

W HIMACHAL PRADESH POWER CORPORATION LTD.

A

CATCHMENT AREA TREATMENT PLAN FOR SHONGTONG-KARCHAM

HYDROELECTRIC PROJECT (402 MW),

DISTRICT, KINNAUR, HIMACHAL PRADESH

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WAPCOS LIMITED

(A GOVERNMENT OF INDIA UNDERTAKING)

PLOT NO. 76 - C, SECTOR 18, GURGAON -122 015, HARYANA

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CONTENTS

CONTENTS

1.	GENERAL	1
2.	PROJECT DETAILS	1
3.	NEED FOR CATCHMENT AREA TREATMENT	5
4.	SILT YIELD INDEX (SYI) METHOD	6
	4.1 Data Acquisition	7
	4.2 Data Preparation	8
	4.3 Output Presentation	9
5.	ESTIMATION OF SOIL LOSS USING SILT YIELD INDEX (SYI) METHOD	9
6.	WATERSHED MANAGEMENT – AVAILABLE TECHNIQUES	11
7.	CATCHMENT AREA TREATMENT MEASURES	14
8.	TREATMENT MEASURES	15
9.	JOINT FOREST MANAGEMENT	16
	9.1 Objectives of Joint Forest Management (JFM)	16
	9.2 Policy Framework	17
	9.3 Strategies for implementation	17
	9.4 Activities In Joint Forest Management (JFM)	20
	9.5 Budget	22
10.	WILDLIFE MANAGEMENT	22
11.	SILT OBSERVATORIES	27
12.	BASIN LEVEL CAT PLAN	27
13.	TRAINING OF FOREST STAFF	27
14.	PROVISION OF ENERGY SAVING DEVICES	27
15.	FOREST PROTECTION MEASURES	27

16.	COMMUNITY DEVELOPMENT	30
17.	FORESTRY RESEARCH	30
18.	RESEARCH WORK ON SNOW LEOPARD	31
19.	CONSERVATION PLAN FOR NEOZA PINE	31
20.	CONSERVATION PLAN FOR OAK	31
21.	RESCUE CENTRE FOR WILDLIFE	31
22.	SNOW HARVESTING	31
23.	INFRASTRUCTURE REQUIRED FOR MONITORING OF CAT PLAN	32
24.	ECO-TOURISM	32
25.	MONITORING AND EVALUATION	32
26.	ECO-SERVICES TO LOCAL COMMUNITIES	33
27.	COST ESTIMATE FOR ENGINEERING AND BIOLOGICAL TREATMENT MEASURES, JOINT FOREST MANAGEMENT (JFM) AND SILT OBSERVATORIES	33
28.	OTHER ISSUES	38

CATCHMENT AREA
TREATMENT PLAN

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CATCHMENT AREA TREATMENT PLAN

1. GENERAL

The Shongtong-Karcham Hydro Electric Project is proposed to be commissioned on river Satluj in district Kinnaur of Himachal Pradesh. The project is envisaged as a run-of-the river Scheme on Satluj river in district Kinnaur of Himanchal Pradesh. The proposed barrage site is near village Powari and the power house is proposed to be located near village Ralli on left bank of river Satluj near confluence of river Baspa with Satluj. The Shongtong-Karcham hydro-electric project is proposed to generate 402 MW of hydropower.

2. PROJECT DETAILS

The Shongtong-Karcham Hydro Electric Project has been envisaged with the purpose of exploiting the potential in the Satluj River between villages Powari and Ralli. The project envisages the construction of:

- Diversion barrage, intake structure with 4 intake bays with gates and four intake tunnels passing through four sedimentation chambers.
- Head Race Tunnel 8.02 km long culminating in open surface surge shaft.
- Three circular steel lined underground pressure shafts to convey water to 3 Francis turbines to generate (3 x 134 MW) 402 MW of power in an underground power house.
- Tail Race Tunnel of 10.0 m dia and 90 m length to discharge flow into river Satluj near village Ralli.

The salient features of the project are given in Table-1. The layout plan is enclosed as shown in Figure-1.

TABLE-1
Salient features of Shongtong-Karcham hydro-electric project

LOCATION

State	Himachal Pradesh
District	Kinnaur
River	Satluj
Location	Diversion barrage site near village Powari. Power House site near village Ralli on NH-22 about 200 km from Shimla

Hydrology

Catchment area at barrage axis	47132 sq.km.
Maximum observed average 10 Daily discharge	1666 cumec
Design flood	4050 cumec
Average runoff (90% dependable Year)	59862 Mm ³
Average runoff (50% mean year)	87253 Mm ³
Firm discharge for 90% availability 50% availability	71.72 cumec 130 cumec

Diversion Barrage

Type	Sloping Glacis
Size	241.5 m (L) and 102.5 m (W)
Water Bay	102.5 m
Top level of Barrage	EI. 1958.00 m
Full Reservoir Level (FRL)	EI. 1956.00 m
Maximum Pond Level	EI. 1956.00 m
Mean Draw Down Level (MDDL)	EI. 1945.50 m
Crest level	EI. 1936.50 m
Live storage	400 ha.m.
Peaking	3.70 hrs
River Bed Level at Barrage axis	+ EI. 1936.000 m
Length of stilling basin	60.00 m

Diversion Tunnel

Type	Circular concrete lined
Size	10.0 m dia
Length	1187 m
Bed Slope	1 : 593

Intake structure

No. of intake bays	4
Width of each bay	10.00 m
Discharge through each bay	116 cumec
Crest level	1938.00 m
Minimum water level u/s	El. 1945.50 m
No. of Intake Gates	5
Size	5.00 m x 4.25 m

Intake Tunnels

No. of Intake Tunnels	4
Type	Modified horse shoe
Size	5.00 m
Design discharge	464 cumec
Velocity	4.10 m/sec

Sedimentation Chambers

No. of sedimentation chambers	4
Width	14 m
Depth	25 m
Length	300 m
Particle size to be settled	+0.25 mm
Design discharge	464 cumec
Flow through velocity	0.3 m/s

Silt Flushing Tunnels

No. of tunnels from the sedimentation Chambers connected with main silt Flushing tunnel	4
Type	Circular
Diameter	2.25 m
Length	70 m

Main Silt Flushing Tunnel

Type	Circular concrete lined
Diameter	5.00 m
Length	450.00 m
Design discharge	93 cumec

Head Race Tunnel

Type	Circular concrete lined
Diameter	10.00 m finished
Length	8020 m
Design discharge	371 cumec
Bed slope	1:303
Velocity	4.77 m/sec

Adits

No. of Adits	4
Type	D-shaped
Size	7.5 m
Length	210.00 m

Surge Shaft

No.	One
Type	Restricted Orifice (Underground)
Diameter	39.50 m
Orifice Dia.	5.54
Elevation of centre line of HRT	1871.11 m
Elevation at invert of surge shaft	1865.11 m
Top elevation	1988.00 m
Maximum upsurge level	1978.00 m
Minimum down surge level	1919.34 m

Pressure Shaft

No.	3
Type	Circular steel lined (Underground)
Diameter	5.10 m (Finished)
Length	211.00 m each

Power House/Transformer Hall cavity

Type	Underground
Installed capacity	402 MW (3 x 134 MW)
Size of machine Hall	90 m (L) x 20 m (W) x 51 m (H)
Size of transformer Hall	72 m (L) x 15.5 m (W) x 25 m (H)
Approach adit to machine hall	8.5 m D-shaped 88 m long
Average gross head	146.00 m
Net head at 371 cumecs tunnel discharge	125.00 m

Tail Race Tunnel

Size & Type	10.00 m dia. Circular shape
Length	90 m
Invert level of tail race tunnel at outfall	1808.00 m
Normal tail water level	1810.00 m
Maximum tail water level	1816.25 m

Power Generation

Installed capacity	402 MW
Annual generation :	
- 90% dependable Year	1735.46 GWh
- 50% dependable year	1817.26 GWh

Project Cost **Rs. 2415.53 crores**

The project is expected to provide annual energy generation of about 1735.5 MU in a 90% dependable year. The project shall also provide peaking capacity benefits of 402 MW for about 4 hours per day during lean season. The project will be constructed in a period of 6 years.

The power generated will be fed into the northern region grid through a 220 KV transmission system. The project is proposed to be operated as a peaking station for power absorption in the grid.

3. NEED FOR CATCHMENT AREA TREATMENT

It is a well-established fact that reservoirs formed by dams on rivers are subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity, and thus affecting the water

availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment adversely affects the agricultural production. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above-mentioned adverse process of soil erosion.

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

The Catchment Area Treatment (CAT) plan highlights the management techniques for to control erosion in the catchment area of a water resource project. The life span of a reservoir is greatly reduced due to erosion in the catchment area. Adequate preventive measures are thus needed for the treatment of catchment for its stabilization against future erosion. The sub-watershed in the catchment area considered for the present study is given in Figure-2.

The catchment area treatment involves:

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

4. SILT YIELD INDEX (SYI) METHOD

In the present study 'Silt Yield Index' (SYI), method has been used. In this method, the terrain is subdivided into various watersheds and the erodibility is determined on relative basis. SYI provides a comparative erodibility criteria of catchment (low, moderate, high, etc.) and do not provide the absolute silt yield. SYI method is widely

used mainly because of the fact that it is easy to use and has lesser data requirement. Moreover, it can be applied to larger areas like sub-watersheds, etc.

A detailed database on natural resources, terrain conditions, soil type of the catchment area, socio-economic status, etc. is a pre-requisite to prepare treatment plan keeping in view the concept of sustainable development. Various thematic maps have been used in preparation of the CAT plan. Due to the spatial variability of site parameters such as soils, topography, land use and rainfall, not all areas contribute equally to the erosion problem. Several techniques like manual overlay of spatially index-mapped data have been used to estimate soil erosion in complex landscapes.

Geographic Information System (GIS) is a computerized resource data base system, which is referenced to some geographic coordinate system. In the present study, real coordinate system has been used. The GIS is a tool to store, analyze and display various spatial data. In addition, GIS because of its special hardware and software characteristics, has a capacity to perform numerous functions and operations on the various spatial data layers residing in the database. GIS provides the capability to analyze large amounts of data in relation to a set of established criteria.

In order to ensure that latest and accurate data is used for the analysis, satellite data has been used for deriving land use data and ground truth studies too have been conducted. The various steps covered in the study are as follows:

- Data acquisition
- Data preparation
- Output presentation

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

4.1 Data Acquisition

The requirement of the study was first defined and the outputs expected were noted.

The various data layers of the catchment area used for the study are as follows:

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

4.2 Data Preparation

The data available from various sources was collected. The ground maps, contour information, etc. were scanned, digitized and registered as per the requirement. Data was prepared depending on the level of accuracy required and any corrections required were made. All the layers were geo-referenced and brought to a common scale (real coordinates), so that overlay could be performed. A computer programme was used to estimate the soil loss. The formats of outputs from each layer were firm up to match the formats of inputs in the program. The grid size to be used was also decided to match the level of accuracy required, the data availability and the software and time limitations. The format of output was finalized. Ground truthing and data collection was also included in the procedure.

For the present study IRS P6-LISS III digital satellite data was used for interpretation and classification. The classified land use map of the catchment area considered for the study is shown as Figure- 3. The landuse pattern of the catchment area is summarized in Table-2.

TABLE-2
Landuse pattern of the catchment area

S. No.	Category	Area (ha)
1.	Dense vegetation	6388 (19.03)
2.	Open vegetation	889 (2.65)
3.	Alpine Pasture	3303 (9.84)
4.	Barren lands	16663 (49.63)
5.	Water bodies	365 (1.09)
6.	Snow cover	5965 (17.75)
	Total	33573 (100.00)

Note: Figure in brackets indicate percentage

Digitized contours from top sheets were used for preparation of Digital Elevation Model (DEM) of the catchment area and to prepare a slope map. The first step in generation of slope map is to create surface using the elevation values stored in the form of contours or points. After marking the catchment area, all the contours on the top sheet were digitised (100 m interval). The output of the digitisation procedure was the contours as well as points contours in form of x, y & z points. (x, y location and their elevation). All this information was in real world coordinates (latitude, longitude and height in meters above sea level).

A Digital Terrain Model (DTM) of the area was then prepared, which was used to derive a slope map. The slope was divided in classes of slope percentages. The slope map is enclosed as Figure – 4. Various layers thus prepared were used for Modeling. Software was prepared to calculate the soil loss using input from all the layers.

4.3 Output Presentation

The result of the modeling was interpreted in pictorial form to identify the areas with high soil erosion rates. The primary and secondary data collected as a part of the field studies were used as an input for the model.

5. ESTIMATION OF SOIL LOSS USING SILT YIELD INDEX (SYI) METHOD

The Silt Yield Index Model (SYI), considering sedimentation as product of erosivity, erodibility and areal extent was conceptualized in the All India Soil and Land Use Survey (AISLUS) as early as 1969 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units. The erosivity determinants are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the unit of the detached soil material. The relationship can be expressed as:

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

Silt Yield Index

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

Prioritization of Watersheds/Sub watersheds

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

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

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

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

The various steps involved in the application of model are:

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

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

a. Silt Yield Index

$$SYI = \frac{\sum (A_i \times W_i)}{A_w} \times 100; \quad \text{where } i = 1 \text{ to } n$$

where

- A_i = Area of i th unit (EIMU)
 W_i = Weightage value of i th mapping unit
 n = No. of mapping units
 A_w = Total area of sub-watershed.

The SYI values for classification of various categories of erosion intensity rates are given in Table-3.

TABLE- 3
Criteria for erosion intensity rate

Priority categories	SYI Values
Very high	> 1300
High	1200-1299
Medium	1100-1199
Low	1000-1099
Very Low	<1000

6. WATERSHED MANAGEMENT – AVAILABLE TECHNIQUES

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

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

Following Engineering and Biological measures have been suggested for the catchment area treatment.

1. Engineering measures

- Step drain
- Check dams

2. Biological measures

- Afforestation /Plantation
- Pasture development
- NTFP Plantation including medicinal plants
- Development of nurseries

The description of various catchment area treatment measures recommended as a part of CAT Plan of the proposed Shongtong-Karcham hydroelectric project is given in the following paragraphs:

i) **Step Drain** : Step drain are recommended in the steep streams where soil erosion is high. The stepped drain can be concrete drain (2-3 ft. steps) or steps can be developed with sausage wall or combination of sausage walls and dry walls. The steps in the drain help in reducing the current of water which reduces the soil erosion.

ii) **Check dam** : The check dam will be provided with stone masonry and G.I. crate walls in the nalah where less vegetative cover and erosion is high.

iii) **Afforestation** : A well stocked forest plays a very important role in control of soil erosion. Thus, it is proposed to increase the vegetal cover in the area. For this purpose, barren areas, devoid of tree growth have been recommended to be brought under afforestation. As a part of the CAT Plan, replenishment afforestation/gap plantation has been recommended.

Many of the forest areas which have been depleted due to excessive pressure of local population for timber, fuelwood and fodder. The natural regeneration is absent as a result of increased human interferences. For such forest areas, it is proposed to

increase the stocking by artificial regeneration. About 600 to 800 trees per ha are proposed to be planted as a part of this measure.

iv) **Pasture development** : Barren lands with slopes greater than 40% have been recommended to be treated by developing pastures over them. Fodder development has been recommended in vicinity to the villages within the catchment. This will reduce the pressure on pasture land being developed as a part of the catchment area treatment plan.

v) **Development of nursery** : Development of nursery is done to provide saplings for various plantation works. Nurseries have been recommended as a part of the CAT Plan in various sub-watersheds covered as a part of the CAT Plan. The size of the nursery can be 1 to 1.5 ha and about 10,000 saplings can be planted in the nursery.

The basis of site selection for different biological and engineering treatment measures under CAT are given in Table -4.

TABLE- 4

Basis for selection of catchment area treatment measures

Treatment measure	Basis for selection
Pasture Development	Open canopy, barren land, degraded surface
Afforestation	Open canopy, degraded surface, high soil erosion, gentle to moderate slope
Step drain	To check soil erosion in small streams, steps with concrete base are prepared in sloppy area where silt erosion in the stream and bank erosion is high due to turbidity of current.
Check dam	Stone masonry with cement mortar in 1:6 with concrete base 1:4:8 and G.I. crate walls on steep slopes, sliding surfaces, where less vegetative cover and silt erosion is high
Nursery	Centrally located points for better supervision of proposed afforestation, minimize cost of transportation of seedling and ensure better survival.

7. CATCHMENT AREA TREATMENT MEASURES

The total directly draining catchment area is 33,573 ha. The erosion category of various watershed in the catchment area as per a SYI index are given in Tables- 5 and 6. The details are shown in Figure-5.

TABLE- 5

Erosion intensity categorization as per SYI classification

Watershed number	Area (ha)	SYI values	Category
W1	4111	1244	High
W2	3127	1240	High
W3	1209	1250	High
W4	2708	1230	High
W5	1539	1219	High
W6	2253	1261	High
W7	4670	1119	Medium
W8	5318	1075	Low
W9	2289	1054	Low
W10	3125	1026	Low
W11	3224	1104	Medium
Total	33573		

TABLE- 6

Area under various erosion categories

S. No.	Category	Area (ha)
1.	Low	10732 (31.97)
2.	Medium	7894 (23.51)
3.	High	14947 (44.52)
	Total	33573 (100.00)

Note: Figure in brackets indicate percentage.

The objective of the SYI method is to prioritize sub-watershed in a catchment area for treatment. The area under very high and high erosion categories is to be treated at the project proponent cost. Hence, CAT plan has been suggested for high erosion category, as a part of the present EIA study, the expenses of which have to be borne by project proponents. The area under high erosion categories is 14,947 ha, which is

about 44.52% of the total catchment area intercepted at the barrage site. There is no area under very high erosion category.

8. TREATMENT MEASURES

As a part of catchment area treatment plan, various biological as well as engineering treatment measures have been recommended. The details of the biological and engineering treatment measures recommended as a part of CAT plan are given in Tables- 7 and 8 respectively.

TABLE-7

Details of biological treatment measures recommended as a part of CAT plan

S. No.	Treatment measures	Watershed No.	Area (ha)
1.	Replenishment Afforestation/ Gap Plantation (800 tree/ha)	W1	42
		W2	130
		W3	20
		W4	119
		W5	57
		W6	33
		Total	401
2.	Pasture Development	W1	310
		W2	248
		W3	333
		W4	836
		W5	549
		W6	85
		Total	2361

TABLE- 8

Details of Engineering measures recommended as a part of CAT plan

S.No.	Treatment measures	Watershed No.	Quantity
1.	Stepped drain	W1	5
		W2	3
		W3	3
		W4	4
		W5	2
		W6	2
		Total	19 (285 Rmt)
2.	Check Dam	W1	5
		W2	4
		W3	6

S.No.	Treatment measures	Watershed No.	Quantity
		W4	4
		W5	3
		W6	3
	Total		25

9. JOINT FOREST MANAGEMENT

Joint Forest Management (JFM) is a concept of developing partnerships between fringe forest user groups and the Forest Department (FD) on the basis of mutual trust and jointly defined roles and responsibilities with regard to forest protection and development. In JFM, the local communities and the Forest Department manage the resource and share the cost equally. Joint management of forest lands is sharing of responsibilities, control, decision making authority and products over forest lands between government and local user groups. The primary purpose of JFM is to create conditions at the local level, which enable improvements in forest conditions and productivity. A second goal is to support a more equitable distribution of forests products than is currently the case in most areas. It is a movement towards a more democratic management of natural resources founded on the principle of equity, transparency and social justice, which aims to build collective community action deeply rooted in many rural communities. Joint forest management activities play an important role in the Catchment Area Treatment. Therefore, as a part of the JFM activities proposed for the Shongtong-Karcham H.E. Project, local communities will be motivated to identify themselves with the development and protection of the forests from which they derive benefits.

9.1 Objectives of Joint Forest Management (JFM)

The objective of the JFM is to review and study the technology and suitable silvicultural practices for increasing the productivity of degraded forests through

participation of local communities. The communities are required to organize forest protection committees, village forest committees, village forest conservation and development societies, etc. Each of these bodies has an executive committee that manages its day-to-day affairs.

9.2 Policy Framework

National forest policy 1988, envisages people's involvement in the development and protection of forests. Following the adoption of 1988 policy by the Govt. of India, several state governments including H.P. have decided to adopt the Joint Forest Management (JFM) approach with suitable modifications. Forest Protection Committees of West Bengal, Hill Resource Management Societies of Haryana, and village Forest Committees of Karnataka are few examples. In H.P. J.F.M. has been initiated in pursuance of Govt. Order No. Forest (C) 3-4/80- V dated 12.5.93. Implementation of JFM works shall be carried out as per the provisions of the Integrated Resource Management Plan (Micro Plan) and annual plan or operations finalised accordingly. Legal provisions, as amended from time to time, should be included in the JFM strategies. The strategies for implementation are discussed as under.

9.3 Strategies for implementation

Primacy of people

Involvement of people is the foremost aspect in JFM. Joint management must be consciously based on people, their needs, their analysis of issues and their decisions. It also implies an explicit faith that people, whatever the condition of poverty and oppression, can progress, and transform their environment without the help of donation by external agencies.

In essence, JFM demands that local people move from being objects to becoming

subjects of developmental process. It must be based on bottom up approach "Only through this approach can any people oriented programme attain any meaningful and lasting success. Thus, there is a need to bring in a change not only in their behavior but in attitude as well. The community awareness of the necessity and effectiveness of participation in their own development will ensure that progress shall continue even after the formalised programme ends. Till now, there is hardly any example where people's participation has continued in a real sense even after the expiry of a particular programme/project. The programme's next purpose is to nurture the enthusiasm and capabilities of the user groups in order that they may attain self sufficiency. The group members will be encouraged to identify and utilise whatever resources, however meager are available to them. Outside inputs shall be limited to the role of stimulants. Only assisting the groups in more effectively managing the own assets by using their knowledge. In no way shall the local community become dependent upon the programme itself for financial and bureaucratic survival. This will not only bridge the gap between officials and people but also result in increased faith and confidence of people in Govt.

Involvement of NGO's

Undoubtedly NGOs have to play a significant role in creating awareness amongst people. NGOs should be involved particularly in documentation, training and community level organising and facilitation. High profile, high sounding NGOs may be of limited use in HP, context as local NGOs like Mahila Mandals, Yuvak Mandals and awakened individuals are more conversant with local customs, traditions and needs of the people and such institutions are working effectively throughout Himachal Pradesh.

Training

JFM envisages frequent interaction with people on part of the staff of Forest Department. Training of staff is thus crucial for the success of JFM programme. It requires extensive training and reorientation of the staff of Forest Department to function effectively in an extensive role and provide support to village management. Attitudinal changes are very important so that the forest officials do not view JFM in total isolation nor consider it to be another Govt. 'Scheme'. It should not be viewed as an entry point activity and plantation, soil conservation activity only. The qualitative factors: whether the Village Forest Committee (VFC) has clearly perceived its role in effectively and judiciously reducing the consumption tends to get lost. How to train officials so that critical evaluation of these qualitative factors becomes an integral part of this programme is the basic issue.

Till recently, forest officials have been depending on physical, resource and position. Use of physical power by way of policing and imposing authority, resource power by giving plethora of benefits in form of timber, fodder, MFP etc., (worth about Rs. 700 crore annually in Himachal Pradesh) and imposing ones own wisdom by virtue of one's position/status has not resulted in establishing a strong link with the local people. It is, therefore imperative now to concentrate on the last two powers i.e. expert power and personal power. Expert power is the power that is vested in someone because of his acknowledged expertise and personal power resides in the person and in his personality, sometimes called charisma, sometimes personality. These two powers in an official would be developed through trainings; not only in professional activities but also in extension, communication, leadership qualities etc. so that he is able to motivate people.

An appropriate training programme would contain three components (1) Seminars to introduce field staff to concepts, goals, tools and the roles they are expected to play in JFM programmes. (2) Field practice in JFM and (3) Extended field visits to successful JFM projects. It will be quite pertinent to mention here that attitudinal changes are required not only at the level of field functionaries but also should include the highest management and planning level including the public representatives.

9.4 Activities in Joint Forest Management (JFM)

Major activities undertaken as part of joint forest management (JFM) in the catchment area of Shongtong Karcham H.E. Project, includes the following:

- Institutional
- Productivity
- Marketing
- Profit sharing

Institutional Arrangements

The primary objective of the JFM programme includes the rehabilitation of degraded forestlands, village resource development, micro watershed to improve the socio-economic status of forest-dependant communities in order to reduce pressure on forests with peoples' organisations e.g. Village Forest Committees –(VFC). Hence, a VFC needs to be constituted for the implementation of JFM.

Productivity

In order to reduce pressure on forests and to provide incentives to communities for economic returns to sustain forest protection and management NTFPs like grasses, bamboo, fruits are being planted in blocks, forest blanks and along trenches, homesteads and agriculture bunds. Fuel wood is the most important commodity that people access from forest areas. Use of fuel-efficient devices like stoves and Biogas

plants otherwise plantations through their agro-forestry and other plantation programmes can be implemented as a part of in JFM to reduce the pressure on the forest. Non-wood forest products (NWFPs) have a key role in JFM efforts. With the increasing awareness of their economic potential and growing concerns for the sustainability of the resources and the distribution of the benefits derived from them, various state governments have taken over control of a number of NWFPs. Some of the explicit objectives for state monopoly of NWFP trade are to:

- prevent unscrupulous intermediaries and their agents from exploiting NWFP collectors;
- ensure fair wages to collectors;
- enhance revenue for the state;
- ensure quality;
- maximize the collection of produce

Marketing

There are three types of products available to communities in JFM areas

- (i) immediate products like Non-Timber Forest Produce (NTFP), grass, fuel wood available almost immediately or after a time period depending upon the state of degradation of the forest that is being managed jointly,
- (ii) intermediate products from operations like thinning, other cultural operations, and
- (iii) final products like timber from felling. In majority of the States, however, JFM is still in the initial stages, and hence marketing has not emerged as an important issue for consideration.

The share of forest products to communities varies as per provisions in the various State orders for JFM. However, from the experience of different states it is evident that the VFC share is rather minimal in case of high revenue earning NTFPs. However, State agencies such as FD and FDCs do have a major role in the marketing of timber and fuelwood. Community involvement in NTFP management needs to be ensured in (i) technology for collection, preservation and regeneration; (ii) scientific harvesting and handling; and (iii) planned extraction and management

based on an NTFP database. Among the important strategies that need to be adopted in JFM.

Benefit sharing

Forest-user communities, dependent on forests for fuelwood, fodder, small timber and NTFPs, have accessed forest products under different rights regimes. Under the JFM programme, residents of forest-fringe villages will be provided access to forest produce to meet their basic needs of fodder, fuel wood and NTFP. In lieu of this, people are protecting and managing the forests with the FD. Social fencing is to be practised for forest protection by VFC's. Regular voluntary patrolling by villagers. The FD is therefore benefiting from reduced workload for forest protection and also reduced expenditure on protection measures. VFCs will be entitled to a share in the timber harvest in varying proportions

9.5 Budget

A provision of Rs. 260.0 lakh has been earmarked for implementation of measures under Joint Forest Management.

10. WILDLIFE MANAGEMENT

The wildlife development shall contain the following aspects:

Wildlife Improvement

- Intensive Management of Wildlife
- Incentive to local communities for fire prevention
- Incentive to local communities for fire prevention
- Incentive to local communities for protection of Wildlife.

Wildlife Development

- Wildlife Census
- Capacity building of staff and community
- Support for communication-mobile connectivity
- Establishment of nursery with an area of 1 ha infrastructure for distribution of plants to the public
- Maintenance of plants in nursery

- Soil and moisture conservation
- Monitoring, evaluation and impact assessment study

Eco-Development Activities

- Support for vermi compost development
- Support for introduction of LPG for poor house holds around project area
- Socio-economic survey around project area

A. WILDLIFE IMPROVEMENT

Intensive Management of Wildlife

Since all wildlife in nature live in complex web of linkage with other organisms, the proper evaluation of habitat of each species followed by its proper management is very essential. The plant life provides a congenial habitat to wildlife. Thus, it is proposed to improve the wildlife habitat by undertaking planting and other works.

For this purpose bushy, shrubby and thick forests are to be maintained and no grass should be removed from the habitat of the wild life. In degraded forest areas, suitable species i.e. fodder and fruit bearing species will be carried out as per site location, the bank area in the forests especially in high reaches along ridge should be maintained as pasture land by sowing suitable local grasses for the benefit of wild animal. Besides this water pond/ hole should be constructed wherever these are required. An outlay for Rs. 150.0 lakh has been proposed to be incurred during the plan period.

Survey and documentation of Flora and Fauna in the catchment

The existing boundary of the forest covering in the CAT Plan will be maintained with pillar, to prevent encroachment by the local inhabitants. In addition, a survey for flora and fauna will also be carried out and recorded. An outlay of Rs. 50.0 lakh has been kept for this purpose.

Incentive to local communities for fire prevention

The local community of the plan area will be provided with incentives in order to prevent the area from fire and outlay of Rs. 35.0 lakh has been kept for this purpose.

Incentive to local communities for protection of Wildlife

Reward / incentive to the informers are required for proper protection of the forest area against poaching and illicit felling. It is proposed to strengthen the Wildlife efforts of forest guard in controlling offences by associating the locals. They can be rewarded and incentives be given by the forest department. It is necessary to make people aware about the biological, ecological hardships which the forests of the area in general are facing. Therefore, people should be encouraged by providing them reward / incentive for giving information about the offender/culprits. It is also ensured that informer's name should not be disclosed publicly or otherwise people will not dare to come forward on this issue. A provision of Rs. 35.0 lakh has kept for this purpose.

B. DEVELOPMENT MEASURES**Wildlife Census**

It is proposed to carry out wildlife census every alternative year in key areas to assess the trends in population of growth of various species. The findings of the survey will help in assessment of various management measures and need for improvements, if any. An amount of Rs. 50.0 lakh has been earmarked for this purpose.

Capacity building of staff and community

The implementing staff and communities will be imparted with training and exposure visit in order to build their capacity for effective management and improvement of wildlife and wildlife sanctuary. An outlay of Rs. 40.0 lakh is proposed to be

earmarked for this purpose.

Support for communication

Mobile connectivity will be provided to the staff to have communication for effective protection of flora and fauna. An amount of Rs. 10.0 lakh is proposed to be earmarked for this purpose.

Establishment of nursery with infrastructure

An ideal nursery will be established with its infrastructure to provide healthy seedlings for distribution of plants in public. Rs. 30.0 lakh has been earmarked to establish this nursery.

Maintenance of plant in nursery

The nursery will be maintained so as to provide sufficient planting stock in perpetuity for public distribution. An amount of Rs. 15.0 lakh has been kept for maintenance of nursery.

Soil and moisture conservation

The tract is prone to soil erosion and in order to check and protect the area from further erosion, a provision for soil and moisture conservation interventions has been proposed. For this purpose an amount of Rs. 50.0 lakh has been earmarked.

Monitoring, evaluation and impact assessment study

A study will be carried out for impact assessment, monitoring & evaluation and for this purpose an amount of Rs. 20.0 lakh has been earmarked.

C. Eco-development activities**Support for vermi compost development**

Vermi composting is one of the alternative sources of income generation which is easy to adopt, home based and can bring fast income returns to the local people in an eco friendly manner. Forest department and horticulturist in Kinnaur district will be

a potential buyer of all such compost for its vast network of Forest Nurseries. Woman organization of the area can adopt these activities as a part time without compromising with their day to day work. An outlay of Rs. 50.0 lakh can be earmarked for this purpose.

Support for introduction of LPG for poor house holds

In order to release pressure on existing forests to meet the demand of fuel in and around the project area. A provision for introduction/ supply of LPG to the poor house holds has been made. An outlay of Rs. 35.0 lakh has been kept under this component

Socio-economic survey

A survey will be conducted in the study area to assess and study the socio-economic conditions. Funds to the tune of Rs. 30.0 lakh have been earmarked for conducting the socio-economic survey.

BUDGET

A total provision of Rs. 600.0 lakh has been estimated for implementation of various measures for Wildlife improvement and development. The details are given in Table-9.

TABLE-9
Details of cost required for wildlife improvement and development

S. No.	Activity	Cost (Rs. Lakh)
1.	Intensive Management of Wildlife	150.0
2.	Survey of flora and fauna in the catchment area	50.0
3.	Incentives to local communities for fire prevention	35.0
4.	Incentives to local communities for wildlife protection	35.0
5.	Wildlife Census	50.0
6.	Capacity Building of staff and community	40.0
7.	Support for communication	10.0
8.	Establishment of nursery with infrastructure	30.0
9.	Maintenance of nursery	15.0
10.	Soil and moisture conservation	50.0
11.	Monitoring, evaluation & impact assessment study	20.0

S. No.	Activity	Cost (Rs. Lakh)
12.	Support for vermin-compost development	50.0
13.	Support for introduction of LPG for poor household	35.0
14.	Socio-economic survey	30.0
	Total	600.0

11. SILT OBSERVATORIES

It is recommended that in areas categorized under very high erosion categories, major streams and river Satluj be monitored. The monitoring shall cover silt content being carried in the river water. A provision of Rs. 30.0 lakh has been earmarked for this purpose.

12. BASIN LEVEL CAT PLAN

The Himachal Pradesh Forest Department has awarded consultancy services for preparation of a Basin Level CAT Plan in which various project developers in the basin will contribute. It is proposed to contribute Rs. 100.0 lakh as contribution towards Basin Level CAT Plan including consultancy charges.

13. TRAINING OF FOREST STAFF

A provision of Rs.120.0 lakh has been earmarked for training of staff and sensitization of local communities.

14. PROVISION OF ENERGY SAVING DEVICES

A provision of Rs. 80.0 lakh has been earmarked for provision of energy saving devices to local communities.

15. FOREST PROTECTION MEASURES

A provision of Rs. 418 lakh has been earmarked for forest protection measures in view of congregations of large labour population and outsiders in the project area and its surroundings during project construction phase.

The break-up is given as below:

- Anti-poaching measures : Rs. 121.3 lakh
- Provision of free fuel wood to labour and technical population : Rs. 296.7 lakh

During construction phase in and around the main construction areas, i.e. the barrage site, power house site, etc. where construction workers congregate, some disturbance to the wildlife population may occur. Therefore, marginal impacts may be on wild life due to various construction activities. In view of this it is recommended that 3 check posts be developed. The location of these check posts could be:

- Upstream of barrage site
- Downstream of power house site
- Labour camp

Each check post shall have 3 guards to ensure that poaching does not take place in the area. The guards will be supervised by a Deputy Range Officer. It is also recommended that the staff manning these check posts have adequate communication equipment and other facilities. Apart from inter-linking of check posts, communication link needs to be extended to Divisional Forest Office and the local police station also.

a) Salary

- | | |
|--|----------------|
| • Guards (9 nos.) @ Rs.10,000 per month | Rs. 10,80,000 |
| • One range officer @ Rs.20,000 per month | Rs. 240,000 |
| • Total cost for one year | Rs. 13,20,000 |
| Cost for 6 years
(Assuming 10% increase per year) | Rs. 101.8 Lakh |

- | | |
|--|----------------------|
| b) Construction of check posts, provision of arm and ammunition, communication system, etc.
(Rs. 650,000 * 3) | Rs. 19.5 Lakh |
|--|----------------------|

Total Cost	Rs.121.3 Lakh
-------------------	----------------------

Provision of Free Fuel

It is recommended that, during the construction phase of hydroelectric projects, the project authorities have to make proper/ adequate arrangements for meeting the demand of fuel supply to the labourers/ workmen engaged through the contractors so that illegal felling of trees does not take place in the near by forest area situated around the project as these projects are normally located in the far-flung remote areas to the forests. The basic aim and objectives behind this measure are to:

- control the illegal felling of trees
- make a sound and eco-friendly project by providing proper fuel arrangements to the labourers/ workmen
- make the project responsible for catering to the demand of fuel for labourers / workmen
- maintain the forest cover and environment of the region, where project is being located.

It is recommended to:

- make a clause mandatory in the contract of every contractor involved in project construction to provide supply of fuel to their labourers, so that trees are not cut for meeting their fuel demands.
- establish LPG godown within the project area for providing LPG cylinder to run community kitchens.
- establish kerosene oil depot near project area with the help of state government to ensure proper supply of kerosene oil.

The project proponents in association with the state government should make necessary arrangements for distribution of kerosene oil and LPG. These fuels would be supplied at subsidized rates to the local/contract laborers for which provision should be kept in the cost estimate. The total cost required for provisions of fuel works out to Rs. 296.7 lakh. The details are given in Tables 10 to 12. The cost required for provision of free fuel to labour population is included in the overall cost of Catchment Area Treatment Plan.

TABLE-10
Cost estimate for LPG distribution

Year	No. of Employees	Annual requirement @1cylinder per family per month (No. of cylinders)	Total Cost @Rs. 400/cylinder (Rs. million) including 10% escalation per year
I	200	2400	0.96
II	200	2400	1.06
III	200	2400	1.16
IV	200	2400	1.28
V	200	2400	1.41
VI	200	2400	1.55
	Total		7.42

TABLE-11
Cost estimate for Kerosene distribution

Year	No. of labours	Quantity @10 litre per labour per month (litre/yr)	Total Cost @ Rs. 20/litre (Rs. million) * including 10% escalation per year
I	800	96,000	2.88
II	800	96,000	3.17
III	800	96,000	3.49
IV	800	96,000	3.84
V	800	96,000	4.22
VI	800	96,000	4.65
	Total		22.25

TABLE-12
Cost estimate for provision of fuel

S.No.	Fuel	Cost (Rs. Lakh)
1.	LPG for Technical staff	74.2
2.	Kerosene for labour population	222.5
	Total	296.7

16. COMMUNITY DEVELOPMENT

A provision of Rs. 1030.0 lakh has been earmarked for development of local communities.

17. FORESTRY RESEARCH

A provision of Rs. 600 lakh has been earmarked for forestry research.

18. RESEARCH WORK ON SNOW LEOPARD

A provision of Rs. 100.0 lakh has been earmarked for snow leopard research.

19. CONSERVATION PLAN FOR NEOZA PINE

A provision of Rs. 100.0 lakh has been earmarked for conservation Plan for Neoza Pine.

20. CONSERVATION PLAN FOR OAK

A provision of Rs. 100.0 lakh has been earmarked for conservation Plan for Oak.

21. RESCUE CENTRE FOR WILDLIFE

A provision of Rs. 100.0 lakh has been earmarked for rescue centre for wildlife.

22. SNOW HARVESTING

Harvesting snow water in cold desert regions is not merely a way to rehabilitate the land for crop growth, as it is also a way to bring cultural identity to a people in between the ancient times and the rapid pace of a global world.

The technique of harvesting snow by creating snow reservoirs in the winter months, the water from an upstream nallah is being diverted into a reservoir constructed under the natural shadow of a towering rock face, which would begin freezing with the onset of December. The reservoir, whose other three sides consist of crete walls and metal-wire mesh filled with boulders has a capacity to store more than 625 kl. of snow. This should thaw at a time when the farmers need the water for irrigation the most. A provision of Rs. 450.0 lakh has been earmarked for snow harvesting at various sites in the catchment area.

23. INFRASTRUCTURE REQUIRED FOR MONITORING OF CAT PLAN

A provision of Rs. 67.5 lakh has been earmarked for infrastructure required for implementation and monitoring of CAT Plan. The details are given in Table-13.

TABLE-13

Cost estimate for infrastructure required for implementation and monitoring of CAT Plan

S.No.	Fuel	Cost (Rs. Lakh)
1.	3 Nos of Mahindra Xylo	30.0
2.	1 No. of Maruti Swift Desire	7.0
3.	1 No. of Ambassador Car	7.0
4.	1 No. of Mobile Van(capacity 18-20 person)	22.0
5.	Computer with printer, scanner and all other accessories and 2 Nos of Digital Camera	1.5
	Total	67.5

24. ECO-TOURISM

As outlined in the guidelines for the preparation of CAT Plan issued by the Forest Department, Government of Himachal Pradesh, a provision of 1% of the total CAT Plan cost has been earmarked for Eco-tourism. These shall include construction of trekking routes, small treatment plants for various sources of sewage and water pollution, installation of air pollution control devices in various guest houses, restaurants, greenbelt around at various locations, etc.

25. MONITORING AND EVALUATION

As outlined in the guidelines for the preparation of CAT Plan issued by the Forest Department, Government of Himachal Pradesh, a provision of 5% of the total CAT Plan cost has been earmarked for monitoring and Evaluation.

26. ECO-SERVICES TO LOCAL COMMUNITIES

As outlined in the guidelines for the preparation of CAT Plan issued by the Forest Department, Government of Himachal Pradesh, a provision of 10% of the total CAT Plan cost has been earmarked for Eco-services to local communities.

27. COST ESTIMATE FOR ENGINEERING AND BIOLOGICAL TREATMENT MEASURES, JOINT FOREST MANAGEMENT (JFM) AND SILT OBSERVATORIES

The per ha cost for afforestation in degraded forest land and their maintenance and replenishment afforestation/ gap plantation development is given in Table- 14.

TABLE - 14

Cost Model for Replenishment/ Gap Plantation (800 tree/ha)

A) PLANTATION COST

S.No.	Particulars of Work	Quantity	Rate in Rs.	Amount in Rs.
Fencing				
1	Survey & demarcation of Plantation area	1 Ha.	67.33	67.33
2	Preparation/ purchase of RCC fence posts	60 Nos.	200 per post	12000.00
3	Carriage of RCC fence posts upto 2 mt. long over distance 2 km	60 Nos.	907.34 per hundred	544.40
4	Preparation/digging of holes 20-30 cm dia & 50 cm. deep	60 Nos.	604.51 per hundred	362.70
5	Fixing of Wooden fence posts including strutting	60 Nos.	477.34 per hundred	286.40
6	Carriage of Barbed wire over distance 2 Km.	0.90 Qti	54.50 /Qti/Km	98.10
7	Stretching & fixing of barbed wire in 4 stands.	720 Rmt	3.16 per mtr	2275.20
8	Preparation of inspection path 60 cm width	250 mtr.	7.24 per mtr	1810.00
9	Preparation of water retention mounds/trches.	L.S.		2000.00
10	Interlacing of thorny bushes along the fence.	180 Rmt	2.74 per mtr	493.20
Total - Fencing cost				19937.33
Planting				
1	Digging of pits 45x45x45 cm	300 Nos.	636.28 per hundred	1908.84
2	Digging of pits 30x30x30 cm	500 Nos.	318.22 per hundred	1591.10
3	Filling of pits 45x45x45 cm	300 Nos.	182.31 per hundred	546.93
4	Filling of pits 30x30x30 cm	500 Nos.	127.22 per hundred	636.10

5	Carriage of naked roots plants over distance 2 Km. uphill	300 Nos.	23.49 per hundred per Km	140.94
6	Carriage of plants in P/bags over distance 2 Km. uphill	500 Nos.	145.39 per hundred	1453.90
7	Planting of entire plant raised in P.bags	500 Nos.	145.49 per hundred	727.45
8	Planting of naked roots plants	300 Nos.	122.66 per hundred	367.98
9	Planting of grass tufts/Preparation of strips including sowing in strips 100x30x5 cm for grass sowing along contour	500 Nos.	613.33 per hundred	3066.65
Total - Planting cost				10439.89
Material				
1	Cost of barbed wire	0.90 Qtl.	7000 Per Qtl.	6300.00
Nursery cost of plants				
1	Naked root plants	300 Nos.	6 per plant	1800.00
2	Polythin bags plants	500 Nos.	8 per plant	4000.00
Total - Cost of Plants				5800.00
Grand Total				42477.22
				Or say 42500.00
(B) MAINTENANCE COST				
Sl. No.	Particular of Work	Quantity	Rate in Rs.	Amount in Rs.
1st year maintenance -30% mortality				
1	Re-digging of pits 45x45x45 cm.	90 Nos.	318.22 per hundred	286.39
2	Re-digging of pits 30x30x30 cm.	150 Nos.	159.07 per hundred	238.60
3	Filling of pits 45x45x45 cms.	90 Nos.	182.31 per hundred	164.07
4	Filling of pits 30x30x30 cms.	150 Nos.	127.22 per hundred	190.83
5	Planting of P. bag plants.	150 Nos.	145.49 per hundred	218.23
6	Planting of naked root plants	90 Nos.	122.66 per hundred	110.39
7	Planting of grass tufts/preparation strips /C sowing in strips 100x35x5 cms for grass sowing	200 Strips	613.13 per hundred	1226.26
8	Carriage P. bags plants distance 2 km. Uphill	150 Nos.	145.39 per hundred	218.08
9	Carriage of naked roots plants over distance 2 km. Uphill	90 Nos.	23.49 per hundred	21.14
10	Nursery cost of plants	240 Nos.	8 & 6 per plant	1620.00
11	Repair of fence	180 rmt	1.16/rmt	208.80
12	Repair of inspection path	L.S.		700.00
13	Moisture conservation works	L.S.		1000.00
Total				6202.79
				Or say 6200.00
2nd year maintenance -20% mortality				
1	Re-digging of pits 45x45x45 cm	60 Nos.	318.22 per hundred	190.93
2	Re-digging of pits 30x30x30 cm	100 Nos.	159.07 per hundred	159.07
3	Filling of pits 45x45x45 cms.	60 Nos.	182.31 per hundred	109.385
4	Filling of pits 30x30x30 cms.	100 Nos.	127.22 per hundred	127.22
5	Planting of P. bag plants.	192 Nos.	145.49 per hundred	279.34
6	Planting of naked root plants	60 Nos.	122.66 per hundred	73.60
7	Carriage P. bags plants distance 2 km.	150 Nos.	145.39 per hundred	218.08

	Uphill			
8	Carriage of naked roots plants over distance 2 km. Uphill	60 Nos.	23.49 per hundred	28.19
9	Nursery cost of plants	160 Nos.	8 & 6 per plant	1080.00
10	Repair of fence	180 rmt	1.16/rmt	208.80
11	Repair of inspection path	L.S.		500.00
12	Moisture conservation works	L.S.		800.00
	Total			3774.616
			Or say	3800.00
	3rd year maintenance -10% mortality			
1	Re-digging of pits 45x45x45 cm.	30 Nos.	318.22 per hundred	95.47
2	Re-digging of pits 30x30x30 cm.	50 Nos.	159.07 per hundred	79.535
3	Filling of pits 45x45x45 cms.	30 Nos.	182.31 per hundred	54.69
4	Filling of pits 30x30x30 cms.	50 Nos.	127.22 per hundred	63.61
5	Planting of P. bag plants.	50 Nos.	145.49 per hundred	72.74
6	Planting of naked root plants	30 Nos.	122.66 per hundred	36.79
7	Carriage P. bags plants distance 2 km. Uphill	50 Nos.	145.39 per hundred	72.69
8	Carriage of naked roots plants over distance 2 km. Uphill	30 Nos.	23.49 per hundred	14.09
9	Nursery cost of plants	80 Nos.	8 & 6 per plant	540.00
10	Repair of fence	200 rmt	1.16/rmt	232.00
11	Repair of inspection path	L.S.		400.00
12	Moisture conservation works	L.S.		800.00
	Total			2461.615
			Or say	2500.00
	4th year maintenance -10% mortality			
1	Re-digging of pits 45x45x45 cm.	30 Nos.	318.22 per hundred	95.46
2	Re-digging of pits 30x30x30 cm.	50 Nos.	159.07 per hundred	79.535
3	Filling of pits 45x45x45 cms.	30 Nos.	182.31 per hundred	54.69
4	Filling of pits 30x30x30 cms.	50 Nos.	127.22 per hundred	63.61
5	Planting of P. bag plants.	50 Nos.	145.49 per hundred	72.74
6	Planting of naked root plants	30 Nos.	122.66 per hundred	36.79
7	Carriage P. bags plants distance 2 km. Uphill	50 Nos.	145.39 per hundred	72.69
8	Carriage of naked roots plants over distance 2 km. Uphill	30 Nos.	23.49 per hundred	14.09
9	Nursery cost of plants	80 Nos.	8 & 6 per plant	540.00
10	Repair of fence	200 rmt	1.16/rmt	232.00
11	Repair of inspection path	L.S.		300.00
12	Moisture conservation works	L.S.		700.00
	Total			2261.605
			Or say	2300.00
	5th year maintenance -10% mortality			
1	Re-digging of pits 45x45x45 cm.	30 Nos.	318.22 per hundred	95.46
2	Re-digging of pits 30x30x30 cm.	50 Nos.	159.07 per hundred	79.535
3	Filling of pits 45x45x45 cms.	30 Nos.	182.31 per hundred	54.69
4	Filling of pits 30x30x30 cms.	50 Nos.	127.22 per hundred	63.61
5	Planting of P. bag plants.	50 Nos.	145.49 per hundred	72.74
6	Planting of naked root plants	30 Nos.	122.66 per hundred	36.79

7	Carriage P. bags plants distance 2 km. Uphil	50 Nos	145.39 per hundred	72.69
8	Carriage of naked roots plants over distance 2 km. Uphil	30 Nos	23.49 per hundred	14.09
9	Nursery cost of plants	80 Nos.	8 & 6 per plant	540.00
10	Repair of fence	200 rmt	1.16/rmt	232.00
11	Repair of inspection path	L.S.		300.00
12	Moisture conservation works	L.S.		700.00
	Total			2261.605
			Or say	2300.00
ABSTRACT				
1	New Plantation	-		42500.00
2	1st Year Maintenance	-		6200.00
3	2nd Year Maintenance	-		3600.00
4	3rd Year Maintenance	-		2500.00
5	4th Year Maintenance	-		2300.00
6	5th Year Maintenance	-		2300.00
	GRAND TOTAL	-		59600.00

The total cost for CAT Plan is Rs. 604.4 million. The details of cost required for implementation of biological treatment measures and engineering treatment measures, wildlife improvement and development, joint forest department and silt observatories are given in Tables – 15 & 17. The details are given in Figure-6.

TABLE- 15

Cost estimate for Catchment Area Treatment - Biological Measures

S. No.	Item	Rate (Rs.)	Target	
			Physical	Financial (Rs. lakh)
1.	Replenishment Afforestation/ Gap plantation(800 plants/ha)	59,600/ha	401 ha	239.00
2.	Pasture Development	11,800/ha	2361 ha	278.60
3.	Establishment of New Nurseries	200,000/no	10	20.00
	Total			537.60

TABLE- 16

Cost estimate for Catchment Area Treatment - Engineering Measures

S. No.	Item	Rate (Rs.)	Unit	Qty (No.)	Target	
					Physical	Financial (Rs. Lakh)
1.	Step drain	25,000	Rmt	19	285	71.25
2.	Check dams	200,000	No.	25	25	50.00
	Total					121.25

TABLE-17

Cost for implementation of CAT Plan

S. No.	Activity	Cost (Rs. Lakh)
1.	Biological measures	537.60
2.	Engineering measures	121.25
3.	Joint Forest Management	260.00
4.	Wildlife Management	600.00
5.	Silt observatories	30.00
6.	Basin level CAT Plan	100.00
7.	Training of forest staff	120.00
8.	Provision of energy saving devices	80.00
9.	Forest protection measures	418.00
10.	Community Development	1030.00
11.	Forestry Research	600.00
12.	Research work on Snow Leopard	100.00
13.	Conservation Plan for Neoza pine	100.00
14.	Conservation Plan for Oak	100.00
15.	Rescue Centre for wildlife	100.00
16.	Snow harvesting	450.00
17.	Infrastructure required for monitoring of CAT Plan	67.50
	Sub-Total : A	4814.35
18.	Eco-tourism (1%) of A	48.144
19.	Monitoring & Evaluation	240.72
20.	Eco-services to local communities	481.44
	Sub-Total : B	770.80
	Total (A+B) :C	5584.60
	ESCALATION @ 10%	
	Expenditure on Year 1(40%) of C – No escalation	2233.86
	Expenditure on Year 2(40%) of C – Escalation@ 10 %	2457.24
	Expenditure on Year 3 (20%) of C Escalation @ 21%	1351.48
	Total	6042.59 say Rs. 604.26 million

28. OTHER ISSUES

As suggested by the HPPCB, the following aspects shall be covered as a part of the CAT plan:

- Project proponent shall ensure providing display boards for all the works done under the CAT Plan.
- Project proponent shall ensure effective monitoring of the works done under CAT Plan.
- Monitoring reports shall be shared with the Environment Department.

FIGURES