30.00	503.45	1510.34
8	Digging of holes for fixing of Fence posts	% Nos.	30.00	669.78	200.94
9	Fixing of Fence posts	% Nos.	30.00	514.06	154.22
10	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
15	**TOTAL (S. No. 11 TO 12)**				**4174.70**
16	Cost of Plants	Nos.	120.00	3.00	360.00
17	Cost of U/stapples	Kg	0.50	45.00	22.50
18	**GRAND TOTAL (S. No. 15 TO 17)**				**4557.20**
				SAY	**4557.00**

ANNEXURE-II

Maintenance Norms of Fifth Year (10% Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	80.00	352.52	282.02
2	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	80.00	201.97	161.58
3	Carriage of naked root plants over a distance of 6 km uphill.	%/Nos./km	80.00	26.03	124.95
4	Planting of naked root plants including cramming	% Nos.	80.00	135.88	108.70
5	Mulching/weeding of plants in planting area.	% Nos.	900.00	44.12	397.11
6	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	30.00	956.68	287.00
7	Carriage of Fence posts over a distance of 10 km uphill	%/Nos./km	30.00	503.45	1510.34
8	Digging of holes for fixing of Fence posts	% Nos.	30.00	669.78	200.94
9	Fixing of Fence posts	% Nos.	30.00	514.06	154.22
10	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
11	**TOTAL (S. No. 1 TO 10)**				**3836.08**
16	Cost of Plants	Nos.	80.00	3.00	240.00
17	Cost of U/stapples	Kg	0.50	45.00	22.50
18	**GRAND TOTAL (S. No. 15 TO 17)**				**4098.58**
				SAY	**4099.00**

ABSTRACT OF COST MODEL FOR TIMBER PLANTATION

S. No.	Particulars of Works	Amount (Rs.)
1	**New Norm for Plantation**	**32334.00**
2	**Maintenance Norm for 1st Year Plantation (25% Mortality)**	**5474.00**
3	**Maintenance Norm for 2nd Year Plantation (20% Mortality)**	**5016.00**
4	**Maintenance Norm for 3rd Year Plantation (15% Mortality)**	**4557.00**
5	**Maintenance Norm for 4th Year Plantation (15% Mortality)**	**4557.00**
6	**Maintenance Norm for 5th Year Plantation (10% Mortality)**	**4099.00**
7	**TOTAL**	**56037.00**

III FODDER PLANATION COST MODEL

Per Ha. Cost Model for Fodder Plantation

(Calculated at Wage Rate of Rs. 120/-)

Assumption: Per Ha. Cost Model for Fodder Plantation, calculation is based on average of 5 Ha. plot of dimension 250 x 200 m.

S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Survey and demarcation of plantation area including making sections path and preparation of Map etc.	Ha.	1	75.6	75.6
2	Layout of pits over 1 Ha.	Ha.	1	125.8	125.8153846
3	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	60	956.7	574.01
4	Charring and Coaltaring of the ends of Wooden Fence Posts 45 cm bottom and 15 cm conical top.	% Nos.	60	206.4	123.84
5	Carriage of Fence post up to 2 m long and 8 to 10 cm dia over distance 5 km	% Nos./Km	60	503.4	1510.34
6	Digging of holes 20 - 30 cm dia and 45 cm deep	% Nos.	60	669.8	401.87
7	Fixing of fence post including strutting	% Nos.	60	514.1	308.44
8	Carriage of barbed wire over average distance of 10 km up hills	Qtls./km	1	126.0	1260
9	Stretching and fixing of Barbed wire with V-stapple in each strand (3 strands)	Rm	720	3.5	2525.54
10	Preparation of inspection path 60 cm wide	Rm	150	8.0	1204.62
11	Interlacing of throne bushes in Barbed wire fence	Rm	180	3.0	548.31
12	Digging of pits 45 cm x 45 cm x 45 cm	% Nos.	320	704.9	2255.56
13	Digging of pits 30 cm x 30 cm x 30 cm	% Nos.	480	352.5	1692.11
14	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	320	202.0	646.30
15	Filling of pits 30 cm x 30 cm x 30 cm	% Nos.	480	141.0	676.58
16	Carriage of naked root plants over distance 5 km uphills	% Nos./Km	320	26.0	416.49
17	Carriage of plants in Polythene bags over a distance of 5 km uphill.	% Nos./Km	480	161.1	3865.85
18	Planting of naked root plants including ramming	% Nos.	320	135.9	434.8061538
19	Planting of plants raised in Polythene bags including ramming.	% Nos.	480	161.2	773.6123077
20	Moisture retention intervention including V. ditches (MRI)	Ha.	1	1661.5	1661.54
21	Construction of stairs	Nos.	2		200.00
22	Preparation/Digging of Patches 30 cm x 30 cm x 25 cm	% Nos.	100	478.2	478.25
23	Patch sowing	% Nos.	100	139.0	139.02
24	**Total (S. No. 1 to 23)**				**21898.47**
27	Material cost of Barbed wire	Qtl.	1	3900.00	3900.00
28	Cost of U-Nails	Kg	1.25	45.00	56.25
29	Cost of Seeds	Kg	1	120.00	120.00
30	Cost of Plants	Nos.	800	3.00	2400.00
31	Cost of Fence Posts			L.S.	4900.00
32	**Total Material Cost (S. No. 27 to 31)**				**11376.25**
33	**GRAND TOTAL (S. No. 26 + S. No. 32)**				**33274.72**
				SAY	**33275.00**

ANNEXURE-II

Maintenance Norms of First Year (20 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	120.00	176.22	211.46
2	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	80.00	352.52	282.02
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	120.00	141.01	169.21
4	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	80.00	201.97	161.58
5	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	%Nos./km	120.00	161.08	386.58
6	Carriage of naked root plants over a distance of 2 km uphill.	%Nos./km	80.00	26.03	41.65
7	Planting of plants raised in Polythene bags including ramming.	%Nos.	120.00	161.17	193.40
8	Planting of naked root plants including cramming	% Nos.	80.00	135.88	108.70
9	Mulching/weeding of plants in planting area.	% Nos.	800.00	44.12	352.98
10	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
11	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
12	Digging of holes for fixing of Fence posts	% Nos.	15.00	669.78	100.47
13	Fixing of Fence posts	% Nos.	15.00	514.06	77.11
14	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
15	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
16	**TOTAL (5. No. 1 TO 15)**				**3191.17**
19	Cost of Plants	Nos.	200.00	3.00	600.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (5. No. 18 TO 20)**				**3813.67**
22				**SAY**	**3814.00**

Maintenance Norms of First Year (25 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	120.00	95.45	114.54
2	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	80.00	190.95	152.76
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	120.00	76.38	91.66
4	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	80.00	109.40	87.52
5	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	%Nos./km	120.00	87.25	209.40
6	Carriage of naked root plants over a distance of 2 km uphill.	%Nos./km	80.00	14.10	22.56
7	Planting of plants raised in Polythene bags including ramming.	%Nos.	120.00	87.30	104.76
8	Planting of naked root plants including cramming	% Nos.	80.00	73.60	58.88
9	Mulching/weeding of plants in planting area.	% Nos.	800.00	23.90	191.20
10	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	518.20	77.73
11	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	272.70	61.36
12	Digging of holes for fixing of Fence posts	% Nos.	15.00	362.80	54.42
13	Fixing of Fence posts	% Nos.	15.00	278.45	41.77
14	Repair of Barbed wire Fence.	RM	20000.00	0.65	130.00
15	Interlacing of throny bush wood in Barbed wire.	RM	200.00	1.65	330.00
16	**TOTAL (S. No. 1 TO 15)**				**1728.55**
19	Cost of Plants	Nos.	200.00	3.00	600.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**622.50**
22				**SAY**	**623.00**

ANNEXURE-II

Maintenance Norms of Second Year (20 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	96.00	176.22	169.17
2	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	64.00	352.52	225.61
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	96.00	141.01	135.37
4	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	64.00	201.97	129.26
5	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	%Nos./km	96.00	161.08	309.27
6	Carriage of naked root plants over a distance of 2 km uphill.	%Nos./km	64.00	26.03	33.32
7	Planting of plants raised in Polythene bags including ramming.	%Nos.	96.00	161.17	154.72
8	Planting of naked root plants including cramming	% Nos.	64.00	135.88	86.96
9	Mulching/weeding of plants in planting area.	% Nos.	800.00	44.12	352.98
10	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
11	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
12	Digging of holes for fixing of Fence posts	% Nos.	15.00	669.78	100.47
13	Fixing of Fence posts	% Nos.	15.00	514.06	77.11
14	Repair of Barbed wire Fence.	RM	20000.00	1.20	240.00
15	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
16	**TOTAL (S. No. 1 TO 15)**				**2880.25**
19	Cost of Plants	Nos.	160.00	3.00	480.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**3382.75**
22				**SAY**	**3383.00**

ANNEXURE-II

Maintenance Norms of Third Year (15 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	72.00	176.22	126.88
2	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	48.00	352.52	169.21
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	72.00	141.01	101.53
4	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	48.00	201.97	96.95
5	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	%Nos./km	72.00	161.08	231.95
6	Carriage of naked root plants over a distance of 2 km uphill.	%Nos./km	48.00	26.03	24.99
7	Planting of plants raised in Polythene bags including ramming.	%Nos.	72.00	161.17	116.04
8	Planting of naked root plants including cramming	% Nos.	48.00	135.88	65.22
9	Mulching/weeding of plants in planting area.	% Nos.	800.00	44.12	352.98
10	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
11	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
12	Digging of holes for fixing of Fence posts	% Nos.	15.00	669.78	100.47
13	Fixing of Fence posts	% Nos.	15.00	514.06	77.11
14	Repair of Barbed wire Fence.	RM	20000.00	1.20	240.00
15	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
16	**TOTAL (S. No. 1 TO 15)**				**2569.33**
19	Cost of Plants	Nos.	120.00	3.00	360.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**2951.83**
22				**SAY**	**2952.00**

ANNEXURE-II

Maintenance Norms of Fourth Year (15 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	72.00	176.22	126.88
2	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	48.00	352.52	169.21
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	72.00	141.01	101.53
4	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	48.00	201.97	96.95
5	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	%Nos./km	72.00	161.08	231.95
6	Carriage of naked root plants over a distance of 2 km uphill.	%Nos./km	48.00	26.03	24.99
7	Planting of plants raised in Polythene bags including ramming.	%Nos.	72.00	161.17	116.04
8	Planting of naked root plants including cramming	% Nos.	48.00	135.88	65.22
9	Mulching/weeding of plants in planting area.	% Nos.	800.00	44.12	352.98
10	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
11	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
12	Digging of holes for fixing of Fence posts	% Nos.	15.00	669.78	100.47
13	Fixing of Fence posts	% Nos.	15.00	514.06	77.11
14	Repair of Barbed wire Fence.	RM	20000.00	1.20	240.00
15	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
16	**TOTAL (S. No. 1 TO 15)**				**2569.33**
19	Cost of Plants	Nos.	120.00	3.00	360.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**2951.83**
22				**SAY**	**2952.00**

ANNEXURE-II

Maintenance Norms of Fifth Year (15 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of failure pits 30 cm x 30 cm x 30 cm	% Nos.	48.00	176.22	84.58
2	Re-digging of failure pits 45 cm x 45 cm x 45 cm	% Nos.	32.00	352.52	112.81
3	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	48.00	141.01	67.68
4	Filling of pits 45 cm x 45 cm x 45 cm	% Nos.	32.00	201.97	64.63
5	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	%Nos./km	48.00	161.08	154.63
6	Carriage of naked root plants over a distance of 2 km uphill.	%Nos./km	32.00	26.03	16.66
7	Planting of plants raised in Polythene bags including ramming.	%Nos.	48.00	161.17	77.36
8	Planting of naked root plants including cramming	% Nos.	32.00	135.88	43.48
9	Mulching/weeding of plants in planting area.	% Nos.	800.00	44.12	352.98
10	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
11	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
12	Digging of holes for fixing of Fence posts	% Nos.	15.00	669.78	100.47
13	Fixing of Fence posts	% Nos.	15.00	514.06	77.11
14	Repair of Barbed wire Fence.	RM	20000.00	1.20	240.00
15	Interlacing of throny bush wood in Barbed wire.	RM	200.00	3.05	609.23
16	**TOTAL (S. No. 1 TO 15)**				**2258.41**
19	Cost of Plants	Nos.	80.00	3.00	240.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**2520.91**
22				**SAY**	**2521.00**

ABSTRACT OF COST MODEL FOR FODDER PLANTATION

S. No.	Particulars of Works	Amount (Rs.)
1	**New Norm for Plantation**	**33275.00**
2	**Maintenance Norm for 1st Year Plantation (25% Mortality)**	**623.00**
3	**Maintenance Norm for 2nd Year Plantation (20% Mortality)**	**3383.00**
4	**Maintenance Norm for 3rd Year Plantation (15% Mortality)**	**2952.00**
5	**Maintenance Norm for 4th Year Plantation (15% Mortality)**	**2952.00**
6	**Maintenance Norm for 5th Year Plantation (10% Mortality)**	**2521.00**
7	**TOTAL**	**45706.00**

ANNEXURE-II

BIOLOGICAL MEASURES

III NTFP PLANTATION

Per Ha. Cost Model for NTFP Plantation

(Calculated at Wage Rate of Rs. 120/-)

Assumption: Per Ha. Cost Model for NTFP Plantation, calculation is based on average of 5 Ha. plot of dimension 250 x 200 m.

S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)
1	Survey and demarcation of plantation area including making sections path and preparation of Map etc.	Ha.	1	75.6	75.6
2	Layout of Pathes over 1 Ha.	Ha.	1	125.8	125.8153846
3	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	60	956.7	574.01
4	Carriage of Fence post up to 2 m long and 8 to 10 cm dia over distance 1.5 km	% Nos./Km	60	503.4	453.10
5	Digging of holes 20 - 30 cm dia and 45 cm deep	% Nos.	60	669.8	401.87
6	Fixing of fence post including strulting	% Nos.	60	514.1	308.44
7	Charring and Coaltarring ends of Fence posts 45 cm bottom, 15 cm conical top.	% Nos.	60	206.4	123.84
8	Carriage of barbed wire over average distance of 1.5 km up hills	Qtls./km	1	126.0	189.00
9	Stretching and fixing of Barbed wire with V-stapple in each strand (3 strands)	Rm	720	3.5	2525.54
10	Interlacing of throne bushes in Barbed wire fence	Rm	180	3.0	548.31
11	Preparation of inspection path 60 cm wide	Rm	150	8.0	1204.62
12	Preparation of Patches 30 cm x 30 cm x 25 cm	% Nos.	1000	241.7	2416.62
13	Planting of Medical plants in Patches (Naked root)	% Nos.	5000	126.0	6300.00
14	Carriage of naked root plants over distance 2 km uphills	% Nos./Km	5000	26.0	2603.08
15	**Total (S. No. 1 to 14)**				**17849.82**
18	Cost of Medical plants	Each	5000	3.00	15000.00
19	Material cost of Barbed wire	Qtl.	1	3900.00	3900.00
20	Cost of U-Nails	Kg	1.25	45.00	56.25
21	Cost of Fence Posts			L.S.	6720.00
22	**Total Material Cost (S. No. 18 to 21)**				**25676.25**
23	**GRAND TOTAL (S. No. 17 + S. No. 22)**				**43526.07**
				SAY	**43526.00**

ANNEXURE-II

Maintenance Norms of First Year (25 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of Patches 30 cm x 30 cm x 25 cm.	% Nos.	250.00	120.83	302.08
2	Planting of Medicinal plants in 600 patches each.	% Nos.	1250.00	135.88	1698.46
3	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	% Nos./km	1250.00	26.03	650.77
4	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
5	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
6	Re-digging of holes for fixing of Fence posts.	%Nos.	15.00	334.89	50.23
7	Fixing of Fence posts	%Nos.	15.00	514.06	77.11
8	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
9	Interlacing of throny bush wood in Barbed wire.	RM	180.00	3.05	548.31
10	**TOTAL (S. No. 1 TO 9)**				**3823.74**
19	Cost of Plants	Nos.	1250.00	3.00	3750.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**7596.24**
22				**SAY**	**7596.00**

ANNEXURE-II

Maintenance Norms of Second Year (20 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of Patches 30 cm x 30 cm x 25 cm.	% Nos.	200.00	120.83	241.66
2	Planting of Medicinal plants in 600 patches each.	% Nos.	1000.00	135.88	1358.77
3	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	% Nos./km	1000.00	26.03	520.62
4	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
5	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
6	Re-digging of holes for fixing of Fence posts.	%Nos.	15.00	334.89	50.23
7	Fixing of Fence posts	%Nos.	15.00	514.06	77.11
8	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
9	Interlacing of throny bush wood in Barbed wire.	RM	180.00	3.05	548.31
10	**TOTAL (S. No. 1 TO 9)**				**3293.47**
19	Cost of Plants	Nos.	1000.00	3.00	3000.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**6315.97**
22				**SAY**	**6316.00**

ANNEXURE-II

Maintenance Norms of Third Year (15 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of Patches 30 cm x 30 cm x 25 cm.	% Nos.	150.00	120.83	181.25
2	Planting of Medicinal plants in 600 patches each.	% Nos.	750.00	135.88	1019.08
3	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	% Nos./km	750.00	26.03	390.46
4	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
5	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
6	Re-digging of holes for fixing of Fence posts.	%Nos.	15.00	334.89	50.23
7	Fixing of Fence posts	%Nos.	15.00	514.06	77.11
8	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
9	Interlacing of throny bush wood in Barbed wire.	RM	180.00	3.05	548.31
10	**TOTAL (S. No. 1 TO 9)**				**2763.21**
19	Cost of Plants	Nos.	750.00	3.00	2250.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**5035.71**
22				**SAY**	**5036.00**

ANNEXURE-II

Maintenance Norms of Fourth Year (15 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of Patches 30 cm x 30 cm x 25 cm.	% Nos.	150.00	120.83	181.25
2	Planting of Medicinal plants in 600 patches each.	% Nos.	750.00	135.88	1019.08
3	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	% Nos./km	750.00	26.03	390.46
4	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
5	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
6	Re-digging of holes for fixing of Fence posts.	%Nos.	15.00	334.89	50.23
7	Fixing of Fence posts	%Nos.	15.00	514.06	77.11
8	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
9	Interlacing of throny bush wood in Barbed wire.	RM	180.00	3.05	548.31
10	**TOTAL (S. No. 1 TO 9)**				**2763.21**
19	Cost of Plants	Nos.	750.00	3.00	2250.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**5035.71**
22				**SAY**	**5036.00**

ANNEXURE-II

Maintenance Norms of Fifth Year (10 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of Patches 30 cm x 30 cm x 25 cm.	% Nos.	100.00	120.83	120.83
2	Planting of Medicinal plants in 600 patches each.	% Nos.	500.00	135.88	679.38
3	Carriage of Plants with Polythene bags over a distance of 2 km uphill.	% Nos./km	500.00	26.03	260.31
4	Cutting and preparation of Wooden Fence Posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm conical shape	% Nos.	15.00	956.68	143.50
5	Carriage of Fence posts over a distance of 1.5 km uphill	%Nos./km	15.00	503.45	113.28
6	Re-digging of holes for fixing of Fence posts.	%Nos.	15.00	334.89	50.23
7	Fixing of Fence posts	%Nos.	15.00	514.06	77.11
8	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
9	Interlacing of throny bush wood in Barbed wire.	RM	180.00	3.05	548.31
10	**TOTAL (S. No. 1 TO 9)**				**2232.95**
19	Cost of Plants	Nos.	500.00	3.00	1500.00
20	Cost of U/stapples	Kg	0.50	45.00	22.50
21	**GRAND TOTAL (S. No. 18 TO 20)**				**3755.45**
22				**SAY**	**3755.00**

ABSTRACT OF COST MODEL FOR NTFP PLANTATION

S. No.	Particulars of Works	Amount (Rs.)
1	**New Norm for Plantation**	**43526.00**
2	**Maintenance Norm for 1st Year Plantation (25% Mortality)**	**7596.00**
3	**Maintenance Norm for 2nd Year Plantation (20% Mortality)**	**6316.00**
4	**Maintenance Norm for 3rd Year Plantation (15% Mortality)**	**5036.00**
5	**Maintenance Norm for 4th Year Plantation (15% Mortality)**	**5036.00**
6	**Maintenance Norm for 5th Year Plantation (10% Mortality)**	**3755.00**
7	**TOTAL**	**71265.00**

ANNEXURE-II

BIOLOGICAL MEASURES

III PASTURE DEVELOPMENT

Per Ha. Cost Model for Pasture Development

(Calculated at Wage Rate of Rs. 120/-)						
Assumption: Per Ha. Cost Model for Pasture Development, calculation is based on average of 5 Ha. plot of dimension 250 x 200 m.						
S. No.	Particulars of Works	Unit	Qty.	Rate (Rs.)	Amount (Rs.)	
1	Survey and demarcation of plantation area including making sections path and preparation of Map etc.	Ha.	1	75.6	75.6	139.5692
2	Weeding of obnoxious weeds.	Ha.	1	15	187.50	
3	Prepartaion of strips including sowing along contour at 100 cm x 30 cm x 5 cm interval of 2m for grass sowing.	% Nos.	800	679.57	5436.55	1254.589
4	Application of vermi compost/organic fertilizers (twice over 1 Ha. @ 25 Kg/Tin)	Ha.	1	15	300.00	
5	Carriage of fertilizers to work site over a distance of 5 km by manual labour	Qtl./km	0.5	61.66	154.15	113.8367
6	Moisture retention intervention including V. ditches (MRI)	Ha.	1	2769.230769	2769.23	5112.426
7	Cost of fertilizer and seed			L.S.	500.00	
8	**Total (S. No. 1 to 7)**				**9423.04**	
				SAY	**9423.00**	

ANNEXURE-II

Maintenance Norms of First Year (25 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-preparation of strips 100 cm x 0.30 cm x 0.5 cm.	% Nos.	200.00	350.77	701.54
2	**TOTAL**				**701.54**
5	Cost of Seed	Kg	1.00	386.25	386.25
21	**GRAND TOTAL (S. No. 4 TO 5)**				**1087.79**
22				**SAY**	**1088.00**

Maintenance Norms of Second Year (20 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-preparation of strips 100 cm x 0.30 cm x 0.5 cm.	% Nos.	160.00	350.77	561.23
2	**TOTAL**				**561.23**
5	Cost of Seed	Kg	1.00	386.25	386.25
21	**GRAND TOTAL (S. No. 4 TO 5)**				**947.48**
22				**SAY**	**947.00**

ABSTRACT OF COST MODEL FOR PASTURE DEVELOPMENT

S. No.	Particulars of Works	Amount (Rs.)
1	**New Norm for Plantation**	**9423.00**
2	**Maintenance Norm for 1st Year Plantation (25% Mortality)**	**1088.00**
3	**Maintenance Norm for 2nd Year Plantation (20% Mortality)**	**947.00**
4	**TOTAL**	**11458.00**

BIOLOGICAL MEASURES

III REVERINE LINEAR/STRIP PLANTATION

Per Ha. Cost Model for Reverine Linear/Strip Plantation

(Calculated at Wage Rate of Rs. 120/-)					
Assumption: Per Ha. Cost Model for Reverine Linear/Strip Plantation, calculation is based on average of 5 Ha. plot of dimension 250 x 200 m.					
S. No.	**Particulars of Works**	**Unit**	**Qty.**	**Rate (Rs.)**	**Amount (Rs.)**
1	Survey and demarcation of plantation area including making sections path and preparation of Map etc.	Ha.	1	75.6	75.60
2	Cutting and prepartion of Wodden posts 1.80 m long and 8 to 10 cm dia. including debarking & fastening of the top 15 cm conical shape.	% Nos.	60	956.7	574.01
3	Charring and Coaltarring of the ends of Fence posts 45 cm bottom and 15 cm conical top.	% Nos.	60	206.4	123.84
4	Carriage of Fence posts over a distance of 1.5 km.	% Nos./km	60	503.4	453.10
5	Digging of holes for Fence posts for 45 cm deep.	% Nos.	60	669.8	401.87
6	Fixing of Fence posts including strutting.	% Nos.	60	514.1	308.44
7	Carriage of Barbed wire from depot to site over a distance of 1.5 km uphill.	Qtl./km	1	126.0	189.00
8	Stretching and fixing of barbed wire with U stapples an 3-strands.	RM	720	3.5	2525.54
9	Interlacing of bushes in barbed wire fence.	RM	180	3.0	548.31
10	Preparation and digging of patches 60 cm x 60 cm x 25 cm.	% Nos.	250	478.2	1195.62
11	Sowing of seeds in patches.	% Nos.	250	139.0	347.54
12	Diging of pits 30 cm x 30 cm x 30 cm for Polythene bags planting.	% Nos.	250	352.5	881.31
13	Carriage of plants in Polythene bags over a distance of 2 km uphill.	% Nos./km	250	161.1	805.38
14	Planting of plants raised in Polythene bags including ramming.	% Nos.	250	161.2	402.92
15	Filling of pits 30 cm x 30 m x 30 cm.	% Nos.	250	141.0	352.38
16	**TOTAL (S. No. 1 TO 15)**				**9184.86**
19	Cost of plant	Each	250	3.00	750.00
20	Cost of barbed wire	Qtl.	1	3900.00	3900.00
21	Cost of U Nails	Kg	1.25	45.00	56.25
22	Cost of Seeds	Kg	0.5	120.00	60.00
23	Cost of Fence posts.			L.S.	5000.00
24	**TOTAL (S. No. 19 TO 23)**				**9766.25**
25	**GRAND TOTAL (S. No. 18 + S. No. 24)**				**18951.11**
				SAY	**18951.00**

Maintenance Norms of First Year (25 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of patches 60 cm x 60 cm x 25 cm.	% Nos.	65.00	239.11	155.42
2	Re-digging of pits 30 cm x 30 cm x 30 cm	% Nos.	65.00	176.22	114.54
3	Filling of pits 30 cm x 30 cm x 30 cm.	% Nos.	65.00	141.01	91.66
4	Carriage of plants in Polythene bags over a distance of 2 km uphill.	% Nos./km	65.00	161.08	209.40
5	Planting of plants raised in Polythene bags including ramming.	%Nos.	65.00	161.17	104.76
6	Sowing of seeds in patches.	%Nos.	65.00	139.02	90.36
7	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
8	Cutting and prepartion of Wodden posts 1.80 m long and 8 to 10 cm dia. including debarking & fastening of the top 15 cm conical shape.	%Nos.	15.00	956.68	143.50
9	Carriage of Fence posts over a distance of 1 km.	%Nos./km	15.00	503.45	75.52
10	Digging of holes for Fence posts for 45 cm deep.	%Nos.	15.00	669.78	100.47
11	Fixing of Fence posts including strutting.	%Nos.	15.00	514.06	77.11
12	Interlacing of bushes in barbed wire fence.	RM	180.00	3.05	548.31
13	**TOTAL (S. No. 1 TO 12)**				**1951.04**
16	Cost of Plants	Nos.	65.00	3.00	195.00
17	Cost of Seeds	Kg	0.20	120.00	24.00
18	Cost of U/stapples	Kg	0.50	45.00	22.50
19	**GRAND TOTAL (S. No. 18 TO 20)**				**2192.54**
20				**SAY**	**2193.00**

Maintenance Norms of Second Year (20 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of patches 60 cm x 60 cm x 25 cm.	% Nos.	50.00	239.11	119.56
2	Re-digging of pits 30 cm x 30 cm x 30 cm	% Nos.	50.00	176.22	88.11
3	Filling of pits 30 cm x 30 cm x 30 cm.	% Nos.	50.00	141.01	70.50
4	Carriage of plants in Polythene bags over a distance of 2 km uphill.	% Nos./km	50.00	161.08	161.08
5	Planting of plants raised in Polythene bags including ramming.	%Nos.	50.00	161.17	80.58
6	Sowing of seeds in patches.	%Nos.	50.00	139.02	69.51
7	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
8	Cutting and prepartion of Wodden posts 1.80 m long and 8 to 10 cm dia. Including debarking & fastening of the top 15 cm conical shape.	%Nos.	15.00	956.68	143.50
9	Carriage of Fence posts over a distance of 1 km.	%Nos./km	15.00	503.45	75.52
10	Digging of holes for Fence posts for 45 cm deep.	%Nos.	15.00	669.78	100.47
11	Fixing of Fence posts including strutting.	%Nos.	15.00	514.06	77.11
12	Interlacing of bushes in barbed wire fence.	RM	180.00	3.05	548.31
13	**TOTAL (S. No. 1 TO 12)**				**1774.24**
16	Cost of Plants	Nos.	50.00	3.00	150.00
17	Cost of Seeds	Kg	0.20	120.00	24.00
18	Cost of U/stapples	Kg	0.50	45.00	22.50
19	**GRAND TOTAL (S. No. 18 TO 20)**				**1970.74**
20				**SAY**	**1971.00**

Maintenance Norms of Third Year (15 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of patches 60 cm x 60 cm x 25 cm.	% Nos.	40.00	239.11	95.65
2	Re-digging of pits 30 cm x 30 cm x 30 cm	% Nos.	40.00	176.22	70.49
3	Filling of pits 30 cm x 30 cm x 30 cm.	% Nos.	40.00	141.01	56.40
4	Carriage of plants in Polythene bags over a distance of 2 km uphill.	% Nos./km	40.00	161.08	128.86
5	Planting of plants raised in Polythene bags including ramming.	%Nos.	40.00	161.17	64.47
6	Sowing of seeds in patches.	%Nos.	40.00	139.02	55.61
7	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
8	Cutting and prepartion of Wodden posts 1.80 m long and 8 to 10 cm dia. including debarking & fastening of the top 15 cm conical shape.	%Nos.	15.00	956.68	143.50
9	Carriage of Fence posts over a distance of 1 km.	%Nos./km	15.00	503.45	75.52
10	Digging of holes for Fence posts for 45 cm deep.	%Nos.	15.00	669.78	100.47
11	Fixing of Fence posts including strutting.	%Nos.	15.00	514.06	77.11
12	Interlacing of bushes in barbed wire fence.	RM	180.00	3.05	548.31
13	**TOTAL (S. No. 1 TO 12)**				**1656.37**
16	Cost of Plants	Nos.	40.00	3.00	120.00
17	Cost of Seeds	Kg	0.20	120.00	24.00
18	Cost of U/stapples	Kg	0.50	45.00	22.50
19	**GRAND TOTAL (S. No. 18 TO 20)**				**1822.87**
20				**SAY**	**1823.00**

Maintenance Norms of Fourth Year (15 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of patches 60 cm x 60 cm x 25 cm.	% Nos.	40.00	239.11	95.65
2	Re-digging of pits 30 cm x 30 cm x 30 cm	% Nos.	40.00	176.22	70.49
3	Filling of pits 30 cm x 30 cm x 30 cm.	% Nos.	40.00	141.01	56.40
4	Carriage of plants in Polythene bags over a distance of 2 km uphill.	% Nos./km	40.00	161.08	128.86
5	Planting of plants raised in Polythene bags including ramming.	%Nos.	40.00	161.17	64.47
6	Sowing of seeds in patches.	%Nos.	40.00	139.02	55.61
7	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
8	Cutting and prepartion of Wodden posts 1.80 m long and 8 to 10 cm dia. Including debarking & fastening of the top 15 cm conical shape.	%Nos.	15.00	956.68	143.50
9	Carriage of Fence posts over a distance of 1 km.	%Nos./km	15.00	503.45	75.52
10	Digging of holes for Fence posts for 45 cm deep.	%Nos.	15.00	669.78	100.47
11	Fixing of Fence posts including strutting.	%Nos.	15.00	514.06	77.11
12	Interlacing of bushes in barbed wire fence.	RM	180.00	3.05	548.31
13	**TOTAL (S. No. 1 TO 12)**				**1656.37**
16	Cost of Plants	Nos.	40.00	3.00	120.00
17	Cost of Seeds	Kg	0.20	120.00	24.00
18	Cost of U/stapples	Kg	0.50	45.00	22.50
19	**GRAND TOTAL (S. No. 18 TO 20)**				**1822.87**
20				**SAY**	**1823.00**

Maintenance Norms of Fifth Year (10 % Mortality)

S. No.	Particulars of Works	Unit	Qty.	Rate(Rs.)	Amount (Rs.)
1	Re-digging of patches 60 cm x 60 cm x 25 cm.	% Nos.	25.00	239.11	59.78
2	Re-digging of pits 30 cm x 30 cm x 30 cm	% Nos.	25.00	176.22	44.05
3	Filling of pits 30 cm x 30 cm x 30 cm.	% Nos.	25.00	141.01	35.25
4	Carriage of plants in Polythene bags over a distance of 2 km uphill.	% Nos./km	25.00	161.08	80.54
5	Planting of plants raised in Polythene bags including ramming.	%Nos.	25.00	161.17	40.29
6	Sowing of seeds in patches.	%Nos.	25.00	139.02	34.75
7	Repair of Barbed wire Fence.	RM	200.00	1.20	240.00
8	Cutting and prepartion of Wodden posts 1.80 m long and 8 to 10 cm dia. Including debarking & fastening of the top 15 cm conical shape.	%Nos.	15.00	956.68	143.50
9	Carriage of Fence posts over a distance of 1 km.	%Nos./km	15.00	503.45	75.52
10	Digging of holes for Fence posts for 45 cm deep.	%Nos.	15.00	669.78	100.47
11	Fixing of Fence posts including strutting.	%Nos.	15.00	514.06	77.11
12	Interlacing of bushes in barbed wire fence.	RM	180.00	3.05	548.31
13	**TOTAL (S. No. 1 TO 12)**				**1479.57**
16	Cost of Plants	Nos.	25.00	3.00	75.00
17	Cost of Seeds	Kg	0.20	120.00	24.00
18	Cost of U/stapples	Kg	0.50	45.00	22.50
19	**GRAND TOTAL (S. No. 18 TO 20)**				**1601.07**
20				**SAY**	**1601.00**

ABSTRACT OF COST MODEL FOR REVERINE LINEAR/STRIP PLANTATION

S. No.	Particulars of Works	Amount (Rs.)
1	**New Norm for Plantation**	**18951.00**
2	**Maintenance Norm for 1st Year Plantation (25% Mortality)**	**2193.00**
3	**Maintenance Norm for 2nd Year Plantation (20% Mortality)**	**1971.00**
4	**Maintenance Norm for 3rd Year Plantation (15% Mortality)**	**1823.00**
5	**Maintenance Norm for 4th Year Plantation (15% Mortality)**	**1823.00**
6	**Maintenance Norm for 5th Year Plantation (10% Mortality)**	**1601.00**
7	**TOTAL**	**28362.00**

TABLE 7.12

Schematic Planning for Execution 2 x 36 MW Dhamvari Sunda Hydro Electric Project CAT Plan for an Effective Catchment Area 86.46 Sq.km.

Physical and Financial Details of CAT Plan

S. No.	Description of Item	Phy. Qty	Unit	Fin. unit cost in Rs.	1st Year (2010-11) Phy	1st Year Fin. in Lacs	2nd Year (2011-12) Phy	2nd Year Fin. in Lacs	3rd Year (2012-13) Phy	3rd Year Fin. in Lacs	4th Year (2013-14) Phy	4th Year Fin. in Lacs	5th Year (2014-15) Phy	5th Year Fin. in Lacs	6th Year (2015-16) Phy	6th Year Fin. in Lacs	7th Year (2016-17) Phy	7th Year Fin. in Lacs	8th Year (2017-18) Phy	8th Year Fin. in Lacs	9th Year (2018-19) Phy	9th Year Fin. in Lacs	10th Year (2019-20) Phy	10th Year Fin. in Lacs	Total Phy	Total Fin. in Lacs	% age of Total outlay
A	ENGINEERING MEASURES/SOIL AND MOISTURE CONSERVATION																										
1	Gully Control																										
a	Model I	100	Ha.	12500			20	2.50	20	2.50	20	2.50	20	2.50	20	2.50									100	12.50	0.93
b	Model II	100	Ha.	14800			20	2.96	20	2.96	20	2.96	20	2.96	20	2.96									100	14.80	1.10
c	Model III	100	Ha.	14590			20	2.92	20	2.92	20	2.92	20	2.92	20	2.92									100	14.59	1.09
2	Stream Bank Protection																										0.00
a	Wire Crates	80	Ha.	30500			16	4.88	16	4.88	16	4.88	16	4.88	16	4.88									80	24.40	1.82
b	Vegetative Spurs	80	Ha.	2040			16	0.33	16	0.33	16	0.33	16	0.33	16	0.33									80	1.65	0.12
c	Bench Terracing	24	Ha.	11500			4.8	0.55	4.8	0.55	4.8	0.55	4.8	0.55	4.8	0.55									24	2.76	0.21
d	Contour Stagger Trenching	20	Ha.	5500			4	0.22	4	0.22	4	0.22	4	0.22	4	0.22									20	1.10	0.08
3	Landslides Controls																										0.00
a	Catchwater Drains	120	Ha.	1800			24	0.43	24	0.43	24	0.43	24	0.43	24	0.43									120	2.16	0.16
b	R.R. Check Dams	100	Ha.	14590			20	2.92	20	2.92	20	2.92	20	2.92	20	2.92									100	14.59	1.09
c	Establishment silt observation Post	1	No.	500000	1	5.00																			1	5.00	0.37
4	Maintenance Total Engineering Measures							0.15		0.60		1.24		1.78		2.32		2.87		2.87		2.87		2.87		17.60	1.32
	Total (A) All Engineering Measures					5.00		18.28		18.80		19.34		19.88		20.42		2.87		2.87		2.87		2.87		113.18	8.48
B	BIOLOGICAL MEASURES																										0.00
1	Plantation																										0.00
a	Afforestation- 50 Ha @ Rs.45318 (19034+26284)																										0.00
i	Advance Work	100	Ha.	19034	20	3.81	20	3.81	20	3.81	20	3.81	20	3.81											100	19.03	1.42
ii	Plantation Completion	100	Ha.	26284			20	5.26	20	5.26	20	5.26	20	5.26	20	5.26									100	26.28	1.96
b	Timber Plantation 90 Ha @ Rs.32334 (13580+18754)																										
i	Advance Work	90	Ha.	13580	18	2.44	18	2.44	18	2.44	18	2.44	18	2.44											90	12.22	0.91
ii	Plantation Completion	90	Ha.	18754			18	3.38	18	3.38	18	3.38	18	3.38	18	3.38									90	16.88	1.26
c	Fodder Plantation 64 Ha @ Rs.23275 (13979+9296)																										
i	Advance Work	64	Ha.	13979	12.8	1.79	12.8	1.79	12.8	1.79	12.8	1.79	12.8	1.79											64	8.94	0.67
ii	Plantation Completion	64	Ha.	19296			12.8	2.47	12.8	2.47	12.8	2.47	12.8	2.47	12.8	2.47									64	12.35	0.92
d	NTFP Plantation 48 Ha @ Rs.43526 (18281+25245)																										0.00
i	Advance Work	80	Ha.	18281	16	2.93	16	2.93	16	2.93	16	2.93	16	2.93											80	14.62	1.09
ii	Plantation Completion	80	Ha.	25245			16	4.04	16	4.04	16	4.04	16	4.04	16	4.04									80	20.20	1.51
e	Pasture Development 50 Ha @ Rs.9423 (3769+5654)																										
i	Advance Work	80	Ha.	3769	16	0.60	16	0.60	16	0.60	16	0.60	16	0.60											80	3.02	0.22
ii	Plantation Completion	80	Ha.	5654			16	0.90	16	0.90	16	0.90	16	0.90	16	0.90									80	4.52	0.34
	Sub Total (B-1)	414				11.57		27.81		27.81		27.81		27.81		18.09										138.07	10.28
2	Conservation & Regeneration of riverine tree Spp.																										
a	New Nurseries Development	5	Nos.	600000	1	6	1	6	1	6	1	6	1	6											5	30.00	2.23
b	Maintenance of Nurseries	5	Nos.	100000			1	1	2	2	3	3	4	4	5	5	5	5	5	5	5	5	5	5	5	35.00	2.61
c	Riverine Linear Strip Planting	6	Ha.	18951	1.2	0.23	1.2	0.23	1.2	0.23	1.2	0.23	1.2	0.23											6	1.14	0.08
	Sub Total (B-2)					3.23		4.23		2.23		0.87		0.87		5.4										11.82	0.88
3	Maintenance of Biological Measures																										
a	Afforestation	100	Ha.												20	0.88	40	1.48	60	1.83	80	2.18	100	2.04		8.69	0.65
b	Timber Plantation	90	Ha.												18	0.89	36	1.81	54	1.46	72	3.28	90	3.65		12.22	0.91
c	Fodder Plantation	64	Ha.												12.8	0.40	25.6	0.87	38.4	1.13	51.2	1.51	64	1.61		5.61	0.42
d	NTFP Plantation	80	Ha.												16	1.23	32.0	2.03	48.0	2.43	64.0	3.21	80	3.00		11.88	0.89
e	Pasture Development	80	Ha.												40	0.44							80	0.76		1.16	0.09
f	Riverine Linear Strip	6	Ha.												1.2	0.03	2.4	0.05	3.6	0.07	4.8	0.09	6	0.10		0.31	0.02
	Sub Total (B-3)															4.03		8.22		7.86		10.28		11.20		39.62	2.95
	Total (B) All Biological Measures					14.88		31.84		29.84		28.48		28.48		28.47		8.22		7.86		10.28		11.20		188.01	14.11

C	ADMINISTRATIVE/INFRASTRUCTURE EXPENSE																				
1	Vehicle/Machineries and Equipments																				
a	Bolero / Maruti/Camper 1		L.S		40.00															40.00	2.98
b	Maintenance of Machineries		L.S		5.00		5.00		5.00		5.00		5.00	2.00	2.00	2.00	2.00	2.00		35.00	2.60
c	Computer, Photo Copier, Fax		L.S		10.00															10.00	0.74
2	Buildings																				
a	Repair and Maintenance old Forest Rest House (FRH)		L.S		20.00		15.00		10.00											45.00	3.35
b	Construction of new FRH				50.00		50.00													100.00	7.44
3	Awareness, Publicity and Other Charges				2.00		2.00		2.00		2.00		2.00							10.00	0.74
	Total (C)				127.00		72.00		17.00		7.00		7.00							240.00	17.86
D	PRIVATE LAND TREATMENT																				
1	Pasture Development 48 Ha. @ Rs.9423/- (3769+5654)																				
i	Advance Work	48 Ha	3769	9.6	0.36	9.6	0.36	9.6	0.36	9.6	0.36	9.6	0.36						80	1.81	0.13
ii	Plantation Completion	48 Ha	5654	9.6	0.54	9.6	0.54	9.6	0.54	9.6	0.54	9.6	0.54						80	2.71	0.20
2	Horti./Agriculture Land Development 72 Ha. @ Rs.32334/- (13580+18754)																				
i	Advance Work	72 Ha	13580	14.4	1.96	14.4	1.96	14.4	1.96	14.4	1.96	14.4	1.96						80	9.78	0.73
ii	Plantation Completion	72 Ha	18754	14.4	2.70	14.4	2.70	14.4	2.70	14.4	2.70	14.4	2.70						80	13.50	1.01
	Total (D)				5.56		5.56		5.56		5.56		5.56							27.80	2.07
E	FUEL CONSERVATION MEASURES																				
1	Alternate Fuel		L.S		5.00		5.00		5.00		5.00		5.00							25.00	1.86
2	Fuel Saving Devices (Crematories)	2 No.		1	10.00							1	10.00							20.00	1.49
	Total (E)				15.00		5.00		5.00		5.00		15.00							45.00	3.35
F	FORESTRY RESEARCH AND STUDIES																				
	Total (F)		L.S		2.00		2.00		2.00		2.00		2.00	2.00	2.00	2.00	2.00	2.00		20.00	1.49
G	TRAINING OF FOREST OFFICERS/OFFICIALS IN INDIA & ABROAD																				
	Total (G)		L.S		10.00		10.00		10.00		10.00		10.00							50.00	3.72
H	PROTECTION OF FOREST																				
1	Maintenance of Fire lines and Controlled burning		L.S		5.00		5.00		5.00		5.00		5.00							25.00	1.86
2	Incentives to Mahila Mandal and Self Help Groups		L.S		2.00		2.00		2.00		2.00		2.00	2.00	2.00	2.00	2.00	2.00		20.00	1.49
3	Fire Fighting Kits		L.S		5.00		5.00		5.00		5.00									20.00	1.49
	Total (H)				12.00		12		12		12.00		2.00	2.00	2.00	2.00	2.00	2.00		65.00	4.84
I	PAYMENT FOR ENVIRONMENTAL SERVICES (PES)																				
	Total (I)				15.00		15.00		15.00		15.00		15.00							75.00	5.58
J	DEVELOPMENT OF DUMPING SITES																				
	Total (J)			1	15.00	1	15.00	1	15.00											45.00	3.35
K	PROTECTION AND MANAGEMENT OF WILDLIFE																				
a	C/O of water holes				1.00		1.50		1.50		1.00		1.00							6.00	0.45
b	Sign and Slogan Boards				0.50		0.50		0.50		0.50		0.50	0.50	0.50	0.50	0.50	0.50		5.00	0.37
c	Wild life Census Operation				2.00				2.00				2.00		2.00		2.00			10.00	0.74
d	Plantation of wild fruit bearing plants				1.50		1.50		1.50		1.50		1.50	1.50	1.50	1.50	1.50	1.50		15.00	1.12
e	Training to Forest staff in Animal rescue				5.00				6.00				7.00							18.00	1.34
	Total (K)				10.00		3.50		11.50		3.00		12.00	2.00	4.00	2.00	4.00	2.00		54.00	4.02
L	INCOME GENERATION ACTIVITIES																				
a	Vermicomposting and Organic Farming				1.00		1.50		1.00		2.00		1.50							7.00	0.52
b	Bee Keeping				0.60		0.60		0.60		0.60		0.60							3.00	0.22
c	Animal Husbandry & Dairy Development				5.00		5.00		5.00		5.00		5.00							25.00	1.86
	Total (L)				6.60		7.10		6.60		7.60		7.10							35.00	2.61
	TOTAL A to L				247.66		197.00		146.30		124.80		120.83	46.80	17.20	16.70	21.15	20.07		877.31	
M	ECO-TOURISM @ 7% of A+B+C+D+E+F+G+H+I+J+K)																				
	Total (M)				8.78		8.78		8.78		8.78		8.78	8.78	8.78	8.78	8.78	8.78		87.75	7.28
N	MONITORING AND EVALUATION ACTIVITIES @ 4% of A+B+C+D+E+F+G+H+I+J+K)																				
	Total (N)				4.88		4.88		4.88		4.88		4.88	4.88	4.88	4.88	4.88	4.88		48.80	3.64
O	ECO-SERVICES TO THE LOCAL COMMUNITIES @ 10% of A+B+C+D+E+F+G+H+I+J+K)																				
	Total (O)				8.78		8.78		8.78		8.78		8.78	8.78	8.78	8.78	8.78	8.78		87.75	7.28
P	Total (A to O)				272.28		221.75		173.74		148.43		148.47	71.34	41.92	41.28	45.68	44.99		1221.84	91.00
Q	Contingencies @ 10% of Total Outlay				27.24		22.17		17.37		14.84		14.85	7.13	4.20	4.13	4.56	4.45		120.88	9.00
R	Grand Total				299.52		243.87		190.91		164.27		163.32	81.47	46.67	46.32	51.15	51.44		1343.77	100.00