

PREFACE

The Preliminary Feasibility Report (PFR) of Jakhol Sankri Hydro Electric Project was originally investigated by Uttarakhand Jal Vidyut Nigam Ltd. Govt. of Uttarakhand in the year 2003 under the 50000 MW hydro electric power project under the initiative of Ministry of Power, Govt. of India. It was proposed on river Supin, a major tributary of river Tons in the Supin valley. The purpose of the Jakhol Sankri Hydro Electric Project is to generate **51MW electricity** by using **two turbines of 25.5 MW each on run off the river scheme**. The river will be used to utilize a natural fall of about 447 m. The project component is a Barrage 33 m long across the river Supin. The diverted water from Barrage is to pass through de-silting chambers 100m (L) x 12m (W) x 12.27 (H) with hopper bottom and then to a head race tunnel of 3.0 m dia and 6.6 km long from Barrage to underground power house at Guiyanghati via 7.5 m dia surge shaft and 2.0 m dia pressure shafts. The Project involve **diversion of 2.25 ha forest land, 21.876 ha civil soyam land and 15.691 ha private land**.

In the year 2005, the project was allotted to SJVN Limited by the Govt. of Uttarakhand on “BOOM” (Build, Own, Operate & Maintain) basis.

The Ministry of Environment and Forest, Govt. of India has accorded Pre-Environment Clearance (PEC) for 45 MW on 15.07.09 and for 51MW on 11.01.2011. The Principal Chief Conservator of Forests (PCCF), Uttarakhand, Dehradun directed on 16.02.2010 to Dy. Director, Govind Wild Life Sanctuary & National Park, Purola to prepare the CAT Plan (Catchment Area Treatment Plan) for the Jakhol Sankri Hydro Electric Project at the earliest possible.

Construction of Hydro power project involves large scale disturbances in geological and environmental conditions of the area around the project. These disturbances need to be compensated by treating the area for soil, water and moisture conservation. Also a lot of people are affected directly or indirectly. So there is need to treat the catchment and impact area of the Hydro Electric Power Project in order to stabilize the eco-fragile sensitive zone.

Therefore, the prime and important environmental considerations of this eco-sensitive catchment and impact area, and concern of local residents for eco-restoration of the catchment and impact area needs to be implemented in this plan on perspective basis, so that the proposed

components could match with ground level ecological and environmental needs of the area. Based on the grounds of the consultations and discussions at various levels with public representatives, District Administration, Geologist, Scientists and Experts from Wildlife Institute of India, Dehradun, Chairman Zila Panchayat, this CAT Plan has been prepared. **The total catchment and impact area of River Supin at the project site is 30687 ha., which comprise 34% forest land, 6% agriculture & habitation and 60% blank & snow cover.** The project construction period is 4 years from the start, but works of soil conservation structures and various provisions of Wild Life Management Plan will go for 7 years from the start. The outlay of this plan has been computed @ **rate of 2.0%** of the total project cost of the project (which is Rs. **340.37 Crores as per DPR**, except IDC & finance charges) and the total cost of CAT Plan is **Rs. 680.00 Lacs.**

The catchment area proposed to be treated is situated in Govind Wild Life Sanctuary & National Park. In the CAT Plan, provisions for afforestation, soil and water conservation, wild life management, landslide control, leveling and retaining wall of agricultural fields of farmers, maintenance of old staff quarters/minor civil works, community utility activities, Veterinary care for wild & domestic animals, rural employment, income generation schemes etc. have been preferred while finalizing the proposal for the CAT plan of Jakhol Sankri HEP.

A detailed field survey and collection of data helped to write this plan and to decide priorities. Interactions with local people and public representatives, expert of various fields helped a lot in preparing this CAT Plan. The data & maps collected from Watershed Directorate, Uttarakhand and Draft Environment Impact Assessment & Environment Management Plan of Jakhol Sankri Hydro Electric Project is being prepared by WAPCOS Limited (Govt. of India Enterprises) were taken into consideration while preparing the CAT Plan. An article by *Nandy S., Kushwaha S.P.S., Dadhwal V.K., 2010. Forest degradation assessment in the upper catchment of the river Tons using remote sensing and GIS. Elsevier Ltd.* was very helpful for the preparation of the CAT Plan.

A large area of agricultural field of stakeholders is lying in the project area. So, a special provision for treating the stakeholders land for soil and moisture conservation has been made, in order to check soil erosion and to control decreasing of land holdings of the farmers. In the catchment area landslides causes heavy damage. Furthermore, efforts have been made to involve local community in plan implementation directly and indirectly both. This CAT plan will be implemented

CAT Plan of Jakhol Sankri HEP

by Dy. Director Govind Wild Life Sanctuary under the direction of PCCF (Wild Life)/ Chief Wild Life Warden, Uttarakhand, Dehradun.

This CAT plan of Govind Wild Life Sanctuary & National Park has been prepared with consultation of Sh. S.S. Sharma, PCCF (WL)/CWLW, Uttarakhand & Smt. Veena Sekhri, PCCF (Projects), Uttarakhand.

The basis of this CAT Plan is the eco-restoration of the project area i.e. Protected Area of Govind Wild Life Sanctuary/National Park and participation of the local community for their livelihood support system. Efforts have been made to incorporate all the important factors which are important part of modern system of Catchment and Impact Area Treatment Plan.

Hope, this plan will serve its purpose from all aspects.

Dated:

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ABBREVIATIONS

ACF	-	Assistant Forest Conservator
CF	-	Conservator of Forests
CIATP	-	Catchment & Impact Area Treatment Plan
CWLW	-	Chief Wild Life Warden
DD	-	Deputy Director
DFO	-	Divisional Forest Officer
EDC	-	Eco Development Committee
FDA	-	Forest Deposit Account
GWLS & NP	-	Govind Wild Life Sanctuary & National Park
IGA	-	Income Generating Activity
MIS	-	Management Information System
MP	-	Management Plan
MWS	-	Micro watershed
NGO	-	Non-Government Organization
NMHEP	-	Jakhol Sankari Hydro Electric Project
OWP	-	Overall Work Plan
PIMC	-	Project Implementation Monitoring Committee
PIU	-	Project Implementation Unit
PMC	-	Project Management Cell
RNP	-	Raja Ji National Park
SJVNL	-	Satluj Jal Vidyut Nigam Ltd.
PC	-	Project Co-ordinator
UIC	-	Unit - In-Charge
VIC	-	Village - In-Charge
WC	-	Wildlife Consultant
WII	-	Wildlife Institute of India
WP	-	Working Plan

CAT Plan for Jakhol Sankari Hydro-Electric Project

Project

At A Glance

Hydro Electric Project Detail:

1. Location

State : Uttarakhand
District : Uttarakshi
Tehsil : Mori
Location of Power House : Guyian Ghati near Confluence of River Supin & Tons
Access to Power House : Nearest Airport- Jolly Garnt, Dehradun (250 Km)
Nearest Rail Head – Dehradun (220 Km)
Latitude : 31 05'19''N - 31 07'06''N
Longitude : 78 01'10''E - 78 04'07''E
Name River / Tributary : Supin River (Tributary of River Tons)
Name of River Basin : Yamuna River Basin

2. Capacity : 51 MW

3. Type : Run off River Type

4. Total Forest Land Involved for HEP: 24.126 ha.

District	Forest Division	Detail of area Proposed for Diversion		Total
		Reserve Forest Land	Civil Soyam Land	
Uttarkashi	Tons Forest Division	2.25	--	2.25
Uttarkashi	Govind Wild Life Sanctuary & National Park	--	21.876	21.876
G. Total (ha.)		2.25	21.876	24.126

5. Project Developing Agency: SJVN Limited (A joint venture of Govt. India & Govt. of H.P.)

6. Total Project Cost : **340.37 Crore**

CAT Plan Detail

- 1. Forest Land Involved for Diversion** : 24.126 ha.
(R.F. - 2.25 ha., Civil Soyam land- 21.876 ha.)
- 2. Total Catchment Area** : 30687 ha.
Project Catchment Area: 26820 ha.
Impact Catchment Area: 3867 ha.
- 3. Hydrological Units :**
Catchment : Yamuna
Sub Watershed (01): Supin Tons
Micro Watershed (04): Supin Gad, Obra Gad,
Saturi and Jakhol
- 4. Treatable Area:** : Erodability Class wise (E2+E3): 27801 ha.
: Slope wise (Gradient <33% + ¼ of the area
having gradient 33 to 50%): 1562ha.
- 5. Division Involved** : Govind Wild Life Sanctuary & National Park
- 6. No. of Villages & EDCs** : 12
- 7. Total cost** : **680.00 Lacs**
- 8. Executing Forest Division** : Govind Wild Life Sanctuary & National Park

9. Compensatory afforestation :48.252 hac Civil forest land has been proposed

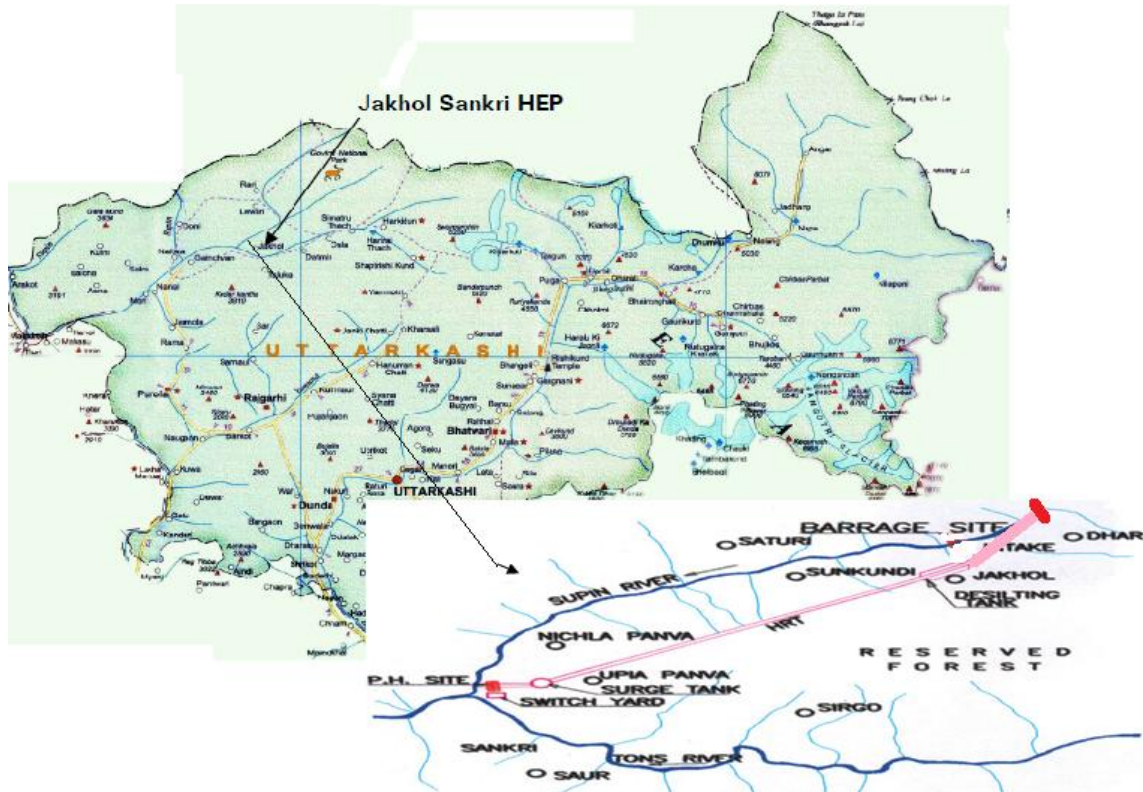
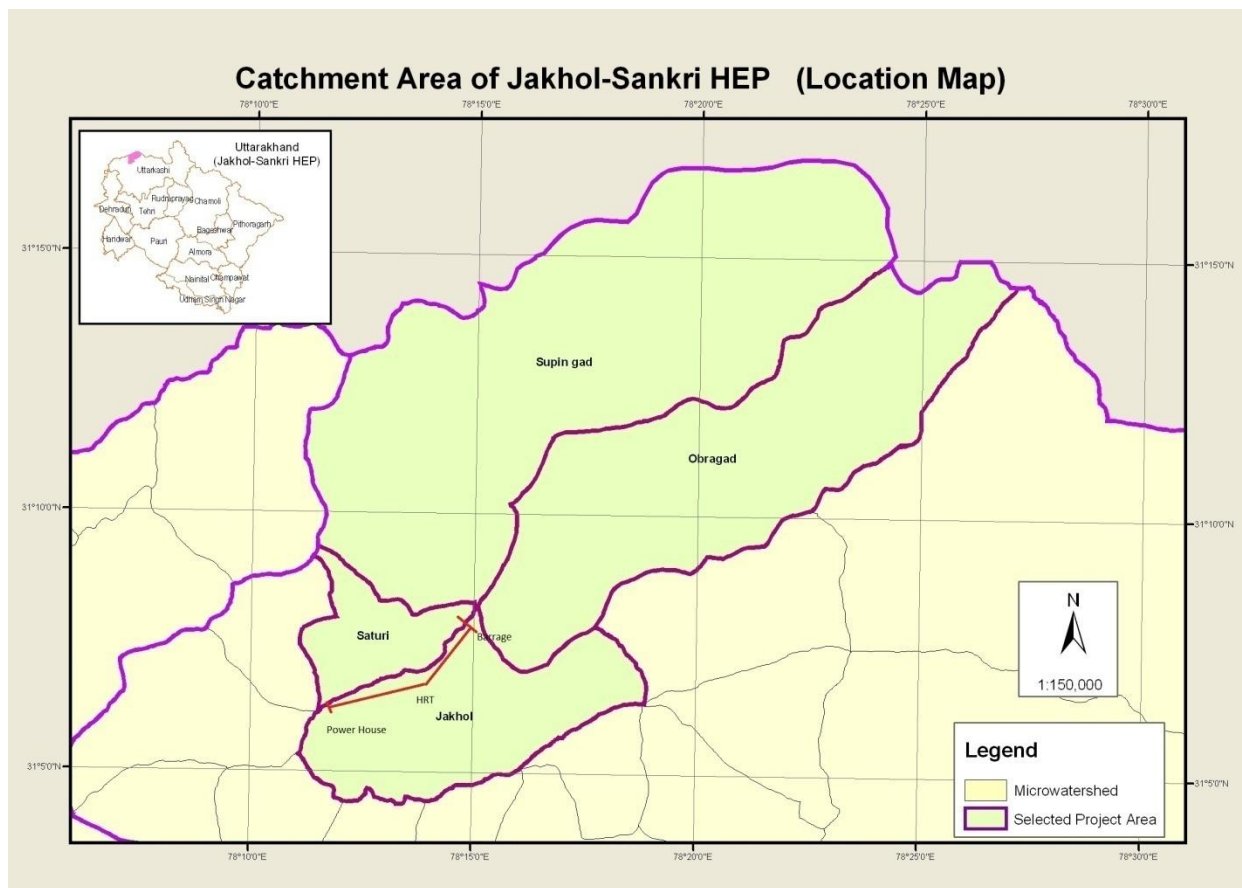


Fig. 1.1 Location Map of Jakhol Sankri HEP



Source: Watershed Directorate, Uttarakhand

Fig. 1.2- Catchment Area Map of Jakhol Sankri HEP

CHAPTER – 1

INTRODUCTION

1.1 JAKHOL SANKARI HYDRO-ELECTRIC POWER PROJECT: AN OVERVIEW

The Sankari Hydro Electric Power Project is around 30687 ha. which is spread over Supin Gad, Obra Gad, Satri and Jakhol Micro watersheds of Supin Tons Sub Watershed (SWS) under Yamuna watershed of Yamuna catchment. Total catchment area of proposed Jakho

JSHEP has been conceived to utilize perennial flow of **river Supin**, which originates from Kimlong glacier, having a gross head of 445.80 m available upto Guinya Ghati (near Sankri Power House Site). The barrage site is proposed at Kheda Ghati near cave on Supin river. The reservoir will stretch over an area of 0.24 ha at EL 1959.40 m. The project will have underground power house on the Left bank of river Supin. The power house will have 2 units of 25.5 MW each.

1.1.1 Location & Approach

The proposed JSHEP is located on river Supin flowing in the Uttarkashi district of Uttarakhand. (Location Map Fig. 1.1) The diversion site is located at latitude 31°05'19''N - 31°07'06''N, and longitude 78°11'10''E - 78°14'07''E. The distance from state capital Dehradun is 220 km. The nearest airport Jolly-Grant is 245 km from the project site. Due to the JSHEP about 10 km natural flow of the river will be disturbed. (*Ref: DPR of the Project*)

1.1.2 Need of Catchment Plan

The developmental activities, including hydroelectric projects, often have some impacts on natural resources. Accelerated soil erosion in the catchment areas of reservoirs and transport of detached material through the drainage network gives rise to a series of problems, notably siltation, depletion of flow capacity, steady loss of storage capacity, consistent drop in hydro-electric power generation and frequent floods. Therefore for sustainable hydropower development with least negative impact on the environment watershed management plays a pivotal role. Thus, a well-designed Catchment Area Treatment Plan (CAT) is essential to ameliorate the above-mentioned adverse causes and process of soil erosion. The catchment area treatment involves understanding of the erosion characteristics of the terrain and suggesting remedial measures to reduce the erosion rate. For this reason, the catchment of the directly draining rivers, streams, tributaries, etc. are to be treated.

Chapter-2

CATCHMENT AREA**2.1 Catchment Area Details:****2.1.1 The Catchment Area:**

The Yamuna catchment is one of the important catchment of India which spreads in Uttarakhand in to Uttarkashi, Tehri Garhwal & Dehradun district and includes Algar, Asan, Lower Tons, Tons & Yamuna watersheds. The four micro watersheds namely Obragad, Supingad, Saturi & Jakhol of Supin Tons Sub watersheds of Tons watershed are shaped out the catchment area of Jakhol Sankari Hydro Electric project. The Catchment area of Jakhol Sankari Hydro Electric project is 30687 ha. This comprises **34% forests land, 6% under agriculture & habitation and 60% Snow & blank**. The detail of catchment area is as under:

Table: 2.1 Detail of Catchment Area of Jakhol Sankari Hydro Electric Project

Supin – Tons Sub Water Shed of Tons Watershed																	
M.W. S.	Agriculture					Forest					Blank					Snow Bound	Total (Ha.)
	E1	E2	E3	E4	T.tal	E1	E2	E3	E4	T.tal	E1	E2	E3	E4	T.tal		
Saturi	0	218	0	0	218	0	525	0	0	525	0	6	1016	0	1022	0	1765
Supin Gad	0	693	365	0	1058	668	2182	150	0	3000	0	75	8158	0	8233	1218	13509
Obragad	0	129	0	0	129	0	3137	371	0	3508	0	231	5642	262	6135	738	10510
Jakhol	0	412	193	0	605	0	3337	43	0	3380	0	137	781	0	918	0	4903
	0	1452	558	0	2010	668	9181	564	0	10413	0	449	15597	262	16308	1956	30687

Source: Watershed Directorate, Uttarakhand

Note:-

Total Catchment Area= 30687 Ha.

Catchment Area above Barrage of the Project= 26820 Ha.

Catchment Area between Barrage & Power House (Tail Race Tunnel) =3867 Ha.

CAT Plan of Jakhol Sankri HEP

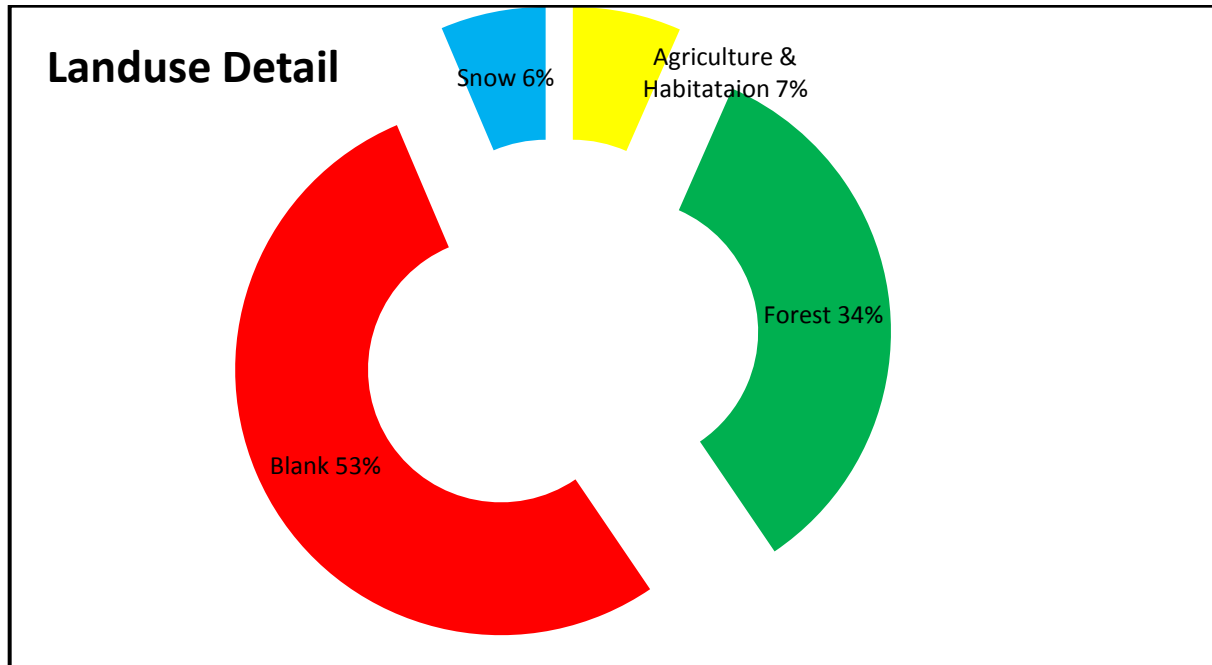
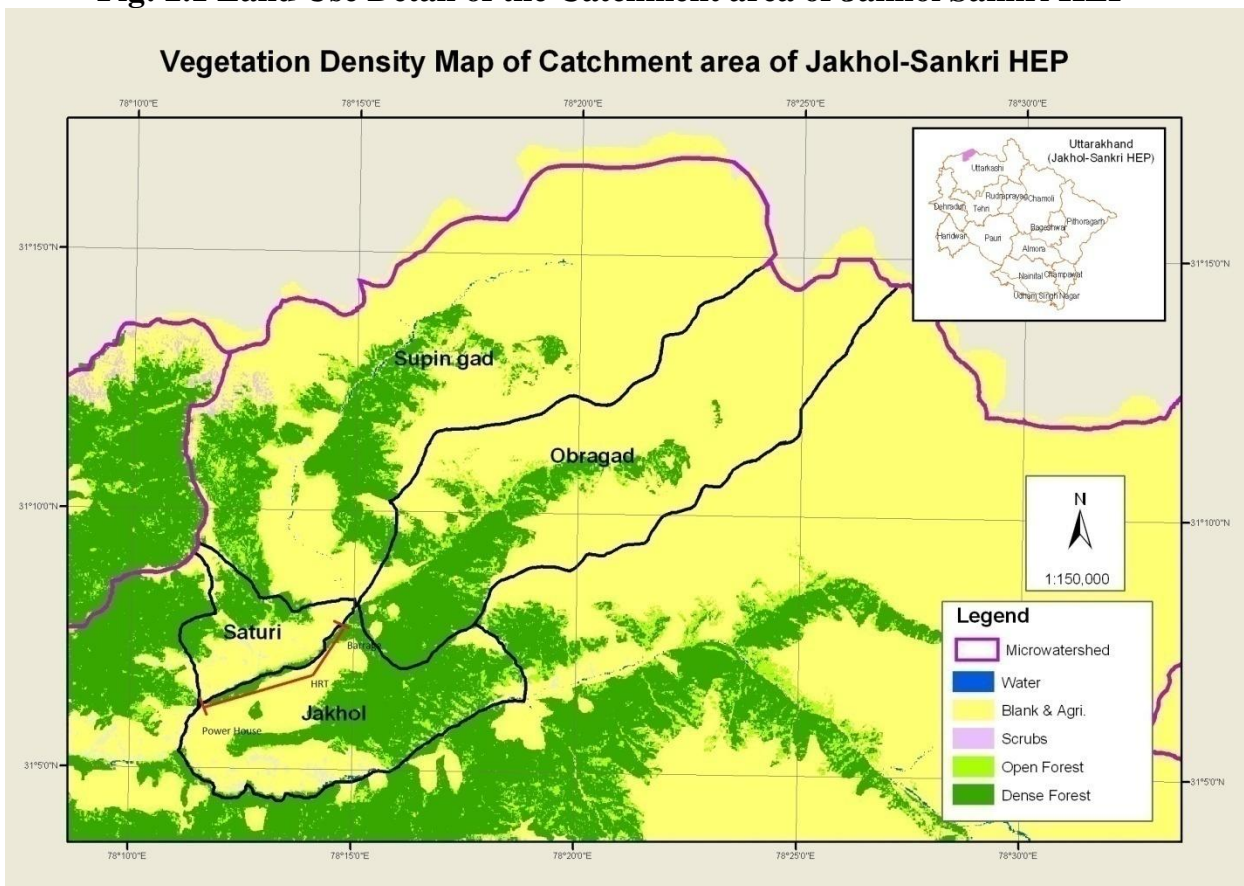


Fig: 2.1 Land Use Detail of the Catchment area of Jakhol Sankri HEP



Source: Watershed Directorate, Uttarakhand

Fig.: 2.2 Vegetation Density Map of Jakhol Sankari HEP

2.1.2 Physiography:

The Supin catchment exhibits an intricate pattern of mountain system consisting of high mountains covered with snow and glaciers in the north-eastern part of the basin, moderately to very steep sloping summits and peaks and with narrow valleys. On the basis of relief and slope, the Tons basin could be subdivided into two major physiographic zones.

- i. High mountains
- ii. Moderately high mountains

i. High Mountains

The area with 3000 m and above elevation with conspicuous changes in the climate and land use pattern could be classified as high mountains. The high mountains are further subdivided into glaciated high mountains and seasonally snow capped high mountains. This physiographic unit consists of magnificent glaciers, viz. Devkiara, Bhararsar glaciers. The rivers viz., Obra gad, Liwari gad, Supin, Sural gad, Chakrai gad, Vishal gad, Kamti gad, Goda gad, Duaraka gad, Akhoti gad, Launka gad, Ghattu gad (Liwari), Dacha gad, Gaudar gad, Gangad gad, Devkiya gad, Dudi gad and Fitari gad are mainly fed by the mountain glaciers, valley glacier and glacier lakes. The area is subjected to regular snowfall interrupted by cloud bursts in the higher altitude. The retreating movements of glaciers which comprise of various cirques at the height of turf causing sharp knife edged arêtes may be observed in the form of 'U' shaped valleys with mountains and smooth and gradational slopes. The summits are permanently under snow cover. The rocky slopes and cliffs are mainly barren. The debris is produced by avalanche and landslides and is observed under Deokiyar glacier.

ii. Moderately High Mountain

Theses occur in between the altitude of 2000m and 3000m above MSL. It is observed that the high summits of mountains are under snow cover for 2 to 3 months during December to March. It is a massive mountainous tract with a series of ridges and spurs divided by river valleys.

2.1.3 River System:

River Supin is the tributary of river Tons, which is ultimate tributary of river Yamuna, an important river of the Indo-Gangetic plains which joins latter at Dak Patther about 35 km west of the Dehradun city. Major tributaries of river Supin are Obra gad (Originates from Devkiyar glacier at an

altitude of 4300m joins Supin 3km upstream to Dhara, flows NE-SW direction length 17 km) and Supin Nadi (Originates from Kimlog glacier from Baslaw Thach area at 4100m, flows NE-SW direction, joins Tons near Sankri length 21km). River Supin and its tributaries originate from Kimlong and Deokiyara glaciers of Himalaya in the west of Yamunotri in Uttarakhand. The ridges which occur within the basin form summits, repose slopes and formation of intermittent ridges demarcate the basin in a number of sub watersheds. There are numerous passes and valleys which are accessible during May to November at higher altitudes and April to November at lower altitudes.

2.1.4 Soils:

Soil is the product of geological, chemical and biological interactions. The soils are formed either on moderate to steep slopes with vegetation cover or in the narrow mountain valleys. The soils in the region vary according to altitude and climate. The soil in the catchment area is young like any other region of Himalayas. The vegetal cover is one of the most important influencing factors characterizing the soil type in a region. At higher elevations and very steep slopes soil development is lacking due to water erosion and colluvial movement of soil particles. The higher altitude above 4000m above MSL frost action is a common weathering agent and erosion is caused by glacial or glacio-fluvial water derived from melted glaciers. Soil on the slope above 30°, due to erosion and mass weathering process are generally shallow and usually have very thin surface horizon. As a result of this and owing to scanty or no vegetation in the higher altitudes generally rock outcrops are seen. The soils are shallow to moderately deep, well to excessively drained and loamy to loamy skeletal. Generally, the soils are dark brown in colour with rich in organic matter.

2.1.5 The Flora (Forest / Vegetation):

The great variation in altitude and aspect has resulted in a great diversity of natural vegetation. Champion and Seth (1968) recorded five type groups viz. subtropical pine forest, Himalayan moist temperate forest, Himalayan dry temperate forest, sub alpine forest and moist alpine scrub and 29 sub-groups of forests in the region. The major species in these forests are: Chirpine (*Pinus roxburghii*), Kadam (*Prunus cerasoides*), Deodar (*Cedrus deodara*), Kaphal (*Myrica sapida*), Blue pine (*Pinus wallichiana*), Utis (*Alnus nepalensis*), Bhojpatra (*Betula utilis*), Busha (*Meliosma pungens*), Rhododendron campanulatum, R. lepidotum, R. arboretum, Fir (*Abies pindrow*), etc. The vast alpine grasslands support herbivorous wild and domestic animals. The species found in alpine grasslands are Gorda (*Chrysopogon fulvus*), Kumras (*Heteropogon contortus*), *iris kumaonensis*,

Aconitum sp., *Primula sp.*, etc. Ten species of grasses, twenty four species of shrubs and twenty six species of trees are of high economic utility in the catchment area.

2.1.6 The Fauna:

The area is habitat of large number of endangered fauna, including Snow leopard, Brown bear, Black bear, Bharal, Himalayan tahr, Musk deer, Serow, Monal Pheasant etc. The main wild life found in the area is shown in the table below:

Table: 2.2 Mammals species of the Catchment area of the Project

S. No.	Common Name	Scientific Name	Altitudinal range (m)	IUCN Status	Under Wild Life Protection Act-1972
1	Snow Leopard	<i>Uncia uncia</i>	3700-5000	Endangered	Schedule-I
2	Asiatic Black Bear	<i>Ursus thibetanus</i>	Seasonal altitude migration	Vulnerable	Schedule-I
3	Himalayan Brown Bear	<i>Ursus arctos</i>	Above tree line	Vulnerable	Schedule-I
4	Himalayan Musk Deer (Kasturi)	<i>Moschus chrysogaster</i>	Above 2700 m	Lower Risk	Schedule-I
5	Bharal-Blue Sheep	<i>Pseudois nayaur</i>	3500-5000	Lower Risk	Schedule-I
6	Himalayan Thar	<i>Hemitragus jemlahicus</i>	2800-4000	Vulnerable	Schedule-I
7	Serow (Mainland Serow)	<i>Nemorhaedus sumatraensis</i>	1800-3000	Vulnerable	Schedule-I
8	Sambar	<i>Cervus unicolor</i>	1850-3000	Lower Risk	Schedule-III
9	Indian Muntjak (Barking Deer)	<i>Muntiacus muntjak</i>	1450-2400	Lower Risk	Schedule-III
10	Goral	<i>Nemorhaedus goral</i>	1550-2075	Lower Risk	Schedule-III
11	Rhesus Macaque	<i>Macaca mulatta</i>	1450-2400	Lower Risk	Schedule-II
12	Hanuman Langur	<i>Semnopithecus entellus</i>	1450-2700	Lower Risk	Schedule-II
13	Asiatic Jackal (Golden Jackal)	<i>Canis aureus</i>	1400-3000	Lower Risk	Schedule-II
14	Common Red Fox	<i>Vulpes vulpes</i>	1400-3000	Lower Risk	Schedule-II
15 16	Leopard Cat	<i>Prionailurus bengalensis</i>	2075-2550	Lower Risk	Schedule-I

CAT Plan of Jakhol Sankri HEP

17	Leopard	<i>Panthera pardus</i>	1400-3500	Lower Risk	Schedule-I
18	Yellow- Throated Marten	<i>Martes flavigula</i>	1480-1400	----	-----
19	Mountain Weasel	<i>Mustela altaica</i>	24000	----	---
20	Wild Pig	<i>Sus scrofa</i>	1300-2800	Lower Risk	Schedule-III
21	Indian Pika	<i>Ochotona roylei</i>	Above 2000m	----	---
22	Indian Hare (Black Naped Hare)	<i>Lepus nigricollis</i>	1450	-----	-----
23	Red Giant Flying Squirrel	<i>Petaurista petaurista</i>	1450	---	----
24	Savi's Pygmy Shrew (Pygmy White Toothed Shrew)	<i>Suncus etruscus</i>	1450	-----	-----
25	House Shrew	<i>Suncus murinus</i>	1350	----	-----
26	Blyth's Vole	<i>Microtus leucurus</i>	2075	----	-----
27	Field Mouse	<i>Apodemus wardi</i>	1480-2100	-----	-----
28	Soft- Furred Field Rat	<i>Millardia meltada</i>	1450	-----	-----
29	House Mouse	<i>Mus musculus</i>	1450-1850	-----	-----
30	Indian Crested Porcupine (Short tailed Porcupine)	<i>Hystrix indica</i>	1850-2400	Lower Risk	Schedule-IV
31	Short-Nosed Fruit Bat	<i>Cynopterus sphinx</i>	1450-1900	-----	-----
32	Pipistrelle Bat	<i>Pipistrellus babu</i>	1530-1900	-----	-----

Source: Management Plan of Govind Wild Life sanctuary & National Park

2.2 Climatology / Meteorology

The climatic conditions in the Catchment area vary with elevation. The variations of exposure of sunlight and to rain bearing winds produce a very intricate pattern of local climate in the Catchment area. The climate of the Catchment area can be divided into four seasons. The winter season lasts from December to February followed by pre-monsoon season from March to May. The monsoon season begins in June and continues up to middle of October. The period from second half

of the October to November constitutes the post-monsoon season. During monsoon season, local thunderstorms are frequent, which is often accompanied by heavy hail. The monsoons or rainy season locally called chaumas commences from last week of June continuing upto end of September. Majority of rainfall is received during mid-July to mid-August. The sky remains generally clear in the middle of September and October. The winter season locally known as hyund in Garhwal himalayas, lasts from December to February. At higher reaches, snowfall is common during winter months.

2.2.1 Temperature

Temperature rises rapidly after March and the month of June is the hottest month of the year with mean daily maximum temperature going up to 24.1°C. With the withdrawal of monsoons, by the end of September, there is a sharp decrease in temperatures. The months of December and January are the coolest months of the year, with mean daily minimum temperature as low as 2.5°C.

2.2.2 Rainfall

The rainfall varies from 1000 to 1500 mm annually. The maximum rainfall is received in the months of July and August. About 60% of the rainfall is received under the influence of south-west monsoons during the months from July to September. On an average, there are about 88 rainy days (i.e. days with rainfall of 25 mm) in a year.

2.2.3 Humidity

The average 'humidity' is about 60% Apart from the monsoon months, relative humidity ranges between 55 and 92 % throughout the year.

2.2.4 Wind

Winds are generally light, of the order of 3 to 4 km per hour in the valleys and 5 to 8 km per hour at elevations about 2000 m above sea level. In the wake of western disturbances and in association with thunderstorms, they become quite strong.

2.2.5 Clouds

During monsoon months, i.e. from July to September, skies are generally heavily clouded. Heavy cloud cover persists in short spells during the winter months when the area is affected by the passing western disturbances.

2.2.6 Special weather phenomenon

Thunderstorms occur throughout the year, their frequency being least in the months of November and December. Their activity is greatest during the period from May to September. During winter and the pre-monsoon months, they are accompanied by hail.

Dust storms are rare and occur, if at all, in the valleys in summer. Fog is common during monsoon months and it may also occur in association with western disturbances. Morning fog may also occur in the valley frequently in winter.

The average meteorological conditions in the project area are given in Table-2.3.

Table-2.3 Average meteorological conditions in the project area

S. No.	Month	Mean Temp. Daily (°C)		Rainfall (mm)	No. of rainy days	Relative Humidity (%)
		Max.	Min.			
1.	January	10.6	2.5	51.8	4.5	63
2.	February	12.4	3.8	52.8	4.1	60
3.	March	16.5	7.5	57.7	4.4	55
4.	April	21.2	12.0	30.0	2.5	48
5.	May	24.1	14.7	58.4	4.1	50
6.	June	23.7	16.2	174.9	8.6	71
7.	July	20.8	15.5	662.0	21.9	91
8.	August	20.2	15.2	670.6	21.8	92
9.	September	19.9	14.0	277.5	11.1	84
10.	October	18.9	11.2	64.7	3.0	64
11.	November	15.9	7.3	14.8	0.9	58
12.	December	13.1	4.6	18.2	1.3	56
	Average	18.1	10.4	2176.4	88.2	66

Source: India Meteorological Department (IMD)
(Ref: EIA study of JSHEP conducted by WAPCO Limited)

2.3 Sedimentation Data:

Himalayan rivers are quite well known to bring lot of sediment during monsoon. The Supin and its tributaries also bring lot of sediment. However, there is no site for sediment measurement in the study area (of CAT Plan). For the Tons basin, the only information about sediment is available from Ichari dam site, which is about 85 km downstream of present project site. The reservoir survey of Ichari dam reveals average sedimentation rate of about 1.5 ha-m/100 sq km/yr. Since this is a run of river scheme, the above information is considered adequate. SJVN Limited has established a gauging site at the proposed barrage site at Jakhol. The daily sediment data for this site is available for the period July 2006 to October 2013.

2.4 Seismicity:

The state of Uttarakhand is among the most seismically active parts of India. Seismologically major portion of Uttarakhand falls in zone V and Zone IV as per the seismic zoning Map of India, and thus is very susceptible to earthquakes. Many events of M5.5 or more have struck the region since 1900. Districts along the borders with Nepal and China lie in Zone V. MSK intensities in excess of IX can be expected in these districts. The rest of the state, including the city of Dehra Dun lie in Zone IV, where the maximum intensity expected could reach MSK VIII. The tectonic activities, as a result of continuous mounting pressure of Indian plate on Tibetan plate are still going on in this part of Himalayas. These activities are quite evident by frequently occurring earthquakes in this region. On the basis of intensive study it has been concluded that earthquakes in the area result from strike slip and dip-slip movements along various faults and thrusts.

Earthquake activity in Uttarakhand have been prolific with loss of life and as a result of which over many lives have been lost and property worth millions has been destroyed or rendered unusable in the last two hundred years. The project area district comes under Seismic Zone IV of Seismic Zoning Map of India, which correspond to Zone Factors of 0.24 (effective peak ground acceleration in terms of g) of seismic intensities VIII (MSK –64 scale), (IS 1893, 2002). The Seismic Zoning Map of India is given in Figure-6.1. Largest Instrumented Earthquake in Uttarakhand observed in 19 October 1991 in - Pilang-Bhatwari area. The intensity was observed 6.8. 768 people were killed and nearly 5,000 injured in this earthquake in Uttarkashi district. Some 18,000 buildings were destroyed in the Uttarkashi-Chamoli region. Landslides and rockfalls were widespread in the Gharwal Hills.

The lists of major earthquakes reported in Uttarakhand are given in Table-2.4.

TABLE-2.4 List of major earthquakes in Uttarakhand

Date of occurrence	Area	Intensity	Remarks
06 July 1505	Lo Mustang-Globo	8.2	Heavy damage in regions along the China-Nepal border. Felt strongly in many parts of north India and damage was reported from Agra, Delhi, Dholpur, Gwalior and Mathura.
01 September 1803	Kumaon-Gharwal	7.0	200 - 300 were killed in this shock and several villages were buried by landslides and rockfalls. The Badrinath temple located ~40 km north of Chamoli was severely damaged.
26 May 1816	Gangotri	6.5	Epicenter of the earthquake was located south of Gangotri, in the glaciers surrounding the Badrinath peak.
16 June 1902	Pokhra-Kainur	6.0	Epicenter of the earthquake was located south-east of Pauri in Uttarakhand.
13 June 1906	Gangotri	6.1	Epicenter of the earthquake was located near Gangotri, in the glaciers surrounding the Badrinath peak.
14 October 1911	Indo-China border	6.5	Epicenter of the earthquake was located in southern Xizang (or Tibet), China, along the international border with India
28 August 1916	Near Api Peak, Nepal	7.1	Epicenter of the earthquake was located in Far-western Nepal, to the north-east of Dharchula, Uttarakhand. The shock caused severe damage to civil structures in Dharchula
27 July 1926	Near Changabang Peak	6.5	Epicenter of the earthquake was located in the vicinity of the Changabang Peak, which lies in the vicinity of Nanda Devi National Park in Uttarakhand.
08 October 1927	Indo-China border	6.1	Epicenter of the earthquake was located north of the town of Dakar, Uttarakhand.
20 October 1937	Indo-China border	5.8	Centred along the state border with Himachal Pradesh, this earthquake caused damage in the region.
04 June 1945	Near Nanda Devi Peak	6.5	Epicenter of the earthquake was centred in the vicinity of the peak Nanda Devi (elevation:

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Date of occurrence	Area	Intensity	Remarks
			7,817 metres).
28 December 1958	Rameshwar-Devi Dhura	6.1	This earthquake is known as the Kakpot earthquake. More than a dozen buildings collapsed. Fissures and landslides were generated in an area within 150 kilometres of Kapkote.
27 June 1966	Athpali-Dhung	6.2	This earthquake was centred in Far-western Nepal, along the border with Uttarakhand.
29 July 1980	Bajhang-Ghoghda	6.5	150 - 200 persons were killed and hundreds injured. Extensive damage to several villages in western Nepal. The earthquake also caused damage in Pithoragarh area of Uttarakhand. 13 persons were killed here and 40 were injured. The shock was felt as far away as Kathmandu and New Delhi.
19 October 1991	Pilang-Bhatwari area	6.8	768 people were killed and nearly 5,000 injured in this earthquake in Uttarkashi district. Some 18,000 buildings were destroyed in the Uttarkashi-Chamoli region. Landslides and rockfalls were widespread in the Gharwal Hills.
05 January 1997	Dharchula area	5.6	Felt strongly in many parts of the state then known as Uttaranchal, including Nainital, Kumaon and the Terai areas. Many people ran outdoors in panic and window panes were broken in many localities. Many houses were damaged in western Nepal and it was felt at Baitadi and Dadeldhura.
28 March 1999	Chamoli-Pipalkoti	6.4	115 people killed in the Gharwal region. The earthquake was felt very strongly in Uttar Pradesh, Chandigarh, Delhi and Haryana. In Haryana, one person was killed in the city of Ambala and 2 at Nakodar in the neighbouring state of Punjab. Minor damage to buildings in New Delhi, most significantly in Patparganj.
30 March 1999	Chamoli-Pipalkoti area	4.9	50 people were injured in this tremor, which was an aftershock of the event on 28 March 1999. Several buildings developed cracks and many damaged houses at Maithana village collapsed. At Barai in Chamoli district, 20 houses collapsed and 11 developed cracks,

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Date of occurrence	Area	Intensity	Remarks
			while at Kotiyal 4 houses collapsed and 85 developed cracks. Some damage was also reported from Rudraprayag district
31 March 1999	Chamoli-Pipalkoti	3.0	1 person was killed and several injured in a house collapsed at Hat Pipalkot in Chamoli district.
27 May 2003	Bangina region	5.0	A moderate earthquake struck the Gharwal Himalayas.
14 December 2005	Pokhri-Gopeshwar region	5.0	A moderate earthquake struck the Gharwal region of Uttarakhand, causing minor damage to property in some parts of Uttarakhand. The earthquake was felt at many places in Uttarakhand as well as in Delhi.
5 August 2006	Thal area, eastern Uttarakhand	4.4	Causing damage to property in parts of eastern Uttarakhand. The earthquake was felt at many places in Uttarakhand and surprising as far as Delhi.

Source: Amateur Seismic Centre, Pune, 2007

The seismic history of the area shows that in the last 150 years about 36 earthquakes of damaging effects (Magnitude >5, Richter) have been experienced in Garhwal region and most of these occur in the 50 km wide belt following the trace of Main Central Thrust (MCT). About 11 earthquakes (in Garhwal division) of magnitude more than 5.5 are recorded between longitude 78°- 81°N and latitude 29°-31°20'E. The Uttarkashi earthquake of October 20, 1991 and Chamoli earthquake of March 29, 1999 are the recent ones. Both the earthquakes occurred in the seismological Garhwal block defined by Kaurik fault in the west, Main Central Thrust (MCT) in the north and Alaknanda fault in the south in the Main Himalayan Seismic Zone. The most damaging earthquake observed in the area is the 05 April 1905 earthquake with a magnitude of 8.0 (Richter) at Kangra which took a toll of 20,000 human lives. The project area falls in zone IV of the seismic zoning map of India. The determination of site specific design earthquake parameters for the project has been carried out by the Department of Earthquake Engineering, Indian Institute of Technology, Roorkee for the Jakhol Sankri H. E. Project. MCE condition is estimated to be magnitude of 8.0 earthquakes occurring at MCT. The PGA value for MCE and DBE condition are estimated to be 0.38g and 0.19g respectively.

The map of India is divided into five zones for the Jakhol Sankri HEP. The zones are defined by their geographical location and are labeled with Roman numerals I through V. The legend indicates the following zones:

- ZONE I: Central India (cross-hatched pattern)
- ZONE II: Northern India (diagonal lines from top-left to bottom-right)
- ZONE III: Southern India (diagonal lines from top-right to bottom-left)
- ZONE IV: Western India (horizontal lines)
- ZONE V: Eastern India (vertical lines)

The map includes latitude and longitude coordinates. The Jakhol Sankri HEP is located in the northern part of India, within Zone II. The map also shows the names of various states and union territories, as well as major cities.

Fig: 2.3 Seismic Map of India

2.5 Geology:

The litho-tectonic set-up of the area is given in Table -2.5.

TABLE- 2.5 Litho-Tectonic Set-up (Geology after GSI)

Group	Formation	Lithology
Jaunsar (undifferentiated)		Grey, Green Phyllite, Sericite Quartzite with local carboaceous phyllite, schist and basic rocks
-----Purola Thrust-----		
Purola Crystalline		
		Biotite Schist, Quartz Mica Schist, Garnetiferous biotite schist, biotite gneiss, porphyroblastic gneiss, quartzite and amphibolites
-----Main Central Thrust-----		
Central Crystalline	Gangar	Intercalated sequence of grey micaceous quartzite, quartz mica schist, garnetiferous biotite schist, biotite and porphyroblastic gneiss

Source: Project Detailed Project Report

The Jaunsar Group is represented by snow white massive and sericitised quartzite showing pale and greenish tinge at places. It is highly fractured, jointed and is intruded by numerous basic bodies. Sericitised quartzites near Sankri show enormous thickness due to folding between Mautar in the west and Taluka in the east. It is restricted by tectonic plane, which has been locally named as Purola Thrust. This formation seems to extend southwards across high ranges to Sar area.

In the north, the Jaunsar Group is thrust over by the Purola Crystalline Group, which is locally named as Purola Thrust. In the east, the Central Crystallines have ridden over this Formation along the Main Central Thrust (MCT). Purola Crystalline Group comprises chlorite mica schist, quartz mica schist, porphyroblastic gneiss and pebbly/conglomeratic gneiss. It is lithologically different from the overlying rocks of Jaunsar Group. In project the barrage site is located in Central crystallines, HRT is cutting across the Main Central Thrust (MCT) 300m downstream of barrage axis. Downstream of

MCT upto surge shaft HRT is located in Purola crystallines whereas pressure shaft is cutting across the Purola Thrust (PT) and power house cavern & TRT are located in Jaunsars.

The Purola crystalline Group has thrusts the Jaunsar along the Purola Thrust and is overlain by the Central Crystalline showing sharp thrust contact. It is well exposed in and around Naitwar and Kalaba, and extends towards north up to Himri in the Rupin valley and Saluri and Fetari in the Supin Valley. In north-east, it extends toward Sirga and Jakhol, and does not continue much beyond. In southwest, the rocks of this Group have been traced up to Mori and little farther south. The chlorite mica schist of Purola Crystallines is in direct contact with the Jaunsars and extends all along Purola thrust. At Mautar, quartz biotite schist is exposed. The chlorite mica schist shows interactions of porphyroblastic gneiss (1 to 3 m) and quartzite slightly away from the contact of the Jaunsars. This sequence is well exposed upto Nichla Panva where quartz biotite schist with porphyroblastic gneiss continues up to near Dhara village. In south-west, it extends through Saturi across Unauni gad and Yian gad to Naitwar and beyond. Besides thin intercalations, within the schistose zone, the gneisses are exposed as a separate zone above the schistose rocks.

The gneisses are of two types:

- Compact gneiss
- Porphyroblastic gneiss.

The compact gneiss shows banded structure with well-developed gneissosity, which may be the outcome of the schistose rocks in the area. The porphyroblastic gneisses occur in association with other gneisses of the area. The central crystallines constitute high grade metamorphic rocks containing kyanite –sillimanite bearing schist and gneisses, calc silicate, migmatite etc. falling within green schist to amphibolite facies of rock. The central crystallines are divided in three formations, namely Gangar, Osla and Harkidun. In project area only Gangar formation is occurring. Gangar formation comprises a thick interstratified sequence of low grade crystalline rocks forming the lower part of central crystallines. It constitutes quartz mica schist, quartzite, porphyroblastic gneisses, granitic gneisses, compact gneiss and garnetiferous mica schist. Gangar formation is thrust upon the white quartzite rock of Jaunsar group (undifferentiated) along the MCT. The contact is marked by shearing, crushing, jointing, crumpling and mylonitisation of the rocks, which is well exposed near Taluka village in Tons valley, near Fetari and NE of Lewari villages in Supin valley. This formation

extends from Taluka to Panwani in Tons valley; from Supin Ogra gad confluence to slightly below Himri Thach in the Ogra gad and NE of Pushlari Thach and SW of Mohal Thach in Supin Valley.

2.6 Slope:

Slope is a measure of change in the value of the altitude over the distance that can be expressed in degrees or as a percent. In Himalayan region slope predominately governs the land use pattern and it becomes one of the most important factors in land use planning. The slope of a watershed plays an important role in controlling the soil and water retention time, in that way affecting the land use criteria. The percentage of the slope in a watershed determines the soil erosion susceptibility and forms the basis for classifying different segments of the watershed in to suitable capability classes for formulating suitable soil erosion/conservation measures. Keeping in view the physiography and land use /over of the area, the area has been divided in four classes.

Table: 2.6 Catchment Area detail as per Slope

W.S.	Name of S.W.S.	Name of M.W.S.	Cultivation					Within Reserved Forests					Other Than Reserved Forests					Total Forest
			< 33%	33- 50%	50 to 100%	> 100%	Total	<33%	33- 50%	50to 100%	> 100%	Total	< 33%	33- 50%	50to 100%	> 100%	Total	
1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tons	Supin Tons	Saturi	0	181	37	0	218	0	0	450	75	525	0	0	0	0	0	525
	Supin Tons	Supingad	0	450	608	0	1058	0	450	2438	75	2963	0	12	25	0	37	3000
	Supin Tons	Obragad	0	25	104	0	129	50	87	3371	0	3508	0	0	0	0	0	3508
	Supin Tons	Jakhol	0	355	250	0	605	0	714	2635	31	3380	0	0	0	0	0	3380
			00	1011	999	00	2010	50	1251	8894	181	10376	00	12	25	0	37	10413
Treatable area(Gradient <33%+1/4 of the area having gradient 33 – 50%)			00	253	00	00	253	50	313	00	00	363	00	03	00	00	03	366

(+)

Blank Within Reserved Forests					Blank Outside Reserved Forest					Total blank	River	Snow	Rocky	Grand Total
< 33%	33- 50%	50 - 100%	> 100%	Total	< 33%	33- 50%	50 - 100%	> 100%	Total					
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
0	178	295	106	579	0	111	207	125	443	1022	0	0	0	1765
0	2232	5220	494	7946	0	100	187	0	287	8233	0	1218	0	13509
150	394	4874	717	6135	0	0	0	0	0	6135	0	738	0	10510
0	125	281	106	512	0	31	375	0	406	918	0	0	0	4903
150	2929	10670	1423	15172	0	242	769	125	1136	16308	0	1956	0	30687
150	732	00	00	882	00	61	00	00	61	943	00	00	00	1562

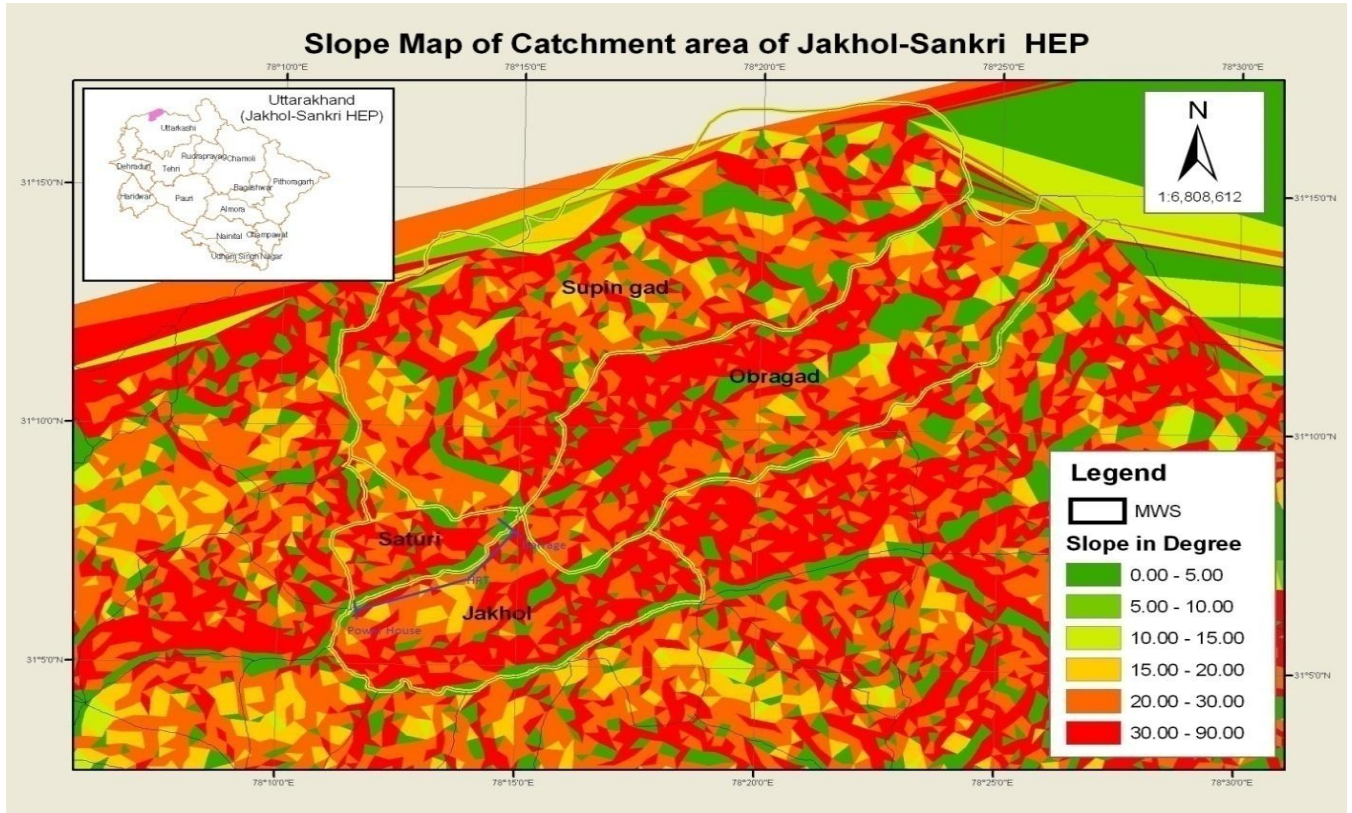
Source: Watershed Directorate, Uttarakhand

Area up to 50% gradient= 5851 Ha.

Area above 50% gradient= 22880 Ha.

Total area (except river, snow & rocky) =28731Ha.

As per the above data about 79.64% of the project area has a slope of more than 50 % which reflects towards the ruggedness of the area



Source: Watershed Directorate, Uttarakhand

Fig: 2.4 Slope Map of the Catchment area of Jakhol Sankri HEP

2.7 Socio Economic Status:

The Jakhol Sankari HEP lies in Mori tehsil of district Uttarakashi. The confluence of River Tons and Supin is the starting point of the Project area is connected by a metalled, all-weather road and Kheda Gahti near Dhara village is the starting point of the Catchment Area. It is at a distance of 220 km. from Dehradun. A 75 km. Long road between Purola and Jakhol is metalled and Jakhol & Dhara Village is connected by approx.3km long un-metalled road. Beyond this, the villages in the Catchment areas are connected each other with the mule track. A part from these bridle paths is also linking the villages inside the area and trek routes joining the places of tourist importance also exist. The village wise socio economic statuses are shown in table-2.7 & 2.8. Villages are usually settled along the river. Most of them, together with their agricultural fields, are however, concentrated at relatively lower elevations along the river Supin. Human settlements reflect local geographical conditions in their location, size, spacing and anatomy.

They also reflect the lifestyle, level of awareness and socio-economic order of the inhabitants as well as prevailing environmental conditions.

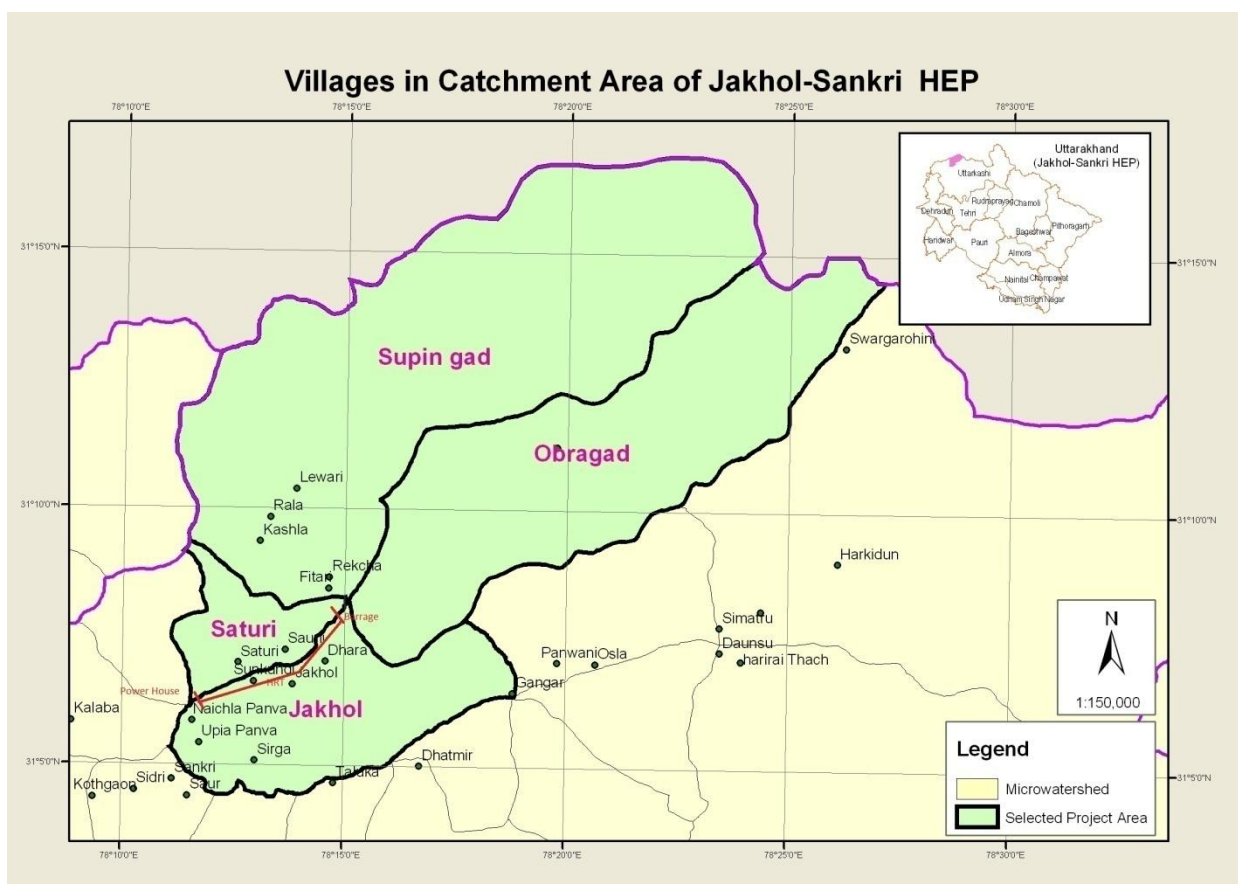
The total private land requirement for various components have been estimated about **15.681 ha** land. There are total of twelve villages in the influence zone of the project area including **Six Project Affected villages** namely **Jakhol, Pown Malla, Pown Talla, Dhara, Sunkundi & Savani**.

Table-2.7 Village-wise Socio Economic Statuses

S. No.	Village	No. of House Hold	Population Male	Population Female	Total Population	Sex Ratio (Female / 1000 male)	Literacy rate (%)	Male Literacy rate (%)	Female Literacy rate (%)
1	Fitari	115	386	383	769	992	34.81	54.81	13.68
2	Liwari	107	373	345	718	925	34.55	59.61	9.302
3	Saturi	33	101	95	196	941	31.25	50.60	10.38
4	Rala	16	61	52	113	852	22.22	34.09	8.108
5	Kasla	56	197	191	388	970	32.84	48.22	16.15
6	Regcha	54	152	145	297	954	21.28	34.12	8.130
7	Dhara	57	173	210	383	1214	42.58	66.42	23.69
8	Jakhol	204	634	622	1256	981	45.84	64.00	27.11
9	Sauni	17	54	62	116	1148	35.41	40.47	31.48
10	Sunkundi	32	118	94	212	797	33.51	49.01	12.98
11	Panw Malla	29	83	94	177	1133	29.49	46.15	14.86
12	Panw Talla	29	94	79	173	840	21.48	36.98	3.225
Total		749	2426	2372	4798	Average			
						979	32	49	15

Source: <http://villages.euttaranchal.com/index.php?d=01&n=Uttarkashi>

The average sex-ratio of these villages was 979 (number of females to per 1000 males). Literacy rate of the area was 32 which are very low compared to the literacy rate of 71.6 of Uttarakhand as a whole. The work participation rate is 54.7 %.



Source: Watershed Directorate, Uttarakhand

Figure: 2.5 Village location map of catchment area of river Supin

2.7.1 Occupation:

A very high number of people are unemployed. Agriculture is the main occupation of the region. Most of the people are involved in agricultural or labour activity, which is mostly, farm labour. Animal husbandry is another important source of supplementing income of the surveyed households.

2.7.2 Dependence on Forests:

Majority of the households are dependent on forests for their day to day requirement of not only fuel and fodder but also for timber for domestic use. As animal husbandry is the second main occupation of the population, there is large number of cattle, specially goats and sheep, per house hold. These cattle are left open to graze freely in the adjoining forests and thus causing intensive biotic pressure on forest.

Details of village wise livestock population in the villages of the project area are given in the table below:

Table-2.8 Details of village wise livestock population of the project area

S. No.	Village	Buffaloes	Cow / Bullocks	Horse	Mules	Sheeps	Goats	Sub Total
1	Panw Malla	0	139	0	0	375	504	1018
2	Panw Talla	0	155	0	1	537	199	892
3	Saturi	0	201	0	2	853	265	1321
4	Sunkundi	0	205	0	0	852	359	1416
5	Jakhol	3	1163	3	14	1754	1129	4066
6	Sauni	0	130	1	0	539	432	1102
7	Dhara	0	366	0	2	822	572	1762
8	Fitari	0	693	12	29	2236	1535	4505
9	Regcha	0	335	0	6	828	545	1714
10	Kashla	0	391	0	9	2088	1143	3631
11	Rala	0	146	3	4	535	484	1172
12	Lewari	0	773	16	31	3129	2215	6164
Total		3	4697	35	98	14548	9382	28763

Source: Veterinary Hospital, Naitwar, Uttarkashi - (18th Livestock Census 2007 of Animal Husbandary Department, Uttarakhand)

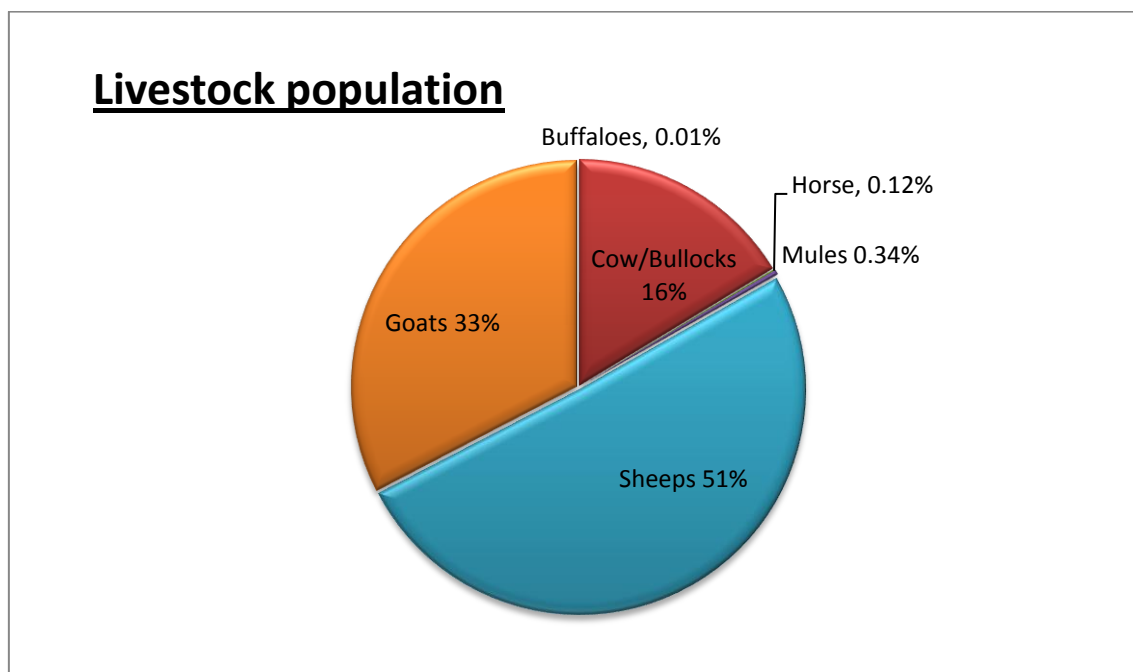


Fig: 2.6 Live Stock Populations

2.8 Hydrological Units

The Land Survey Directorate (LSD), a wing of Uttarakhand Forest Deptt. has hydrologically, divided Uttarakhand broadly into 8 catchments, these catchments have further been divided into 26 watersheds, 110 SWS and finally into 1110 MWS. The details of these hydrological units have been shown in the table below:

Table: 2.9 Details of Catchment, Watersheds, Sub watersheds and Micro watersheds in Uttarakhand

S.No	Catchment	Watershed	No. of Sub-watersheds	No. of MWS	Total Area (ha)
1	Alaknanda	Alaknanda	7	86	6,69,643
		Lower Alaknanda	5	32	95,475
		Mandakini	5	33	1,68,049
		Pindar	5	56	1,87,800
	Total		22	207	11,20,967
2	Bhagirathi	Bhagirathi	14	120	5,77,523
		Bhilangana	4	39	1,49,660
	Total		18	159	7,27,183
3	Ganga –A	Song	5	56	1,76,597
4	Ganga- B	Hiyunl/mal	6	28	1,00,683
		Nayar	6	59	2,08,612
	Total		12	87	3,09,295
5	Kali	Kali	5	82	5,49,682
		Lower Kali	3	34	1,17,760
		Saryu	8	123	4,45,494
	Total		16	239	11,12,936
6	Kosi	Bhakra	3	9	1,64,746
		Gola	3	20	1,65,988
		Kosi	4	71	2,10,075
		Nandhaur Left	3	17	1,23,618
	Total		13	117	6,64,427
7	Ramganga	Dhela Nadi	1	2	45,393
		Khoh	2	8	48,723
		Ramganga	8	75	3,33,926
	Total		11	85	4,28,042
8	Yamuna	Aglar	2	7	25,698
		Asan	3	18	82,088
		Lower Tons	3	19	45,265
		Tons	4	36	1,67,926
		Yamuna	7	80	2,29,185
	Total		19	160	5,50,162
Grand Total			116	1110	50,89,610
				+ Haridwar	2,33,506
Total					53,20,291

Source: Watershed Directorate, Uttarakhand

The **Supin Tons SWS** of **Tons Watershed** of Yamuna Catchment comprises the catchment area of Jakhol Sankri HEP in Uttarkashi district, Uttarakhand.

2.9 Drainage Pattern

Drainage characteristics: About 8 minor II order streams are present in the Project area between Power House and Barrage. In all, **there are 497 streams of various orders are draining in the Catchment area, out of which 376 are Ist order, 108 are IInd order, 10 are IIIrd order and 1 is IVth order streams.** Most of the streams located on left and right side of the valley join the river almost at right angle. **Priority for treatment will be given to actively eroding stream systems.** The work shall start from the top. Efforts shall be made to make as much vegetative structures as possible.

The details of streams of different order found in the MWS of the catchment area of Jakhol Sankri HEP are given in the table and map presented below. This information is helpful in planning of soil Conservation activities.

Table: 2.10 Drainage Pattern & Characteristics

Particulars	Type of Stream				Total
	1st order	2nd order	3rd order	4th order	
Length (m)	376050	289800	84300	8709	758859
Nos.	376	108	10	01	497

Most of streams of first and second order are not nomenclatured and all khudds and gads of third and fourth orders are well named by local people. List of wise rivers and streams is given below-

Table: 2.11 Gradient wise List of Rivers and Streams.

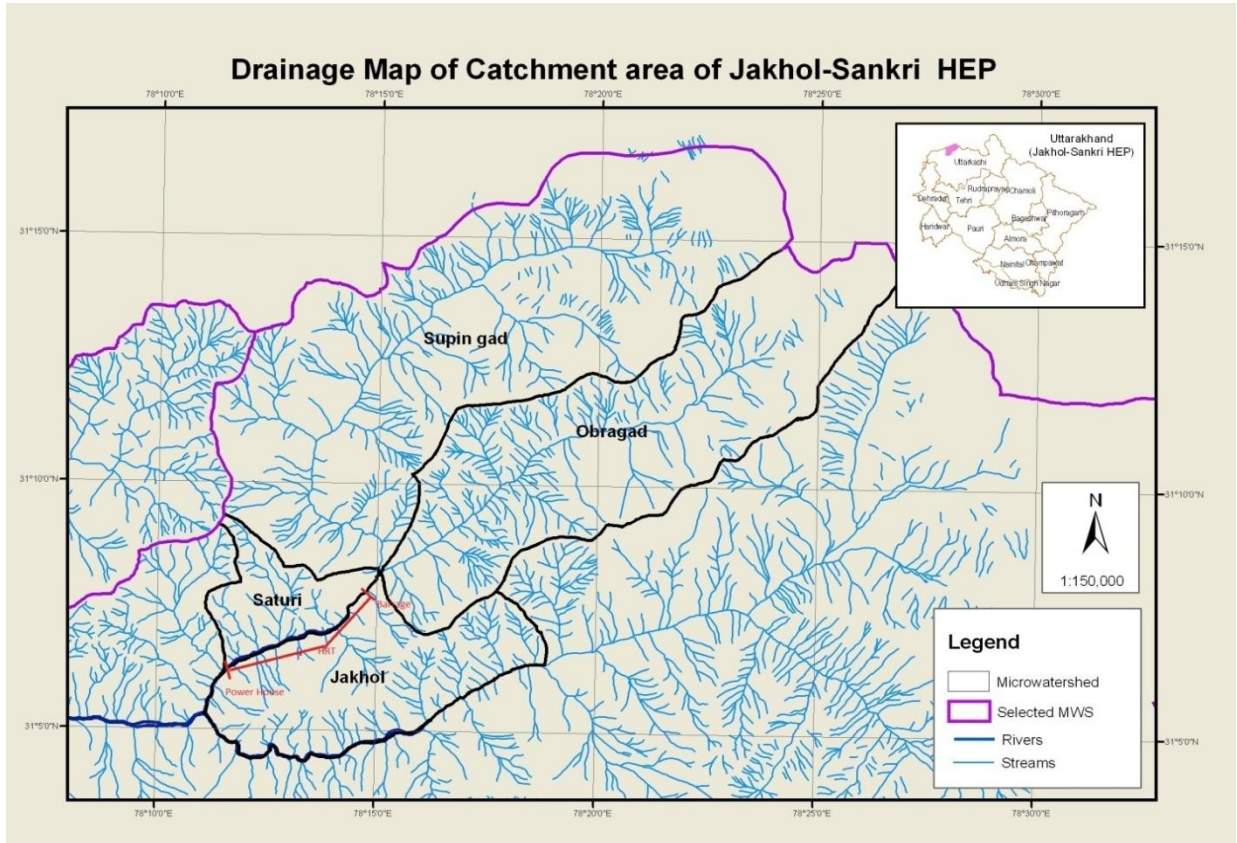
Sl. no.	Name of 4th Grade river and streams	Name of 3rd Grade river and streams	Name of 2nd th Grade river and streams	Name of 1st Grade river and streams
1	Supin River	Santuri gad	Jhayin Khudd	Usually unnamed. All small and dry Rain fed nalas
2		Lewari-	Unani khud	

CAT Plan of Jakhol Sankri HEP

		Ghattugad		spreaded all over the upper reaches of catchment area.
3		Obra Gad	Karba khudd	
4		Kamti gad	Sunni-Saturi khudd	
5		Jakhol Gad	Sanwni khudd	
6		Gairi gad	Paja khudd	
7		Panw gad	Bosni khudd	
8		Gantugad khudd	Dwarika khudd	
9		Bishal gad	Rala khudd	
10		Mora gad	Sural khud	
11			Pustari khudd	
12			Lewari khudd	
13			Godar kudd	
14			Dacha khud	
15			Kamti gad	
16			Tekuna khudd	
17			Bhatuka khudd	
18			Badgad khudd	
19			Karba khudd	
20			Kotodi khudd	
21			Chakuri khudd	
22			Godar khudd	
23			Dewri khudd	
24			Kanora khudd	
25			Kakai khud	
26			Khoduka khudd	
27			Gantugad khudd	
28			Chholga khudd	
29			Cholani khud	
30			Sangeu khudd	
31			Kamrha khudd	

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32			Sastari khudd	
33			Sagai khudd	
34			Poli khudd	
35			Chakrai khudd	
36			Ghugtiyani	
37			Eikarha khudd	
38			Akhoti khudd	
39			Himri khudd	
40			Karba khudd	
41			Kotodi khudd	
			Chakuri khudd	
42			Godar khudd	
43			Dewri khudd	
44			Kanora khudd	
45			Kakai khud	
46			Kenka khudd	
47			Khoduka khudd	
48			Saika khudd	
49			Hatti khudd	
50			Tatka khud	
51			Vishtatar khud	



Source: Watershed Directorate, Uttarakhand

Fig: 2.7 Drainage Map of the Catchment area of Jakhol Sankri HEP

CHAPTER-3

THE PROJECT

3.1 The Project

This project has been conceived as a Multi-Sectoral project with the objective of treatment of catchment area of Jakhol Sankri Hydro-Electric Project to control the sedimentation of the proposed barrage reservoir. A total of 24.126 hectare of civil and reserved forests has been diverted for the proposed Project and this is why this catchment area treatment plan is being proposed as per the mandatory conditions laid down in the GOI notification.

3.2 Catchment Area And Project Duration:

The Catchment area includes a total of **30687 hectares** of land which is spread over **4 MWS of Supin-Tons SWS of Tons catchment of Yamuna basin**. As far as land use pattern is concern around 34% area fall under forests, 06% under agriculture & habitation and the rest 60% includes Snow & blank.

Keeping these facts into consideration a **7-year Catchment Area Treatment (CAT) Plan** with a total **cost of Rs. 705.50 Lacs** has been proposed.

3.3 Project Description:

Proposed plan will have activity in various sectors that will focus on environmental sustainability of the catchment area along with supporting the population of the area with integrated development of the villages falling in the catchment area of the Project. The interventions proposed will be in line with directions of the state government for the catchment area treatment and will include Forestry, Soil conservation, Agriculture, Horticulture, Energy conservation, Livestock development and improving income generation opportunities of the local population.

Project Objectives:

The main objective of the project is the overall treatment of the Catchment Area leading to improvement of ecosystem through plantation and soil conservation measures thereby causing reduction of the silt load in the water bodies present in the catchment area so as to enhance the life of the Jakhol Sankri Hydro Electric Project.

The Secondary objectives of the CAT Plan are:-

- (i) Integrate land based activities of agriculture, animal husbandry, forests, irrigation and rural development for holistic development of catchment area.

- (ii) To promote such activities in the Catchment area which will lead to enhancement of Ecosystem services and improvement in the overall environmental health of the catchment?
- (iii) Enhance capacity of forest departments and other departments, developmental agencies and NGO's through collaboration and experience sharing.

3.5 Methodology

The user agency, SJVN Limited, conducted Environmental Impact Assessment (EIA) of the area and identified different vulnerable and problematic areas in the different physiographic zones in the entire catchment area. The data related to physiography, land use / land cover, lithology, structure, drainage pattern, slope characteristics etc. has been collected from Watershed Directorate, Uttarakhand. On the basis of these data the CAT Plan has been prepared

It has been observed and experienced that the model of Integrated Approach of Watershed Management is the best model, so far, for the treatment of any Catchment. This model of treatment targets for the holistic treatment and development of the MWS under consideration and includes the following activities:

- a. Forestry management
- b. Drainage Line Treatment works (Soil & Moisture Conservation works)
- c. Agriculture improvement
- d. Horticulture
- e. Animal husbandry
- f. Energy conservation
- g. Water Harvesting & Conservation
- h. Training support
- i. Income Generation Activities (IGA) as per PRA micro planning

3.6 Project Components:

As per the land use details of the area around 34% under forest and around, 06% under agriculture & habitation and the rest 60% includes Snow & blank. 94% of the total forest area (9745 ha) falls under E2 and E3 categories and this is the area where forestry activities have been targeted.

There are number of seasonal nalas/gads in the projects area which contributes to soil erosion in the area especially during rains. As one of the main objective of this plan is to ameliorate various potential and degraded ecosystems for increasing the life span of the Project reservoir, the soil and moisture conservation measure involving construction of structures have been proposed. To ensure the effectively of these proposed soil conservation measures it will be mandatory to follow the technical compulsion to follow the top to bottom approach.

The agriculture area of the villages falling in project area is 2010 ha., with 749 households and 4798 population. This population is heavily dependent on the forests for their day to day requirement of fuel wood and fodder for their livestock, which is 28763 in numbers. Though the actual gap between requirement and availability of fuel and fodder will be available after preparation of micro plans, using PRA as a tool, of the villages but it has been observed that there is huge gap between present supply and demand. One of the objectives of the plan is to reduce this gap, accordingly the activities related to agriculture, residuals of which is used both as fodder and fuel, livestock development, to encourage improved breed and stall feeding and energy conservation activities like use of solar energy devices etc. have been proposed in the plan.

Around 72% of the land under agriculture fall under E1 and E2 category of land use classification. Technically these lands are suitable for horticulture. Keeping in this mind distribution and plantation of fruit plant have been proposed under horticulture component of the plan.

Unemployment and lesser opportunities for livelihood and income generation have forced the young mass of the area to migrate to near towns and cities. One of the objectives of the plan is also to improve opportunities of livelihood and make the villagers self sufficient, accordingly this plan includes imparting of training for skill up gradation and other income generation activities.

3.7 Treatable Area:

As shown in table no. 3.1 below, the total project area is 30687 ha. which consists of 2010 ha. as cultivable, 10413 ha. as forest & remaining 16308 ha. as blanks. The treatable area can be determined mainly on the parameters based on erodability class and gradient classification.

i. Erodability class-wise-

The areas classified as E2 & E3 are the areas which are generally suitable for treatment. The following table shows the detail of treatable area of Supin –Tons Sub water shed.

Table: 3.1 Detail of Catchment Area of Supin – Tons Sub Water Shed

M.W. S.	Agriculture					Forest					Blank					Sno w Bou nd	Total (Ha.)
	E1	E2	E3	E 4	T.tal	E1	E2	E3	E 4	T.tal	E1	E2	E3	E4	T.tal		
Saturi	0	218	0	0	218	0	525	0	0	525	0	6	1016	0	1022	0	1765
Supin Gad	0	693	365	0	1058	668	2182	150	0	3000	0	75	8158	0	8233	1218	13509
Obra gad	0	129	0	0	129	0	3137	371	0	3508	0	231	5642	262	6135	738	10510
Jakhol	0	412	193	0	605	0	3337	43	0	3380	0	137	781	0	918	0	4903
	0	1452	558	0	2010	668	9181	564	0	10413	0	449	15597	262	16308	1956	30687
Treatable Area (E2 + E3)		2010				9745					16046					00	27801
Total Treatable Area (E2 + E3)= (Agriculture + Forest + Blank)= 2010 + 9745 + 16046 = 27801 Hectare																	

Table: 3.2 Detail of Treatable Area of the Catchment

M.W.S.	E2	E3	Sub Total (E2+E3) Ha.
Saturi	749	1016	1765
Supin gad	2950	8673	11623
Obra gad	3497	6013	9510
Jakhol	3886	1017	4903
Total	11082	16719	27801

Source: Watershed Directorate, Uttarakhand

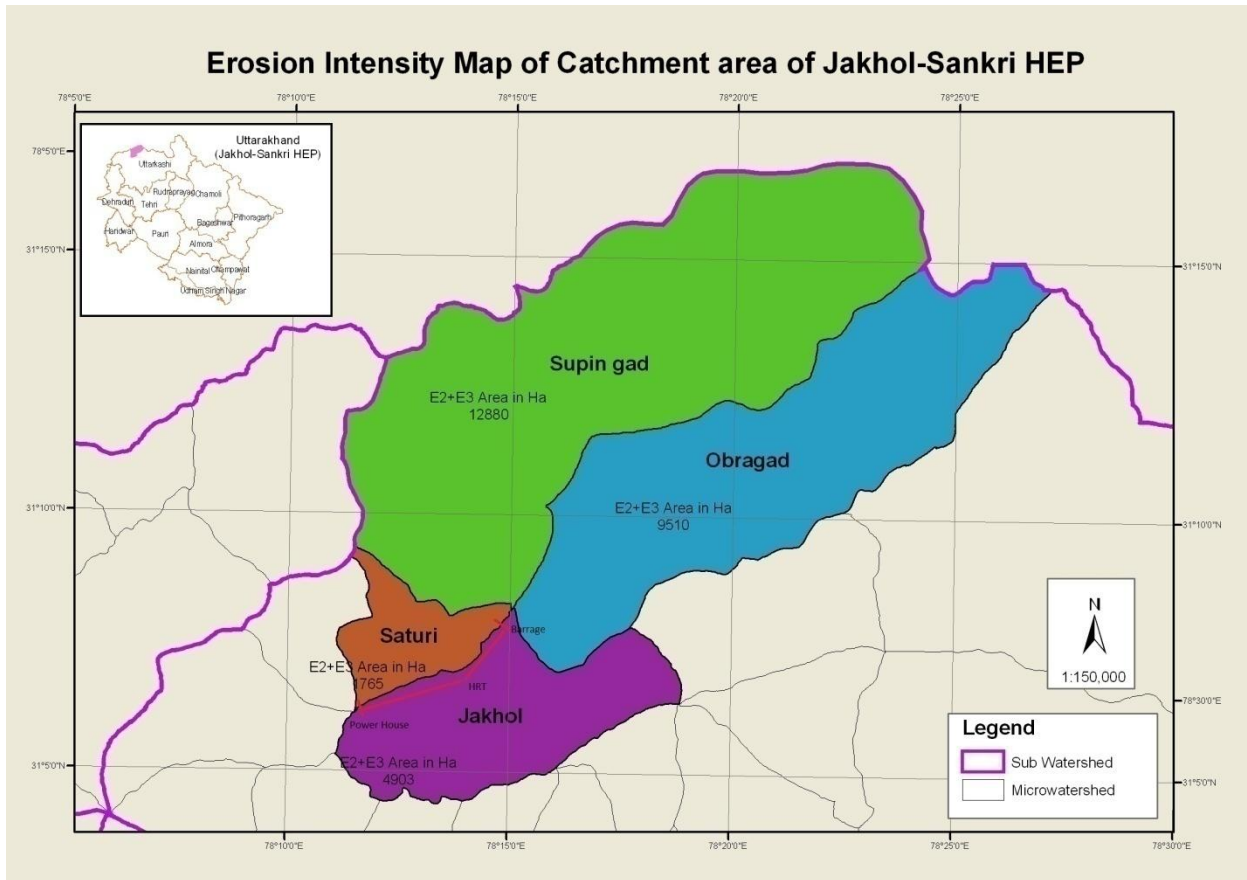


Fig 3.1 Erosion Intensity Map of Catchment Area of Jakhol Sankri HEP

CAT Plan of Jakhol Sankri HEP

ii- Slope wise – The project area may be classified as per gradient into the following broad classification. The areas having less than 40% gradient are generally suitable for treatment. Based on this parameter the whole area falling under category less than (<) 33% gradient and 25% of the area falling under 33-50 % slope category have been taken for treatment.

Table: 3.3- Slope-wise details of Catchment Area and Treatable Area of Supin – Tons Sub Water Shed.

W.S.	Name of S.W.S .	Name of M.W.S.	Cultivation					Within Reserved Forests					Other Than Reserved Forests					Total Forest
			< 33 %	33- 50%	50 to 100%	> 100 %	Total	<33 %	33- 50%	50to 100%	> 100 %	Total	< 33%	33- 50%	50to 100 %	> 100 %	Tot al	
1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tons	Supin Tons	Saturi	0	181	37	0	218	0	0	450	75	525	0	0	0	0	0	525
	Supin Tons	Supingad	0	450	608	0	1058	0	450	2438	75	2963	0	12	25	0	37	3000
	Supin Tons	Obragad	0	25	104	0	129	50	87	3371	0	3508	0	0	0	0	0	3508
	Supin Tons	Jakhol	0	355	250	0	605	0	714	2635	31	3380	0	0	0	0	0	3380
			00	1011	999	00	2010	50	1251	8894	181	10376	0	12	25	0	37	10413
Treatable area(Gradient <33%+1/4 of the area having gradient 33 – 50%)			00	253	00	00	253	50	313	00	00	363	00	3	00	00	03	366

(+)

CAT Plan of Jakhol Sankri HEP

Blank Within Reserved Forests					Blank Outside Reserved Forest					Total blank	River	snow	Rocky	Grand Total
< 33%	33-50%	50 - 100%	> 100%	Total	< 33%	33-50%	50 - 100%	> 100%	Total					
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
0	178	295	106	579	0	111	207	125	443	1022	0	0	0	1765
0	2232	5220	494	7946	0	100	187	0	287	8233	0	1218	0	13509
150	394	4874	717	6135	0	0	0	0	0	6135	0	738	0	10510
0	125	281	106	512	0	31	375	0	406	918	0	0	0	4903
150	2929	10670	1423	15172	0	242	769	125	1136	16308	0	1956	0	30687
150	732	00	00	882	00	61	00	00	61	943	00	00	00	1562

Source: Watershed Directorate, Uttarakhand

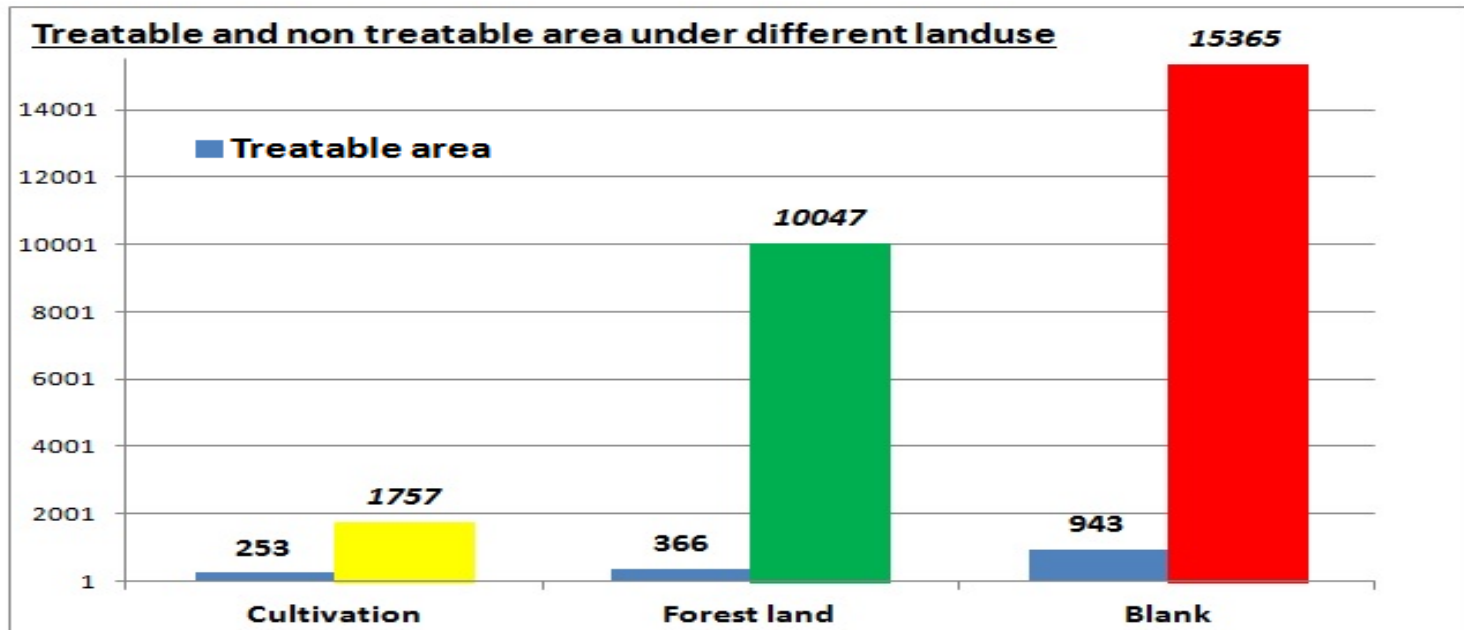


Fig: 3.2 Treatable and Non treatable area

Treatable area = 1562 ha.

Non treatable area = 27169 ha.

Area up to 50% gradient= 5851 Ha.

Area above 50% gradient= 22880 Ha.

Total area (except river, snow & rocky) =28731Ha.

Total area = 30687 ha.

As per the above data about 80.35% of the project area has a slope of more than 50 % which reflects towards the ruggedness of the area

Table: 3.4- Micro Water Shed-Wise detail of Treatable Area.

Class	M.W.S															Grand Total
	Agriculture					Forest					Blank					
	Saturi	Supin Gad	Obra Gad	Jakhol	Total	Saturi	Supin Gad	Obra Gad	Jakhol	Total	Saturi	Supin Gad	Obra Gad	Jakhol	Total	
Erodability	218	1058	129	605	2010	525	2332	3508	3380	9745	1022	8233	5873	918	16046	27801
Slope	45	113	6	89	253	00	116	72	178	366	72	583	249	39	943	1562
Slop wise Treatable Area	45	113	6	89	253	00	116	72	178	366	72	583	249	39	943	1562
Suitable forest area for Plantation						10	158	30	35	233						

Treatable Area: The slope-wise area has been considered as treatable area. All the forestry related activities in the CAT Plan are proposed in this area.

3.8 The Proposals: 3.8.1 Forestry

A total of 10413 ha. forest area is available in the Catchment area for treatment. As per the above table gradient wise 572 ha. of forest area are suitable for plantations and forestry activities. But considering other factors like crown density and soil depth of area out of 572 hac. Only **235 ha. area are proposed for afforestation work.**

Expenditure proposed Rs 112.20 lakhs.

This is a tentative proposal and final proposal will be possible after carrying out micro-planning of the villages in the area.

The following plantation models, which will be site specific, under forestry activities have been proposed:

3.8.1.1 Normal Plantation (Plantation of Fuel species):

Critically degraded areas will be taken up for Normal plantation. In this model 1000 plants per hectare will be planted in pits of size 0.30 X 0.30 X 0.45 m³ at spacing of 3m X 3m. In addition, tufts of fodder grasses like, Napier and Guinnae, will also be planted along contour trenches, of cross section of 0.30 m X 0.30 m.

Locally indigenous plant species such as Devdar (*Cedrus devdara*), Moru (*Quercus floribunda*), Kharsu (*Quercus semicarpifolia*), Utis (*Alnus nepalensis*), Banj (*Quercus leucotrichophora*) etc. will be planted.

Most of lands under treatable areas are of poor soil depth. Usually they are not suitable for normal plantation work. Very few lands among them, mostly existing in Reserve Forests, are of sufficient soil depth and suitable slopes where the result of plantations works may be achieved successfully.

A total of 30 hectares area has been proposed under this model.

3.8.1.2 Assisted Natural Regeneration Work :

It is observed that existing natural forests within the project area have a big biotic pressure. Villagers intensively lop oak leaves for their cattle's green fodder which caused a severe degradation of oak forests. Many of them are at the verge of extinction hence a serious and immediate step should be taken to restore these vanishing oak forests.

ANR is the only treatment which can re-establish these utmost finished oak forests. Under this activity degraded oak forests will be fenced with stone coolie wall. Grazing within fenced area and lopping of oak leaves will be strictly closed for five years. Singling, pruning and other silvicultural operations will be carried out. 400 number of oak (Banj, Moru and Kharsu) seedlings will be planted in blank gaps and oak seeds will be dribbled in contour trenches. Intensive fire protection measures will be adopted in fenced areas.

A total of 50 hectares area has been proposed under this model.

3.8.1.3 Pasture Development:

Area adjoining to habitations mostly come under civil and soyam forests and they have very poor soil depth. Physically they are steep sloppy covered with fodder grasses. These grass lands play very important role in the economy of local residents as they are the main resource of fodder to their livestock. Due to its poor soil depths success possibility of normal plantation seems very least. Basically they are suitable for Pasture development works where only 500 plants of fodder species plants along with high nutritious fodder grasses have to be planted. These pasture lands will ensure easy availability of fodder in the villages and simultaneously soil erosion of catchment areas will get reduced. The species proposed are Kharik (*Celtis tetrandra*), Moru (*Quercus floribunda*) and Banj (*Quercus leucotrichophora*) etc.

For pasture development activity 500 plants per ha. of fodder spp. will be planted along with fodder grasses in contour trenches of cross section of 0.30 m X 0.30 m.

A total of 55 hectares area has been proposed under this model.

3.8.1.4 Ringal Plantation:

Ringal is a very useful species for domestic needs and for local handicraft workers to earn their livelihood. In the project area the Ringal species will be planted in Reserve forest lands. Under this model 500 plants will be planted at 5 m X 4 m spacing.

A total of 50 hectares area has been proposed under this model.

On the basis of scheduled rate of Yamuna circle (2013-14) Plantation model wise proposed expenditure

Normal Plantation	30 ha @ .665/- = 19.95 lac
A.N.R. Plantation	50 ha @ .600/- = 30.00 lac
Pasture Development	55 ha @ .600/- = 33.00 lac
Ringal Plantation	50 ha @ .585/- = 29.25 lac
Total Plantation	185 ha 112.20 lac

Table 3.5 List of Proposed Plantation areas in various micro watershed areas

Sl. No.	Micro watershed	Suitable civil area	Area in hac.	Suitable RF area	Area in hac.
1	Supin Gad	Sanwni civil	10.00 (C.A.)	Kansla- 1	12.00 (P.D.)
		Dabra tok Fetari civil	8.00 (C.A.)	Kansla-3	12.00 (P.D.)
		Suncha tok Sunkundi civil	5.00 (C.A.)		24.00 (P.D.)
		Patidhar tok Panw upla civil	10.00 (C.A.)	Lewari-13	11.00 (P.D.)
			33.00 (C.A.)		11.00 (P.D.)

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		Sanwni civil	6.00 (N.P.)	Sanwni-3	10.00 (R.P.)
		Sunkundi civil	8.00 (N.P.)	Unani-1	10.00 (R.P.)
					20.00 (R.P.)
		Panw talla civil	6.00 (N.P.)		
			20.00 (N.P.)	Kansla-2 Chhamar booti tok	10.00 (ANR)
				Kansla-2 , Ganmuni Thach tok	20.00 (ANR)
		-	-	Lewari-15a	20.00 (ANR)
		-			50.00 (ANR)
		-			
		-	-		
2	Obra Gad	-	-	Obra gad-17	10.00 (R.P.)
		-	-	Obra gad-18	10.00 (R.P.)
		-	-	Tatka 2	10.00 (R.P.)
		-	-		30.00 (R.P.)
3	Santuri	Santuri civil	10.00 (C.A.)		-
			10.00 (C.A.)		
4	Jakhol	Dhara civil (C.A.)	5.00 (C.A.)	Jakhol-7	5.00 (N.P.)
			5.00 (C.A.)	Jakhol-2,3	5.00 (N.P.)
					10.00 (N.P.)
				Sural-2	15.00 (P.D.)
				Unani- 2	5.00 (P.D.)
					20.00 (P.D.)

Abstract- N.P. - Normal plantation = 30.00 hac., ANR - Assisted Natural Regeneration = 50.00 hac., C.A. - Compensatory aforestatio = 48.00 hac., R.P. - Ringal plantation =50.00 hac. and P.D. - Pasture development 55.00 hac.

Note- list of areas selected for various types of aforestation is tentative which may change at the time of DPR preparation. Compensatory Aforestation is not a part of CAT Plan.

3.8.1.6 Establishment Of Mahila Nursery

To involve local villagers, specially women, there is a proposal to establish a women nurseries with buy back guarantee. Such nurseries will be managed by local mahila SHG (Self Help Group). The financial support will be extended through CAT Plan and the groups will be properly trained. The

technical knowledge and support will also be provided by local forest officers and horticulture experts.

3.8.2 Drainage Line Treatment works (Soil & Moisture Conservation works)

The project area includes 10413 hac. of forests, 18264 ha. blank & snow cover and 2010 ha. of agriculture land & habitation. Also as per the detail given in para 2.9 (Drainage Pattern) a total of 497 streams, involving a total length of 759 Km have been reported in the catchment area of the proposed Project, of these 484 stream are of first or second order which are spread over a length of 666 Km. in the Catchment area. Technically these are the nalas/Streams where soil conservation measures are strongly needed. In Supin and Obragad micro catchment areas due to severe river scouring heavy landslides have been taken place along the third and fourth grade khudds, gads and rivers. Lewari and kasla villages are under the great threat of losing its existence. In addition soil erosion has also been observed in the villages where agriculture land has been affected. Keeping this in view soil and moisture conservation activities have been proposed for the treatment of areas prone to erosion. The soil conservation activities will start from top to bottom.

On the merit of vulnerability, priority will be given for treatment of following 25 rivers,nalas,and streams.

Fluctuating from indicative guideline, instead of rupees 68.00 lac a total of 105.40 lac rupees has been proposed under this model. Unit cost will be based on PWD scheduled of rate.

Table: 3.6 List of Micro watershed wise rivers and streams proposed for treatment.

Sl. No.	Supin micro watershed	Obragad micro watershed	Jakhol micro watershed	Saturi micro watershed
1	Unani khud-5.0 km	Chakrai khudd- 4.0 km	Kelasyari khudd- 1.5 km	Sastari khudd- 1.5 km
2	Karba khudd-1.0 km	Vishthatar khud-1.0 km	Chholga khudd- 2.0 km	Sagai khudd- 2.0 km
3	Kotodi khudd- 1.5 km	Karhi thatar khudd- 1.5 km		
4	Sanwni khudd- 2.0 km	Eikarha khudd- 3.0 km		
5	Paja khudd- 1.0 km			
6	Bosni khudd- 1.0 km			
7	Rala khudd- 2.5 km			
8	Sural khud- 3.0 km			
9	Pustari khudd- 2.0 km			
10	Lewari khudd- 1.0 km			

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11	Dacha khud- 1.50 km			
12	Kamti gad- 3.0 km			
13	Tekuna khudd- 2.0			
14	Gairi gad- 2.0 km			
15	Kanora khudd- 1.0 km			
16	Bhatuka khudd- 2.5 km			
17	Kakai khud- 0.5 km			
	17 no. = 32.50 km.	4 no. = 9.50 km	2 no. = 3.50 km.	2 no. = 3.50 km
	Total - 25 no. = 49.00 km.			

Note- List may be changed at the time of DPR preparation time.

The following soil and moisture conservation measures have been proposed under soil conservation component—

Structures proposed :

- Brush Wood Check
- R.R. Dry structures :-Gully plugs, Check Dams and protection walls
- Gabion Structures:-Crate Wire Check dams, Spurs, Protection walls, Gully plugs etc.
- Retaining Wall/ Breast/Side Wall

i) Treatment of Gullies –

(a) Brush Wood Check Dams -

Gullies having depth ranging between 1.2m to 2.1 meters, brush wood check dams will be made by making 2 rows of shrubs and posts. In this method four sufficiently long wooden posts are fixed vertically on the ground across the direction of the gully. These posts are inserted 60 cm inside the earth. The brush wood is thereafter spread on the surface of the gully in such a way that the stumps of the bushes are in opposite direction of the flow of water. The brush woods are tied together and are also tied with the wooden posts. The posts should be made of those species which are good coppices. Brush wood check dams with two rows can also be used for the gullies which have depth of 2.1 meters to 3 meters and width of nearly 6 meters (figure 3.3).

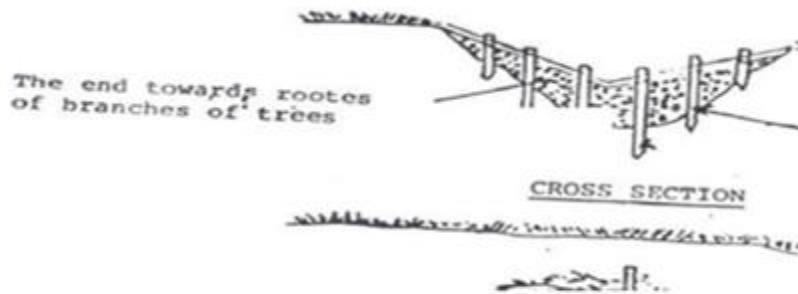


Fig: 3.3

(b) Dry Check Dams -

Where adequate stones and boulders are present dry check dams are made across the gullies. These are made nearly 0.73 meter deep and 1.25 meters wide (figure 3.4).

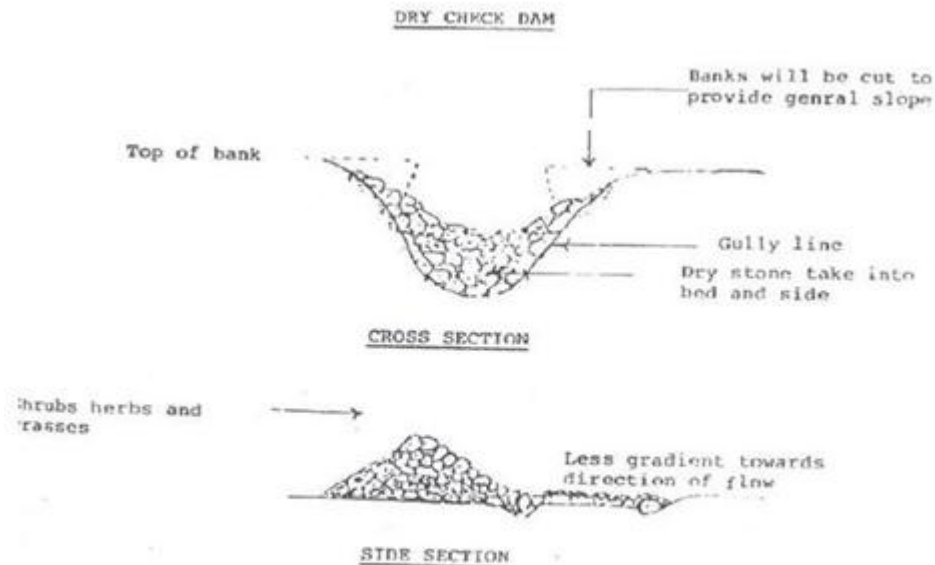


Fig: 3.4

(c) Gully Plugs :-

The primary and secondary streams constitute the upper reaches of project area. Initially these streams generate soil erosions and when they meet in third grade nalas, collectively they form a heavy flood causing severe destructions through plenty number of landslides. For a successful treatment of catchment areas, first of all these primary and secondary streams should be treated with intensive construction of gully plugs and applicable vegetative and other measures.

(d) Gabion Structures/Crate Wire Check Dams –

Gabion structures have multifarious application in erosion control works. Generally these are used for reducing slopes of river and nalas and also for various other purposes as mentioned 'in other paragraphs of this chapter. Gabion boxes are made of galvanised iron wire preferably with No-8 gauge but not less than 10 gauges. Hexagonal or square triple twisted mesh varying in size between 7.5 cm to 15 cm is commonly used. The wire mesh may be made by labourers after short training. One gabion structure is known as gabion unit and bigger structures are made of these gabion units. For construction of these structures in the field first wire mesh is prepared and thereafter boulders are filled in the box by hand placement. Rectangular large stones should be preferred if available locally. In case of stones of various sizes being available the larger one should be placed on sides and smaller ones are used for filling in the centers.

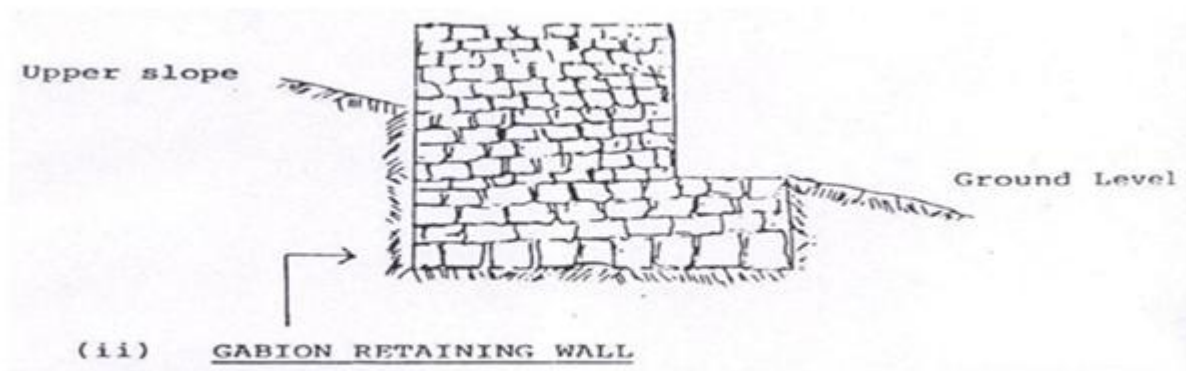


Fig: 3.5

(ii) Stabilization of Land Slips/Slides

Landslides are common phenomenon in hilly areas and these are basically because of the effect of changes in the earth crust and also because of the effect of weather on the earth surface. When landslide/landslip takes place a lot of vegetation or public property is destroyed. Landslide areas require treatment for their rehabilitation and to check accelerated soil erosion in the area. Small and new forming land slide areas will be taken for treatment under this project.

Following are the main methods used for stabilization of land slide affected areas:

- Retaining/ Breast/Side Wall
- Mulching And Wattling
- Crib Structure

(a) Retaining Wall/ Breast/Side Wall

Retaining wall is constructed for protecting land and soil on steep slopes. This is made of either dry masonry work or cement masonry work. The wire mesh or gabion blocks are also used depending on the intensity of erosion. The ratio of width and depth of the foundation should be kept as such that it can withstand the weight/pressure of the retaining wall. The breadth of the retaining wall should be $\frac{2}{3}$ rd of the height of the retaining wall. The width of the retaining wall should decrease gradually when ascending towards upper end and it should be nearly one meter on the top. Normally width of the base is kept in the multiple of meter so that one meter size gabion blocks can be used for this purpose. The reduction in the width of the retaining wall is such that $\frac{1}{3}$ part of measurement of gabion block is reduced (figure 3.4).

- (i) Use of concrete in construction of retaining wall-In every 60 cm of retaining/ breast wall concrete lintel is given and rest of the height is covered by dry masonry work. After every 2 meter gap 100 sq.cm. size weep holes are made Stones are filled between the horizontal wall and the sloping wall.
- (ii) 'T' wall is made with cement concrete at the base of the retaining wall. It should be 60 cm. deep and should be in appropriate ratio of the height. A suitable apron should also be made.

3.8.2.1 Vegetative Support –

To reinforce the protective function of the above soil conservation structures the proposed works will necessarily be strengthened by suitable vegetative measures. The treated areas will be supplemented with the plantation of soil binding shrub and grass species; such as Napier grass (*Pennisetum purpureum*), Ram bans (*Agave cantala*) etc.

3.8.2.2 Repairing of Terraces- The terrain in the catchment area is not suited for good agriculture yield. Maximum agriculture lands are found sloppy and un-terraced where soil erosion is very common feature during rainy season. Potatoes and Razma is the main crop of catchment areas which are soil erosion enhancing in nature. Hence an extensive measure of leveling and terrace repairing of agriculture lands is strongly recommended to stop soil erosion and improve fertility of agriculture fields.

3.8.3 Agriculture-

A total of 2010 ha. agriculture land is available in the project area. The most of agriculture is rain fed. The farmers still stick to conventional agricultural practices.

Use of local seed is common. All these factors lead to low yield per ha. which is only sufficient for 3-4 months, and to full fill their other day to day requirement the villagers migrate to nearby towns and cities.

Keeping all these facts in to consideration the following measures have been proposed under agriculture component.

Expenditure proposed Rs 13.60 lakhs.

1- Field Demonstration and promotion of productive agri-systems-The main agriculture crops-Razma and Potato will be exhibited on the field, so that the farmers may be motivated and encouraged for use of improved variety seeds and farming techniques.

2- Promotion of use of Bio-fertilizer and wormy compost- The use of chemical fertilizers brings many hazards to public health and organic/bio-fertilizers are safer from this viewpoint, simultaneously the productivity is also maintained. Vermi-compost is a preferred nutrient source for organic farming. It is eco-friendly, non-toxic, consumes low energy input for composting and is a recycled biological product, so the Bio/Vermi-compost will be advertised for larger use.

3- Promotion of use of improved Agriculture implements- The conventional implements take a lot of time and are expensive in energy consumption and also results in low productivity, so the use of improved agriculture implements will be encouraged to save the time & energy and increase the productivity.

- Field Demonstration and promotion of productive agro-systems
- Repairing of Terraces
- Promotion of use of Bio/wormy Compost · Promotion of use of improved Agriculture implements.

3.8.4 Horticulture-

The catchment area is rich apple producing area. And also spaces available in the back yard of the houses, where vegetables can be grown to fulfill day to day requirement of the villagers.

Keeping this in mind following activities under Horticulture component have been proposed -

1. Distribution of Fruit Plants.
2. Distribution of Vegetable mini-kits
3. Encourage to cultivation of medicinal and aromatic plants
4. Strengthening of storage capacity building for grading, packaging techniques etc.
5. Encourage to use of organic manures, Quality seed & planting material
6. Encourage to development of Apple and Almond orchards.
7. Encourage to maintenance of new orchards.

Expenditure proposed Rs 20.40 lacs.

3.8.5 Animal Husbandry :

After agriculture Animal Husbandry is the second important occupation and source of income for the villagers. The animals are of local breed and milk production per cattle is very nominal. The number of cattle, specially goats and sheep, per house hold is quite large. These animals are left free to graze in the forest. To improve and develop management of livestock in the village following activities have been proposed under Animal Husbandry component –

- Vaccination- for health improvement
- Chari construction / Naad (troughs)-for better stall feeding
- Encourage to grow of fodder seeds - for better nutrition
- Any other activities identified during DPR preparation.

Expenditure proposed Rs 13.60 lakhs.

3.8.6 Energy Conservation:

The population is largely dependent on forest and forest produce e.g. food, fodder & fuel for their livelihood which ultimately result into deterioration and degradation of forest wealth. So the measures have to be taken in to account which can help reduce the demand of such necessities by providing them other alternatives suggested as under:

- i) Encouraging use of Solar lights
- ii) Bio bricketing- for income generating.
- iii) Encouraging use of solar cookers
- iv) Promoting the use of modified and least fuel consuming chulhas.

Expenditure proposed Rs 13.60 lakhs.

3.8.7 Water Harvesting & Conservation

Most of the agriculture in the area is rain-fed some of which can be put under irrigation if natural water resources are properly utilized. Keeping this in mind following Minor Irrigation structures have been proposed under this component.

- i) Water harvesting tank
- ii) Repair of naula & Chal-Khal
- iii) Construction/ repairing of gool and irrigation channels.

Expenditure proposed Rs 40.80 lakhs.

3.8.8 Training for Income Generating Activities (IGA)

As the opportunities of various income generating activities are very bleak, so the inhabitant of the project area faces the mounting problem of un-employment and this is also an inducing factor for the migration of youths. Keeping this factor in view a large number of employment generating activities will have to be developed to make the villagers self sufficient. The training for skill up gradation and other income oriented activities have been taken care of in this plan. Following activities are being included this purpose:

1- Capacity Building

Training & Exposure Visit of EDC, Villagers and staff

2- Process Building Workshop and Catchment Awareness Programmes

- a. Small level sheep & goat farming
- b. Apiary
- c. Cottage Industries
- d. NTFP Collection
- e. Training & Support for local Artisans, Black smith, Carpenter (Wooden items) and support for handicraft Centers
- f. Training & Support of small IGA Activities
- g. Exhibition of minimizing technique of women's work load.

Expenditure proposed Rs. 68.00 lakhs

3.8.9 Other Interventions

As has been said in the beginning, multi-sartorial approach has been the central theme in planning and execution of CAT Plan proposals. As illustrated above, forestry, SMC, livelihood support and

capacity building/skill up gradation of the stake holders have been the focus activities. Still few other important areas have been identified which will have major role to play in achieving CAT plan objectives. Appropriate fund provisions have been made for these interventions and accordingly activity specific necessary details will be placed in the detailed project report. Such areas are under:

- Facilitation for convergence regarding Social Security schemes (this will be funded by corpus Fund)
- Value Addition & Marketing
- Minor Repairing of community Assets- Panchayat bhavan/community centre -Foot/bridle Path, Village community ponds etc. **Expenditure proposed Rs. 37.40 lakhs**

3.9 Infrastructure and Communication –

To carry out the plan smoothly and successfully, the strengthening of essential infrastructure and communication such as setting up building like field huts/stores, maintenance of old staff quarters/minor civil works and outsourcing of vehicles is an urgent need. The modern technology can be used as a good tool for arriving at better results and healthy operation of the management units. To improve the effectiveness, incentives to personnel and structured Monitoring & Evaluation process will make the plan objectives meaningful and its results more useful. To meet the purpose the expenditure has been provided which is shown in annexures-4, 5 & 6.

3.10 Micro-planning

The detailed project report (DPR) for the treatment of the area will be prepared after preparing micro-plans , using PRA as a tool, for all 12 Forest villages falling in the catchment area of the proposed Jakhhol Sankri HEP.

Expenditure proposed Rs. 6.80 lakh.

3.11 Corpus Fund

As the community participation is an essential part of the planning and execution of the activities proposed, the community will have a vital role in carrying out the works proposed in their respective village, hence; a corpus fund will be generated by the mutual contribution of the stakeholders. As most of the activities are in participatory mode, so these funds can be generated/ contributed in lieu of their physical labour. The “reciprocal obligation” percentage will be flexible and it will be based

on consensus decision of the community.

The Fund so generated, will be utilized for community social support and for the benefit and betterment of Vulnerable Groups e.g. poor, marginalised and disabled people.

Expenditure proposed Rs. 6.80 lakh.

3.12 Executing Agency:

The treatment plan targets both the reserve forest and civil and private land in the villages . While mostly Plantation and soil conservation activities will be carried out in forest land the other activities targeting village development like Agriculture, Horticulture , Animal Husbandry etc will be implemented in villages involving villagers. While the Govind Wild Life sanctuary & National Park, Purola will be the executive agency in the forest areas the Gram Panchayats, through respective Ecological Development Committee (EDC), will implement activities in the villages.

To ensure involvement of villagers in the implementation of the activities formation of local institutions like Self Help Groups (SHGs)/Users groups will be encouraged.

3.13 Dove-Tailing:-

In the respective divisions, other forestry and allied programmes of similar nature with the same mandate are being carried out. The funds available in such schemes may be well utilized for the activities in this plan. The probable schemes which can be dove-tailed to this cat plan are summarized as below:

1. The development scheme of the RF & civil soyam forest.
2. 13th finance commission scheme
3. CAMPA
4. Uttarakhand Bamboo & Fibre Development Board aided scheme

CHAPTER -4**Wildlife Management Plan**

Background: The catchment and eco sensitive impact area of the Jakhol Sankri Hydroelectric Project is mainly located in Protected Areas of Govind Wild Life Sanctuary & National Park. The area is richly endowed with a variety of flora and fauna, many of which are highly endangered e.g. Snow Leopard, Brown Bear, Musk Deer, Serow, Bharal, Himalayan Tahr and Black Bear. The area also houses a variety of high risk pheasants like Tragopans and Snow cocks.

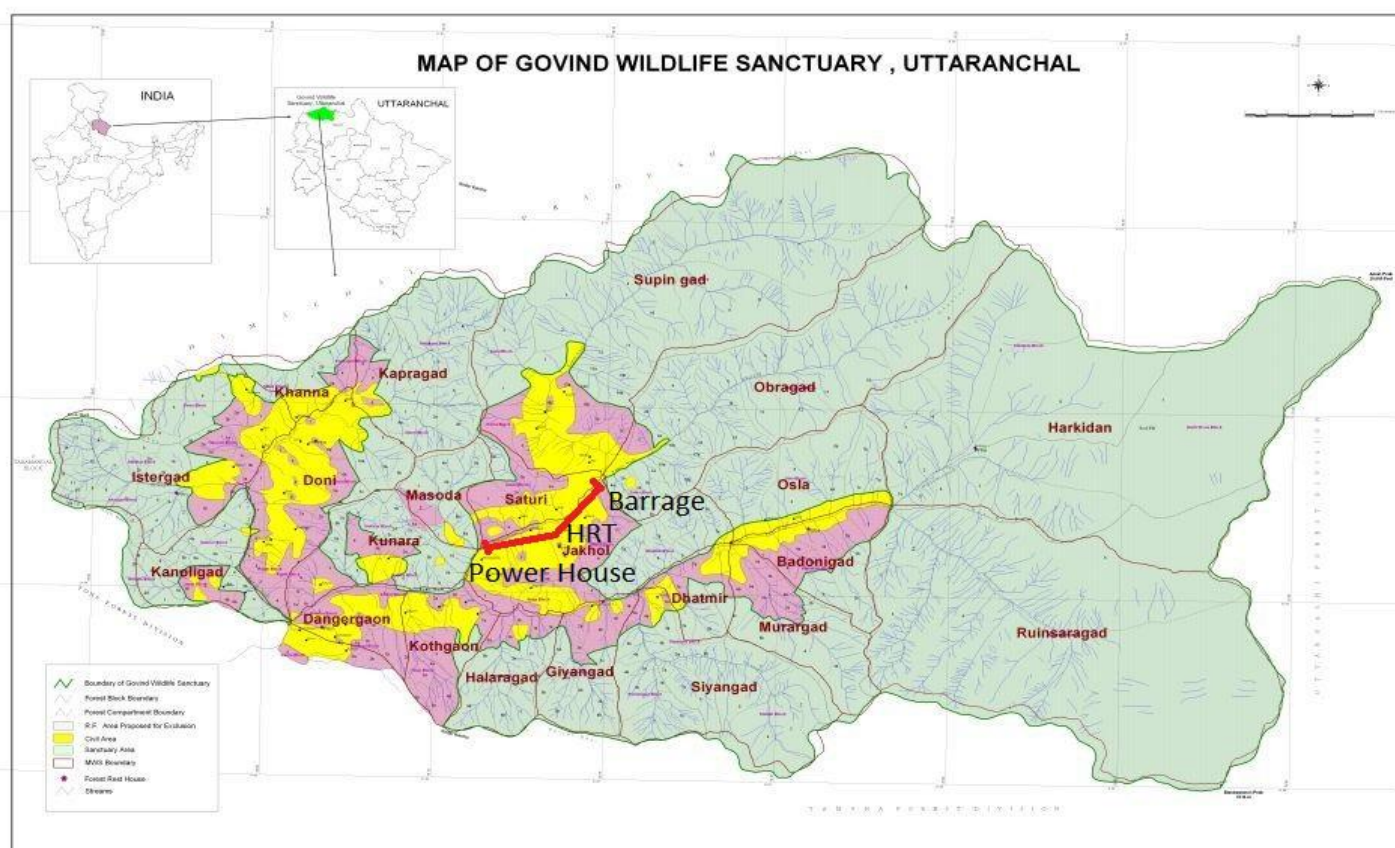


Fig 4.1 Map of Govind Wild Life Sanctuary

Components of Wildlife Management Plan

1. Capacity building of the forest staff and local population for wildlife Protection.

2. Protection of floral and faunal resource,
3. Habitat improvement works
4. Management of man animal conflict
5. Research and monitoring works
6. Protection support to the field level staff

4.1 Capacity building of the forest staff for protection and surveillance

The forest department staff of Govind Wilde Life Sanctuary and National Park will be trained on wild life management and related issues at Wildlife Institute of India and at Corbett Wildlife Training Centre Kalagarh and through in-house trainings. Trainings will comprise of **Concrete Training on Forest Laws for the Forest Staff and Arms training.**

4.2 Protection of floral and faunal resource esp. conservation of threatened flora and fauna

The threat of poachers always lurks at large in this area especially for the high value musk, snow leopards pelt and gall bladder of Himalayan Black Bear. Illegal Storage of herbs is another concern. Total preservation of the existing floral and as well as faunal diversity is the primary aim of the protection activity. A cattle lifting is a common practice in hills by common leopards. Once this is done by an animal by accident or due to some other reason like falling health conditions, the protection of these delinquent animals becomes a problem. Steps will have to be taken to protect the life of these delinquent animals.

Fire protection is also a basic aim of protection activity. Since winter fire is a special feature in the high altitude areas of the Park, providing special provisions in this aspect.

The threatened plant resources suffers from two types of threats viz. over exploitation, illicit Storage and natural process of extinction, whose number has drastically gone down in the wild. Conservation of these threatened natural resources specially the medicinal herbs requires special attention and care. Efforts are also needed for highlighting the biodiversity of the protected areas in the context of human existence. The following actions will be taken to achieve the above mentioned aims:

1. **Patrolling-** Based on the assessment of the strength and the workload of the staff, additional staff will be deployed for watch and ward, Long range and short range patrolling for surveillance and detection of wild life crimes will be done. Every year four long range patrolling will be carried out. A roster of these patrolling will be made in advance.
2. Infrastructure and basic amenities for the field staff to enable them to do effective patrolling in the high altitude will be provided. Anti poaching camps will be established at sensitive locations at natural odors etc.
3. In order to provide quick rescue operation to delinquent wild animal's veterinary kit and additional medical facilities will be purchased. In the patrolling teams, local youths, EDC members ex-servicemen will also be associated. This will not only give local employment but also develop a feeling of involvement for owning the responsibility among the local people.
4. Regular meetings with the police and revenue officials for exchange of views and sensitization will be held once in a month.
5. A secret method of surveillance and intelligence will be developed involving all stakeholders and a secret fund will be kept to run this intelligence network.
6. A special provision is made to keep an eye on snake charmer, madaris and other unwanted elements. Strategic location will be identified. Base line information will be collected and action will be taken.

4.3 Management of man - animal conflict

The case of human & wildlife conflicts is a regular feature in the Jakhol Sankari Hydro Electric Project Catchment and Impact Area. Despite all possible efforts the cases of cattle lifting by leopard take place. Govind Wild Life Sanctuary and National Park receives little funds for paying compensation to the victims. Presently these compensations are however provided for only cattle lifting or loss of human injury by wild animals. Due to good protection, a number of wild boars and Himalayan black bear have increased many fold and they also some time raid the agricultural fields.

In order to have people's co-operation, their grievances in this regard should be mitigated and hence sufficient compensation has to be provided to them in case of not only cattle killed by carnivore and in cases of human life loss/injury but also for the damage of property caused by bears and boars in the villages of the Catchment Impact area.

Following provisions will be made under this component:

1. The locations which have a tendency of man animal conflict will be identified and listed. This exercise will be carried out beat and block wise.
2. The identification of sites will be done in a regional context and transitional areas will also be taken care of.
3. The animals of each such identified locations will be monitored and a study will be done about the frequency/likelihood of man animal conflict in these areas and it will also be studied which animal species activity conflict the human being living in that particular area and why. Based on these findings a safety plan will be prepared.
4. People will be educated about the traditional and institutional mechanism of reduction of conflict. Documentation of such practices will also be done.
5. Provision of driving away the malignant animal's viz. crackers, Gandhi Guns will be provided to the villagers.
6. All the cases with case history will be documented at the Range and Division level.
7. Measures will be taken to prevent the domesticated animals from becoming feral.
8. For quick trapping of delinquent animals light weight and dismantlable trapping cage will be bought and they will be maintained in good conditions to meet any exigency.

4.4 Research, Documentation and Extension

The results of research and surveys provide baseline information that help in assessing the effectiveness of management programs and making management decisions. Flora, fauna and habitat's need to be monitored over the long term for a complete understanding of the factors influencing the abundance and distribution of biodiversity. Flora and fauna monitoring in the area will provide useful information for regional conservation programs that would support local people's livelihood. Apart from this various subjects for site specific research on wildlife/ biodiversity and impacts of HEP on it, shall be decided while micro planning.

A well formulated monitoring exercise will be carried out and field level staff will be trained to monitor the migration pattern of wildlife and tracking their special niche in different seasons of the year and encouraged to carry out need based research regarding habitat use, migration pattern of animal

4.5 Habitat Improvement works

Habitat improvement is an integral part of wildlife management. Habitat improvement consists of bringing into useful association of those conditions needed by a species to reproduce and survive. Even creation of small openings is of great value and importance. Such openings are essential for herbaceous cover and insect production on which ground living animals like pheasants predominantly feed during the first few weeks after birth. Control of cover is also important. Any habitat change due to change in vegetation can affect most species, increasing the carrying capacity for some, decreasing it for others. Providing water to the water deficient places in the region in shape of water holes and water harvesting earthen dams will also be given emphasis. The following works will be done in habitat improvement works:

1. Management of unwanted plants/weeds from the habitat. (grassland/bugyal)
2. Creation of openings so as to increase the edge effect and eco tones.
3. For lowering concentration of wild animals at a point, one or more water and food pockets will be developed.
4. Better cover and refuge points will be provided in those areas where it is lacking.
5. Advance growth of unwanted/ exotic species from the open spaces which competes with the natural flora of the area will be controlled.

Another focus in this component would be maintaining the biodiversity of endangered plants in the project area because most of these plants are of medicinal value to the wild animals and they are important for maintaining the ecological balance of the area.

4.6 Biodiversity conservation support to the village communities

The Jakhol Sankari Hydro Electric Project Catchment and Impact area has many villages with a sizable population. Education and awareness generation for garnering public support for biodiversity conservation is the need of the day. Community education and involvement is a crucial component of a biodiversity conservation strategy because the condition of the environment is reflected by the manner in which the communities treat and manage the natural resource. General perception of the local people about endangered species and their importance in the eco-systems is poor. Education camps and special trainings for the local N.G.Os, Yuvak Mangal Dal, and Mahila Mangal Dal members will have to be provided. In addition capacity of the local staff will also be developed to organize grass root training camps on their own.

CAT Plan of Jakhol Sankri HEP

1. Biodiversity education and community awareness will therefore be strengthened in a variety of ways to reach people from all sections. Awareness, raising and education can take place through such means as the mass media, distribution of extension material, films or interactive education programmes in rural schools .
2. Activities like opening of biodiversity register in every village and promotion of traditional farming system, organic farming, organic seed certification will form the important activities under this component.
3. The hazardous effect of fire will be widely advertised through press, signboards & public meetings in the villages.

Expenditure Proposed under Wild Life Management - 20.40 Lakhs

CHAPTER –5

PROJECT MANAGEMENT UNIT AND STAFFING

5.1 Formation of Project Implementation Unit and Staffing

The Jakhol Sankari Hydroelectric Project Catchment and Impact Area Treatment plan is an elaborate catchment and impact area treatment plan with multifarious integrated works in which community may play a major role in planning and implementation of the Project. The Project would be implemented in the Govind Wild Life Sanctuary & National Park in seven years period. A total of 12 villages will be covered through participation of local communities with an exit strategy after the project implementation.

Supin Forest Range of Govind Wild Life Sanctuary & National Park will act as Project Management Unit (PMU). Effective implementation of these works need focused and expert attention needing both technical and social inputs. The PMU will recruit Project Coordinator, Agriculture/ Horticulture specialist, Livelihood/ specialist, Junior Project Coordinators, Village Motivators. For implementation of other component works, regular staff (Foresters, Forest guards, Accountant, Driver and Runner) shall be deputed. In case of non availability of regular staff on deputation in time, PMU may hire the staff from open market or on contract basis in the interest of timely execution of quality work.

The detail of requirement contractual staffs for implementation of CAT Plan on Multi disciplinary approach is as under.

Table 5.1 Project Management Unit and Staffing

i- Management Cost

Contractual Staff	Monthly emolument	Total No. of Staff	1st Year	2nd Year	3rd Year	4th Year	Sub Total
Project Coordinator	15000	1	1.8	1.89	1.98	2.08	7.76
Junior Project Coordinator	12000	1	1.44	1.51	1.59	1.67	6.21
Agriculture/Horticulture specialist	15000	1	1.8	1.89	1.98	2.08	7.76
Livelihood/ Livestock specialist	15000	1	1.8	1.89	1.98	2.08	7.76
Computer Operator	8000	1	0.96	1.01	1.06	1.11	4.14
Village Motivator	3000	12	0.36	0.38	0.40	0.42	1.55
Total		17	8.16	8.568	9.00	9.45	35.17

ii- Withdrawal Phase (Contractual Staff only)

Contractual Staff	Monthly emolument	Total No. of Staff	5th Year	6th Year	7th Year	Sub Total
Project Coordinator	15000	1	2.18	2.29	2.41	6.89
Junior Project Coordinator	12000	1	1.75	1.84	1.93	5.53
Agriculture/Horticulture specialist	15000	1	0	0	0	0.00
Livelihood/ Livestock specialist	15000	1	0	0	0	0.00
Computer Operator	8000	1	1.17	1.22	1.28	3.67
Village Motivator	3000	12	0.44	0.46	0.49	1.39
Total		17	5.54	5.82	6.11	17.48
Grand Total		(i + ii) = 35.17 + 17.48				52.65

Notes- i- The above PMU staff requirement is based on the schedule communicated by PCCF Uttarakhand vide office memorandum No. kha-174/13-2(2) dated 03-08-2011 and the financial calculations are based on the monthly emoluments fixed by CCF, Garhwal. An annual increase of 5% (3% fixed & 2% performance based) in the wage rate has been considered and working out the expenditure for plan period.

- ii- On the basis of scheduled communicated by PCCF Uttarakhand, the expenditure on PMU is calculated Rs.52.65 lacs, but as per the direction of guideline issued by the PCCF Uttarakhand, the provision of Rs. 27.20 lacs expenditure is kept in the financial outlay of CAT plan.

5.2 Project Management Unit (PMU)

The overall responsibility of implementing the project as envisaged in its objective will lie with the Deputy Director of, Govind Wild Life Sanctuary & National Park who will also head the Project Management Unit. One Assistant Conservator of Forests will closely supervise the project in all respects. He will act as the point of overall coordination of the staff from the field Project Implementation Units and specialists as above and will be directly responsible for field level planning and monitoring of implementation of work under forestry and soil conservation to be executed by the Forest Department and village based eco-restoration works.

All the technical and social staff of PMU will advise ACF and DFO/DD in taking technical and social decisions for project planning and implementation and will assist in project implementation wherever required by the Project Implementation Units as redirected by the DD.

It will be the responsibility of DD to coordinate with all the expert/line agencies to seek adequate support partnership for documentation and information dissemination for planning and execution of work with quality participation of the local communities into the project work.

The project will be closely monitored by CWLW, He will also coordinate with SJVNL and the government for regular fund flow and give expert on hand guidance to PMU for effective implementation of the plan.

5.3 Project implementation Units (PIU)

There will be one unit (Supin) in the whole project area for implementation of the Project. The Unit in-charge will not be below the rank of Range Officer. Each Forest Guard/Wild Life Guard will be made Village in-charge (VIC) of 2-3 villages and will also assist EDC for execution of work wherever work will be done through EDC. To give institutional and technical backing to the project work in the village, one Project Coordinator (PC) and one Junior Project Coordinators (JPC) will be deployed. Project Coordinator (PC) and Junior Project Coordinator (JPC) will closely work with EDC and will be directly responsible for planning and implementation of all the institution building and capacity building trainings, workshops, exposure visits of project staff and villagers and for monitoring the project process in the villages. PC & JPC will mainly nurture and train the village motivators. PC & JPC will make recommendation directly to the DD for execution of all the activities after consulting with ACF.

PC & JPC will be primarily responsible for planning, coordination and monitoring the execution of village based eco-restoration works and livelihood improvement works. PC & JPC will work in close coordination with other specialists and the concerned line agencies for appropriate field level planning and recommending social and technical inputs.

PC & JPC will make the joint recommendation in proposals, estimates and vouchers along with ACF for village based livelihood improvement works. Specialist of different components will plan and execute work through PMU.

PC & JPC will also monitor the institutional health of the EDC assess the adaptive challenges being faced by these institutions and give feedback to the DD.

CHAPTER -6

Project Management Information System

6.1 Project Information Management:

Management Information System (MIS) will be developed in this project for regular and close monitoring of the project in terms of quality and quantity at all levels against the objectives set in the project. Participatory project needs to evolve a mechanism at village level an accounting system will be developed at EDC level so that records will be maintained in an efficient way. Account trainings and review workshops will be organized at PMC level on regular basis to identify the capacity building needs and provide inputs with regards to the management of books and records. For the maintenance of accounts and records, assistance will be provided to EDC through local resource persons and certain amount will be given to them by EDC for this. A reporting mechanism will be developed in this project at every EDC level and at the end of the month, EDC will submit the expenditure details, works done and details of revolving fund to project management cell.

6.2 Documentation and publications

Participatory process evolves in its own experiences. The experiences are very much contextual based on the socio political conditions of each village. For recording every process a mechanism will be developed in this project at EDC level with the support of village level motivator. For constantly educating the common mass and recording the processes, procedures and guidelines will be prepared and printed. This will mainly pertain to planning, creation of revolving fund guidelines for the utilization of revolving fund and Integration awareness, Integration plan making and evolution of Integration guidelines.

Project will bring out wide range of publication and dissemination material aimed at awareness and education of the local community and building their capacity for sustainable natural resource management in the catchment.

To share the experiences of project the documentation of various project activities, success stories and processes etc. will be done on regular basis. Information regarding eco-restoration & livelihood activities such as forestry plantation, Horticulture, Agriculture and Animal husbandry, [69]

Organic farming etc. will be prepared and disseminated to the community members. The Project will bring out directory of works annually. Annual monitoring reports would be brought out. The valuable experience aimed by the project in terms of sustainable livelihood approach to catchment treatment will be documented and shared with the other organization. Hindi version of this plan will be prepared as soon as this plan is approved. Project will also produce a number of reports at different times. Fund allocated under this head will be utilized for this purpose.

6.3 Monitoring And Evaluation:

Regular monitoring of the project at different stages will be ensured at appropriate levels. The different streams of monitoring are as under-

- (i) Internal monitoring system :** Deputy Director of Govind Wildlife Sanctuary/ National Park will hold monthly experience sharing workshop of the project staff on a prefix date and will review the physical and financial progress, the work quality, the accounts and other relevant reports. Internal monitoring will be conducted regularly by PCCF (Project) Uttarakhand, Dehradun. The PMU will organize co-ordination meeting of community representative, village motivators and all the concerned staff to monitor the progress and quality of its implementation in the village. The Project Coordinator and Junior Project Coordinator will have the main responsibility in organizing such workshops and will ensure the participation of all stake holders.
- (ii) External Monitoring :** The external monitoring agency will be undertaking the concurrent monitoring of the project on a sample basis and will assist in following project activities.
 - Baseline data collection on sample tanks and comparable control group.
 - Project wise monitoring, learning and evaluation by undertaking data collection and reporting.
 - Undertake annual implementation audit.
 - Technical and capacity building support for the PMU and Jr. PMU's.
 - Detailed implementation progress report including updated data on key physical and financial indicators.
 - Social auditing of the project.

- (iii) **Physical Monitoring :** The physical verification of all the activities will be carried out at certain levels i.e departmental PIU, PMU. The internal cross checking and the third party-verification will be the integral part of the Physical Monitoring.
- (iv) **Technical Monitoring :** Baseline, Mid-term & End-term monitoring will be done and the evaluation report will be prepared and suggestions if any will be accorded.
- (v) **Audit :** All accounts and reports will be annually audited through AG, Uttarakhand audit team, department internal audit team and through CAMPA deputed CA and suggestions if any will be included.
- (Vi) **Social Audit:** - Social audit is a process of reviewing official records and determining whether state reported expenditure reflect the actual monies spent on the ground. Under the chairmanship of Jila Panchayat Adhyaksh a committee of Civil society Organisations (SCOs), Nongovernment Organizations (NGOs), Political representative, civil servants and Deputy Director of Govind Wildlife Sanctuary/ National Park (PMU) will be constituted and at the end of every financial year this committee will collectively organize such social audits . Suggestions of such committee will be strictly followed by PIU to ensure fair and transparent implementation of CAT Plan.

Table: 6.1- Expenditure Proposed on Project Management Information System & Research

S. No.	Management Information System & Research	Expenditure Proposed (in Lacs)
1	Management Information System (MIS)/GIS - 0.5%	3.40
2	Concurrent Monitoring & Evaluation - 0.5%	3.40
3	Study (Baseline/mid-term/End-term) - 0.5%	3.40
4	Control Systems & Financial review-Audit (Internal & External) - 0.5%	3.40
5	Research Component	6.80
Total Expenditure Proposed		20.40

CHAPTER-7**Summary of CAT Plan Activities & Financial Outlay**

The CAT Plan period is 7 years; first four years will be utilized for *management* and the rest period as *withdrawal phase*. On the basis of office memorandum issued by PCCF, Uttarakhand vide letter No. Kha-2023/13-2(2) dated 25.03.2011, the Component-wise and sub component-wise financial targets are being shown in the table given below:

Proposed Component-wise Cost in % for CAT Plan

S. No.	Component Head & Activities	Proposed Amount (in lacs)	Financial % as per CAT Plan guidelines
1	Project Management- Proposed 15%		
	(i) Administration (Cost (Project Management Cell) – 13%		
	1.1 Investment Cost- Proposed - 4%		
	1.1.1 Equipment & supplies and setting up Building like Field Huts/Store	13.60	2%
	1.1.2 Outsourcing of Vehicles	13.60	2%
	1.2 Recurring Costs- Proposed - 9%		
	1.2.1 Salaries/Service charges of contractual staff (Sectors Heads), Village Motivator, Senior Coordinator, Regional Coordinator etc. and staff on deputation	27.20	4%
	1.2.2 Project Allowance/Honorarium to Forest staff	5.10	0.75%
	2.3 Communication & Conveyance Allowance of total Project Staff & Motivators	8.50	1.25%
	1.2.4 Operation & Maintenance-Vehicles	6.80	1%
	1.2.5 Operation & Maintenance of Old staff Quarters/Minor civil works	6.80	1%
	1.2.6 Operation & Maintenance- Office Expenses	6.80	1%
	(ii) Monitoring and Evaluation-Proposed-2%		
	1.1 Management Information System (MIS)/GIS	13.60	2%
	1.2 Concurrent Monitoring & Evaluation		
	1.3 Study (Baseline/mid-term/End-term)		
	1.4 Control Systems & Financial review-Audit (Internal & External)		
	Sub Total (1)	102.00	15%
2	Preparatory Phase- Proposed-10%		
	(i) Development of Institutional System – Proposed - 4%		
	1. Test Work-Minor Repairing of community Assets	27.20	4%
	2. Provisions for Publicity, Knowledge Management & Dissemination		
	3. Institutional Support to EDC		
	(ii) Social, Institutional & Technical Capacity Buildings- Proposed-5%		
	2.1 Capacity Building Training & Exposure Visit of EDC & Villagers	34.00	5%
	2.2 Capacity Building Training & Exposure Visit of Staff		
	2.3 Process Building Workshop and Catchment Awareness Programme		

CAT Plan of Jakhol Sankri HEP

	(iii) Detailed Project Report including Micro Plans-Proposed - 1%		
	1.Preparation of DPR & Micro Plans	6.80	1%
	Sub Total (2)	68.00	10%
3	Watershed Work Phase-Proposed-70%		
3(i)	Development of Watershed Works - Proposed - 50%		
	1-Aforestation Works in Forest, Civil Soyam, EDC Land – Proposed - 18%	112.20	16.50%
	2- Wildlife Management- Proposed - 3%	20.40	3%
	3- Drainage Line Treatment – Proposed - 10%		
	(a) Biological Measures (Plantation, Brushwood & Perul Chek dams)		
	(b) Engineering Measures (wire Crate, Chekdams, Spurs, Sidewalls etc.)	105.40	15.50%
	(c) Repair of Retaining & Breast Wall of Agricultural land		
	4-Water Collection & Conservation- Proposed - 8%		
	(a) Rain Water harvesting Tanks (Irrigation Tanks, LDPE Tanks, Roof Top Water Harvesting Tanks etc.)	40.80	6%
	(b) Micro Irrigation and Lining of Established feeding Channels		
	(c) Dhara/Naula Repair		
	(d) Chal-Khal & Chari Construction		
	5-Payment to the local Communities/Institutions for Eco-System Services –Proposed - 8%		
	(a) Provision for Biodiversity conservation, Fresh Water, Fuel, fiber, Fodder, Organic Production System.	40.80	6%
	(b) Provision for Soil Erosion Control, Water Conservation, Carbon sequestration, Fire Protection		
	(c) Cultural – Spiritual & Aesthetic Values, Recreation & Eco-Tourism Development		
	6. Non Conventional Energy (Solar Energy, Pine Bricating, Modernization of Gharat)- Proposed - 2%	13.60	2%
	7. Research Component - Proposed - 1%	6.80	1%
	Sub Total- 3(i)	340.00	50%
3(ii)	Livelihood support Activities for Poorest/Marginal Farmers- Proposed - 10%		
	1- Small level livelihood activities		
	(a) Establishment of Wool carding plant and promotion of wool based cottage industries.		
	(b) Apiary.		
	2-Distribution of Fruit Plants		
	3- Distribution of Vegetable Mini-kits		
	4. Exhibition of Conventional crop and crop for wild life Protection	68.00	10%
	5. Exhibition of minimization techniques for women's workload		
	6. Training and support to Nonfarm sector (small enterprises, local artisan, hand craft, nature guide, tailoring, carpentry, band party, non timber forest produce, Fruit processing etc based income generation activities)		
	7- Corpus fund to poor communities		
	8- Support for social safety (health camp etc.)		
	Total -3(ii)	68.00	10%
3 (iii)	Production System & Small Scale Enterprises- Proposed - 10%		
	1-Agriculture		
	(a) Levelling and terrace repairing of agriculture fields.	13.60	2%
	(b) Detailed exhibition		
	(c) Biological / Vermi compost		
	(d) Promotion of Advanced agriculture equipments		

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	2-Horticulture		
	(a) Development of new orchards of apple and almonds.		
	(b) Maintenance of old orchards	20.40	3%
	(c) Exhibition of Seasonal / non seasonal vegetables		
	(d) Exhibition of aromatic and medicinal plants		
	3-Animal Husbandry		
	(a) Development of Pasture land.(Planting fodder species plants and grasses in agriculture fields and at their bunds.)	13.60	2%
	(b) Construction of fodder pots (nad) and water drinking body (Chury) for cattle.		
	(c) Animal Health camp / vaccination and paravate help		
	(d) Any other activities identified during DPR making.		
	4-Training & Support for small enterprises	6.80	1%
	(a) Eco-tourism- Home stays etc.		
	(b) Small processing units based on farming sector		
	5- Support for Value Addition and Market Management		
	(a) Common Facility Centers for Value Addition	13.60	2%
	(b) Support for market management for forest and farming related product		
	Total -3(iii)	68.00	10%
	Sub Total-3- (i+ii+iii)	476.00	70%
4	Consolidation Phase -5 %		
	(a) Preparation for Consolidation phase by villagers		
	(b) Capacity building for execution of withdrawal plan		
	(c) Consolidation and expansion of good works (Social, Institutional and Technical and market related works)	34.00	5%
	(d) Exchange of gained knowledge and experience within other projects		
	(e) Consolidation and end of different project works		
	Sub Total (4)	34.00	5%
	Total (1+2+3+4)	680.00	100%

Notes:- i- The activities proposed under each major component of the four components (**Project Management, Preparatory Phase, Watershed works Phase & Consolidation Phase**) are indicative and may change depending on site specific conditions, after micro planning

.ii - The total cost of the CAT Plan Rs. 680.00 lacs, which is 2.0 % of the Total Project Cost of HEP.

.iii - At the time of implementation physical targets will be rectified as per the escalation in rates.

.iv - Due to site-specific ground requirement, a few flexibility is required from indicative guideline/ manual issue by PCCF Uttarakhand (March-2011) in following component heads-

a- In component no. 3(i)1 (Aforestation works):- instead of 122.40 lac (18%) only 112.20 lac (16.50%) has been proposed

b- In component head no.3 (i) 3 (Drainage Line Treatment):- instead of 68.0 lacs(10%) 105.40%(15.50%) lac rupees has been proposed.

- c- In component head no.3 (i) 4 (Water Harvesting & Conservation):- Instead of 54.40 lac(8%) rupees 40.80 (6%) rupees has been proposed.*
- d- In component head no.3 (i) 5 (Payment to the local communities/ Institutions for Ecosystem Services):- Instead of 54.40 lac (8%) rupees 40.80 (6%) rupees has been proposed.*
- e- Activities proposed in Work component head no.3(ii)1(a) and1(b)(Backyard poultry Form and Kruoiler Mother Unit) are not suitable in project area. Hence more feasible works like Small level woolen based cottage industry and Apiary works has been proposed.*
- f- Leveling and Terrace repairing work has been incorporated in Agriculture work component.*
- g- Under Horticulture work, establishment of new Apple and Almond orchards has been proposed.*

PCCF (Wild Life) / Chief Wild Life Warden
Uttarakhand

(Dy. Director)
Govind Wild Life Sanctuary & National Park

CHAPTER – 8

Objectives of the CAT Plan

The main objective of the project is the overall treatment of the Catchment Area leading to improvement of ecosystem through plantation and soil conservation measures thereby causing reduction of the silt load in the water bodies present in the catchment area so as to enhance the life of the Jakhol Sankri Hydro Electric Project.

The Secondary objectives of the CAT Plan are:-

- (i) Integrate land based activities of agriculture, animal husbandry, forests, irrigation and rural development for holistic development of catchment area.
- (ii) To promote such activities in the Catchment area which will lead to enhancement of Ecosystem services and improvement in the overall environmental health of the catchment?
- (iii) Enhance capacity of forest departments and other departments, developmental agencies and NGO's through collaboration and experience sharing.

Projected Outcomes of CAT Plan

- Improvements in the tree cover of the Catchment area.
- Reduction in the Silt load in the catchment water bodies.
- Reduction in soil erosion in the catchment area.
- Improvement in the condition of the nearby forest by minimizing the removal of forest products thereby improving the natural health of the Watershed .
- Land based activities of Forestry, SMC, agriculture, horticulture, minor irrigation, animal husbandry, is integrated into each other and will certainly ensure the holistic development of fringe forests and adjoining non forest lands along with the development of green cover in other areas.
- Over all plantations of native tree species and development of fruit orchards will reduce pressure on natural resources and providing additional income to the local villagers. Thus

adoption of these measures will ensure better ecology and conservation of native biodiversity.

- Enhancement in the capacity building of forest department and other development agencies and NGOs via joint collaboration and experience sharing.
- For evaluation of the Outcomes of the CAT Plan, impact assessment study along with an exit plan needs to be formulated at relevant level.

Compensatory Afforestation:-

The Jakhol Sankri HEP requires a sum of 30687 Ha. out of that 24.126 ha. is required to divert from forest area/lands. As per the provisions under Forest Conservation Act 1980, a double of the diverted land has to be compensatory afforested i.e. 48.252 ha. on non forest lands. In this context the Project has already applied to divert the land and allotment of afforestation site to the district administration of Uttarkashi. The status of the application is still pending and at present non-availability of non forest land for compensatory afforestation, has been reported by district administration in writing. Hence, 48.252 ha. of degraded civil soyam forest lands for compensatory afforestation as per the decision of the district administration.

Performance INDICATORS:-

Following indicators will reflect that whether our project implementation is moving in right direction or need any corrective measures;

- Acceptance level of Project among local people.
- Reduction in Soil Erosion status of project area.
- Improvement in vegetation covers within catchment area .
- Improvement in employment status of villagers.
- Increase in crop production rate of agriculture lands.
- Acceptance of improved agricultural technologies and agriculture instruments among local farmers.
- Improvement in socio- economic conditions of the community including weaker section, eg- BPL etc.
- Improvement in woman empowerment
- Improvement in Literacy rate of locals.

CHAPTER – 9

EXIT PLAN

During the Consolidation Phase preparation of the Exit Plan will be started. Although, all the activities of the CAT Plan shall be implemented under the direct guidance of the PMU and Jr. PMUs, the village level institutions shall continue to exist even after the project is over. It is anticipated that appropriate institutional arrangements will be incorporated into the Exit Plan so that management of the programme can be transferred to community-controlled institutions and that necessary protocols for smooth withdrawal of the Jakhol Sankri CAT Plan. Various options for post exit institutional framework will be considered, including for example setting up of a registered society, or a democratic federated structure of NTFP grower/collectors. Decisions on the structure will be made on a consultative exercise involving all key stakeholder/stakeholder groups.

The following main aspects can be addressed in the exit protocol; though they can be revisited again at the appropriate time of Exit Plan Formulation.

- **Maintenance of assets created** – Proper record of the status of each asset shall be prepared and formally handed over to the respective implementing agencies for further maintenance.
- **Sustainability of Van Panchayats, VFCs Mahila Nurseries, etc** – Adequate training and capacity building and training would help sustain the people's bodies created during the CAT Plan Implementation phase. However, forest functionaries also need to be sensitized and oriented on this point.
- **Closure of offices created for the project** - The office records, buildings, infrastructures and all kinds of documents and records shall be formally handed over to the Forest Department. Office executives recruited on contract shall cease to work on the expiry of the contract and the project.

- **Operation and utilization of Corpus Fund** - Village level institutions, EDC's and field functionaries shall be adequately sensitized and trained for the purpose.
- **Operation and Utilization of Revolving Fund** – Village level institutions and field functionaries shall be adequately sensitized and trained for the purpose.
- **Documentation** : It is expected that the purposed CAT Plan will be rigorously documented to ensure that learning's from implementation of the Plan as well as institutional memories are retained, sustained and shared not only across and within the Plan's Catchment areas and the State, but also across other states and elsewhere outside India and with Programmes in similar contexts. As such, in addition to documenting the various aspects of the programme on an on-going basis, all efforts will also be made to disseminate the results regularly/ periodically through a range of knowledge products, both print and electronic (websites etc)

A detailed exit protocol shall be designed and implemented during the course of the Jakhol Sankri CAT Plan. Use of corpus fund even after the end of the project period will be clearly delineated in the exit plan. Additionally, various measures for enhances CAT Plan's sustainability such as studies for comprehensive risk analyses, mechanisms for risk transfer- such as insurance and micro-insurance, etc. will be undertaken and incorporated in appropriate places as inbuilt mechanisms so as to counter the withdrawal Syndrome once the CAT Plan period is over.

Annexure

Annexure- 1

S.W.S & M.W.S. Areas (Erodibility Class wise)

M.W.S.	Agriculture					Forest					Blank					Sno w Bou nd	Total (Ha.)
	E 1	E2	E3	E 4	T.tal	E1	E2	E3	E 4	T.tal	E 1	E2	E3	E4	T.tal		
Saturi	0	218	0	0	218	0	535	0	0	535	0	6	1016	0	1022	0	1765
Supin gad	0	693	365	0	1058	668	2182	210	0	3060	0	75	8158	0	8233	1218	13509
Obra gad	0	129	0	0	129	0	3137	371	0	3508	0	231	5642	262	6135	738	10510
Jakhol	0	412	193	0	605	0	3267	43	0	3310	0	137	781	0	918	0	4903
	0	1452	558	0	2010	668	9181	564	0	10413	0	449	15597	262	16308	1956	30687

Source: Watershed Directorate, Uttarakhand

Annexure- 2

Details of Population of Village located in the Project Area

S. No.	Village	No. of House Hold	Population Male	Population Female	Total Population	Sex Ratio (Female / 1000 male)	Literacy rate (%)	Male Literacy rate (%)	Female Literacy rate (%)
1	Fitari	115	386	383	769	992	34.81	54.81	13.68
2	Liwari	107	373	345	718	925	34.55	59.61	9.302
3	Saturi	33	101	95	196	941	31.25	50.60	10.38
4	Rala	16	61	52	113	852	22.22	34.09	8.108
5	Kasla	56	197	191	388	970	32.84	48.22	16.15
6	Regcha	54	152	145	297	954	21.28	34.12	8.130
7	Dhara	57	173	210	383	1214	42.58	66.42	23.69
8	Jakhol	204	634	622	1256	981	45.84	64.00	27.11
9	Sauni	17	54	62	116	1148	35.41	40.47	31.48
10	Sunkundi	32	118	94	212	797	33.51	49.01	12.98
11	Panw Malla	29	83	94	177	1133	29.49	46.15	14.86
12	Panw Talla	29	94	79	173	840	21.48	36.98	3.225
Total		749	2426	2372	4798	Average			
						979	32	49	15

Source: <http://villages.euttaranchal.com/index.php?d=01&n=Uttarkashi>

Annexure- 3**Village level livelihood employment to rural people as Village Motivators**

S. No.	Village	S.W.S.	M.W.S.	Range	No. of Village Motivators
1	Fitari	Supin Tons	Supin Gad	Supin Range	1
2	Liwari				1
3	Regcha				1
4	Rala				1
5	Kasla				1
6	Saturi		Saturi		1
7	Sauni				1
8	Jakhol		Jakhol		1
9	Dhara				1
10	Sunkundi				1
11	Panw Malla				1
12	Panw Talla				1
Total					12

Annexure- 4**Outsourcing of Vehicles & POL**

S. No.	Items	Unit Cost (Lacs)	Expenditure (Lacs)
1	For Wheelers (Mahindra Camper)	13.60	13.60
2	Operational Cost of vehicle for plan period	6.80	6.80
Total			20.40

Annexure- 5**Social, Institutional & Technical Capacity Building**

S. No.	Items	Expenditure (Lacs)
1	Provision for Publicity, Knowledge Management & Dissemination	10.20
2	Institutional Support to EDC	6.80
3	Capacity Building Training & Exposure Visit of EDC & Villagers	13.60
4	Capacity Building Training & Exposure Visit of Forest Staff	13.60
5	Process Building workshop and Catchment Awareness Programme	6.80
Total		51.00

Annexure- 6**Other Expenses**

S. No.	Items	Expenditure (Lacs)
1	Project Allowance / Honorarium to Forest Staffs	5.10
2	Communication & Conveyance Allowance of total Project Staffs and Motivators	8.50
3	Operation & Maintenance of old staff quarters /Minor civil works	6.80
4	Operation & Maintenance- Office expenses	6.80
5	Equipments & Supplies and setting up of building like Field Huts / Store	13.60
Total		40.80