CATCHMENT AREA TREATMENT PLAN
FOR
PHINA SINGH MEDIUM IRRIGATION PROJECT
IN
NURPUR, DISTRICT KANGRA, HIMACHAL PRADESH

PREPARED BY

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PREFACE

Himachal Pradesh is blessed with perennial river systems fed by glaciers, therefore, holds a vast potential of harnessing water resources for irrigation, hydroelectric projects, fisheries, etc. originating from Himalayas. Because of special ecological condition, Himachal Pradesh is also blessed with unique biodiversity that holds huge potential of germplasm for future generation. The Himalayan mountains rise abruptly, resulting in a diversity of ecosystems that range from alluvial grasslands and subtropical broadleaf forests to alpine meadows above the tree line. Life-style of local people is closely interlinked with the forests and natural environment.

The last century has seen unprecedented growth in irrigation projects on a global level. The use of tube well irrigation has decreased the cost of using groundwater, and the subsidization of large reservoirs and canals has been used to achieve food security. Worldwide, irrigated land has increased from 50 mha (million hectares) in 1900 to 267 mha today (Gleick, 2000). Much of this increase has been in developing countries. Between 1962 and 1996, the irrigated area in developing countries increased at about 2 per cent a year, leading to a near doubling in irrigated land. For example, in 1950 India had an irrigation potential of 22.6 mha by 1993-94, this had grown to 86 mha (Saleth, 1996).

An important concern for the future is the limited supply of fresh water. Recent years have seen a decline in the number of water projects build worldwide, because of environmental and cost concerns. Most of the areas that are good locations for water projects have already been developed and there are growing concerns about the quality of available water as well as the quantity.

Increased supplies of irrigation water have been instrumental in feeding the populations of developing countries in the last 50 years. Irrigation water has increased food security and improved living standards in many parts of the world. Benefits include the expansion of food supply, stabilization of water supply, the improved welfare of some native populations, and a relative decrease in deforestation of land for agriculture.

Keeping in view the importance of irrigation for upliftment of the socioeconomic status of the farmers of the Nurpur area, Department of Irrigation and Public Health (I.P.H.), Government of Himachal Pradesh, developed an idea during the year 1984. Initially it was proposed to construct a Dam across Chakki Khad just at the confluence of Chakki Khad and Kalam Nallah for diverting the water through a conveyance system of Tunnel and open channels. The project is named after Late Shri Phina Singh, a local resident of village Niari, who initiated the idea of constructing of Dam across Chakki Khad near village Lahru, which is situated in tehsil Bhatiyat, district Chamba, on the boundary of Kangra and Chamba districts.

Due to increasing biotic pressure and other developmental activities, the environment is under tremendous pressure. The fertile soil is under threat to be washed off causing lot of adverse downstream impact on population and the production systems. Now as per the latest directions of the Government, the loss to be caused due to establishment of developmental project is to be compensated through some management plans. Therefore, the IPH authorities interacted with *Himalayan Forest Research Institute* (HFRI), Shimla - a regional Institute of *Indian Council of Forestry Research & Education* (*ICFRE*) for the development of Catchment Area Treatment (CAT) Plan.

Detailed field work was carried out by HFRI and its associates by using available scientific methodologies for development of CAT Plan. A draft Plan was discussed in detail with IPH authorities including the Chief Engineer, other senior functionaries of IPH, Forest Officers of Himachal Pradesh Forest Department and the experts from HFRI, Shimla on 04.09.2010. After incorporation of the suggestions put forth by the experts and views of the authorities of IPH, the revised and final CAT Plan is being submitted. The Committee appreciated the CAT Plan and approved it with minor suggestions, which were incorporated in this final CAT Plan.

HFRI will like to put on record the cooperation extended by IPH authorities, Divisional Forest Officer, Dalhousie, Range Officers and other local Forest Officials for successfully completing this assignment. HFRI is also thankful to its associates M/ S MANTEC Consultants, New Delhi, whose experts have worked very hard along with experts of HFRI for developing this plan.

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TABLE OF CONTENTS

Chapter No.	Contents	Page No.
Chapter-1: Introduction		**01-14**
1.1	Introduction	01
1.1.1	India's Water Resource vis-à-vis Irrigation	02
1.1.2	Need for Irrigation	04
1.1.3	Development of Irrigation in India	05
1.2	Irrigation Potential of Himachal Pradesh	06
1.3	Irrigation Potential Created	06
1.4	Project Profile	07
1.5	Project Location	10
1.6	Demographic Data of the Village Panchayats falling under the Project Area	11
1.7	Mandatory Requirement for Submission of CAT Plan	14
Chapter-2: Physical Environment of Catchment Area		**01-10**
2.1	Introduction	01
2.2	Climate	01
2.3	Meteorological Characteristics	02
2.3.1	Rainfall	03
2.3.2	Relative Humidity	03
2.3.3	Maximum and Minimum Temperature	03
2.4	Physiography	09
2.5	Topography	09
2.6	Regional Geology	10
Chapter-3: Catchment Area Treatment Plan		**01-60**
3.1	Introduction	01
3.2	Objectives	02
3.3	Catchment Area	03
3.4	Drainage Pattern	06
3.4.1	Gross Trellis	06
3.4.2	Gross Radial, Local Annular	06
3.4.3	Gross Sub-parallel, Local Sub-rectangular	06
3.5	Soil	08
3.6	Methodology Used for the Study	10
3.6.1	Land-use / Land-cover Classification	10
3.6.2	Slope Map Preparation	14

Chapter No.	Contents	Page No.
3.6.3	Soil Loss using Silt Yield Index (SYI) Method	17
3.7	Catchment Area Treatment Plan	22
3.7.1	Erosion and Land-use	23
3.7.2	Activities to be Undertaken	26
3.8	Treatment of Individual Sub-watershed	32
3.8.1	Sub-watershed Kalam Khad 1B1A7(1)	32
3.8.2	Sub-watershed Balud Khad 1B1A7(2)	35
3.8.3	Sub-watershed Chakki Khad 1B1A7(3)	37
3.9	Cost Analysis of Different Works under Plan	40
3.9.1	Afforestation	40
3.9.2	Bio-engineering Works	42
3.9.3	High Density Energy Plantation	45
3.9.4	Reservoir Rim Plantation	46
3.9.5	Nursery Support	48
3.9.6	Engineering Measures	49
3.10	Cost of other Components of CAT Plan	52
3.10.1	Implementation of Support Infrastructure Cost	52
3.10.2	Fuel Wood Saving Devices	52
3.10.3	Training and Extension Programme	53
3.10.4	Provision for Formulation of Micro Plans	53
3.10.5	Provision for Proper Documentation	53
3.10.6	Propagation of Medicinal Trees Species under Afforestation	53
3.10.7	Monitoring of Silt	53
3.10.8	Development of Eco-Tourism	54
3.10.9	Provision for Bamboo Nursery	54
3.10.10	Provision for Monitoring and Evaluation	54
3.10.11	Provision for Providing Environmental Services	55
3.10.12	Moisture Rententivity Intervention, Construction of Van Sarovars and Water Harvesting Structures	56
3.10.13	Wildlife Management and Bio-diversity Conservation Plan	56
3.10.14	Capacity Building	57
3.11	Institutional Mechanism	57
3.11.1	Role of Project Proponent	57
3.11.2	CAT Implementation	57
3.11.3	Project Monitoring and Reporting Procedures	57
3.12	Summary of Cost of Works	58

Chapter No.	Contents	Page No.
Chapter-4:	Wildlife and Biodiversity Conservation Development and Management Plan	01-54
4.1	General	01
4.2	Location	01
4.3	Flora of the Catchment Area	01
4.3.1.	Forest Flora	01
4.3.2	Forest Types	02
4.4	Fauna of Catchment Area	05
4.4.1	General Description	05
5	Summary of Threats to Wildlife Conservator	08
5.1	Socioeconomic Analysis	08
6	Wildlife Management and Development Plan	09
6.1	Wildlife Management and Conservation	09
6.2	Objectives	09
7	Implementation	09
7.1	Habitat Improvement	10
7.2	Protection of Rhododendron Area, Support to Gow Sadan	10
7.3	Support to Mountain Livelihood	10
7.4	Capacity Building and Skill Upgradation	11

LIST OF TABLES

Table No.	Contents	Page No.
1.1	Surface Water Resources in Major River Basins of India	02
1.2	Ground Water Resource of India as on March 31, 2003	03
1.3	Sector-wise Break-up of Irrigation Potential Created	06
1.4	Panchayat-wise Population Data of Project Area	12
1.5	Panchayat-wise Livestock Data of Project Area	13
2.1	Average Air Temperature, Rainfall, Relative Humidity and Mean Wind Speed data of IMD Dalhousie for the period of 30 years	02
2.2	Mean Monthly Rainfall in mm	04
2.3	Mean Monthly Relative Humidity in percentage	05
2.4	Maximum and Minimum Temperature (Degree Celsius)	07
3.1	Hydrological Units	03
3.2	Land-use Details of Sub-watersheds in Free Draining Catchment	13
3.3	Slope Class	14
3.4	Slope Categories in Respective Sub-watersheds	15
3.5	Delivery Ratio (DR) Criteria adopted for the Project	18
3.6	SYI and Priority Rating as per Erosion Intensity	21
3.7	Erosion Intensity and Weightage	22
3.8	Erosion Intensity Categories in Sub-watersheds	23
3.9	Forest Block/ Beat-wise Treatment Measures	33
3.10	Forest Block/ Beat-wise Treatment Measures	35
3.11	Forest Block/ Beat-wise Treatment Measures	37
3.12	Per Ha. Cost Norm for Model Plantation Works	40
3.13	Per Ha. Cost Norms for Model Plantation Works	41
3.14	Cost Estimate for Afforestation Measures	42
3.15	Cost Analysis Per Ha of Bio-Engineering Works	42
3.16	Cost Estimate for Bio-Engineering Works	45
3.17	Cost Analysis Per Ha High Density Energy Plantation	46
3.18	Cost Estimate for High Density Energy Plantation	46
3.19	Per Ha. Cost Norm for Rim Plantation Works	47
3.20	Cost Estimates For Implementing Nursery Support	48
3.21	Cost Analysis for Engineering Structures	49
3.22	Cost Estimate for Engineering Measures	51
3.23	Cost Estimate for Support Infrastructure	52
3.24	Cost Estimates for CAT Plan	58
3.25	Year-wise Break-up of CAT Plan Outlay	59

Table No.	Contents	Page No.
4.1	Financial Abstract for Wildlife and Biodiversity Conservation Management Plan	11
4.2	Financial Abstract for Wildlife and Biodiversity Conservation Management Plan for Five Year	12

LIST OF FIGURES

Figure No.	Contents	Page No.
1.1	General Layout Plan of the Project	08
1.2	General View of proposed Dam Site	09
1.3	General View of Proposed Trench Weir Site on Kalam Khad	09
1.4	Photograph of End or Reservoir	10
2.1	View of Chakki Khad near Village Dadriayara	09
2.2	View of Kalam Khad near Chowari	10
3.1	Satellite Imagery of Free Draining Catchment	4
3.2	Sub-Watershed Location Map of Free Draining Catchment	5
3.3	Drainage Map of Free Draining Catchment	7
3.4	Soil Map of Free Draining Catchment	9
3.5	Land use Map of Free Draining Catchment Area	12
3.6	Slope Map of Free Draining Catchment Area- Soil Loss Using Silt Yield Index (SYI) Method	16
3.7	Erosion Intensity Map of Free Draining Catchment Area	25
3.8	Diagramatic Representation of Bio-engineering Plantation Model for Degraded Forest Land	28
3.9	Thematic Map of SWS 1B1A7(1)	34
3.10	Thematic Map of SWS 1B1A7(2)	36
3.11	Thematic Map of SWS 1B1A7(3)	39

LIST OF ANNEXURES

Annexure No.		Contents	Page No.
I			01-66
	A.	Plantation Activities under Sub-Watershed Kalam Khad – 1B1A7(1)	1-6
	B.	Soil Conservation Works Sub-Watershed Kalam Khad – 1B1A7(1)	7-21
	C.	Agriculture, Horticulture Crops, Animal Husbandry & Amenities related Data Sub-Watershed Kalam Khad – 1B1A7(1)	22-32
	A.	Plantation Activities under Sub-Watershed Balud Khad – 1B1A7(2)	33-35
	B.	Soil Conservation Works Sub-Watershed Balud Khad – 1B1A7(2)	36-38
	C.	Agriculture, Horticulture Crops, Animal Husbandry & Amenities related Data Sub-Watershed Kalam Khad – 1B1A7(1)	39-42
	A.	Plantation Activities under Sub-Watershed Chakki Khad – 1B1A7(3)	43-48
	B.	Soil Conservation Works Sub-Watershed Chakki Khad – 1B1A7(3)	49-58
	C.	Agriculture, Horticulture Crops, Animal Husbandry & Amenities related Data Sub-Watershed Chakki Khad – 1B1A7(3)	59-66
II		Photographs depicting various field related activities undertaken during preparation of CAT Plan	1-10
III		Map showing suitable locations for various interventions as per Annexure-I (page 1 to 66).	1

CHAPTER-1

1.1 INTRODUCTION

Of late India has turned into a vibrant economy. The growth process and expansion of economic activities has understandably lead to ever increasing demands for water for diverse purpose like domestic, industrial, agriculture, hydro-power, thermal power, navigation, recreation etc. Water is a scarce and one of the most precious natural resources and a key element in the socio-economic development of a country. Rainfall is the main source of water. From precipitation alone, including snowfall, India receives 4000 BCM of water out of which monsoon rainfall from June to September alone accounts for 3000 BCM. A significant part of it is lost-through evaporation, evapo-transpiration and yet large part of it percolates into the ground and is available to us in the form of ground water. The availability from surface water and replenishable ground water is put at 1869 BCM. Because of topographical and other constraints about 60% of it i.e. 690 BCM form surface water and 432 BCM from ground water, can be put to beneficial use.

India accounts for a meager 2.4% of the world's surface area of 135.79 million sq km yet it supports and sustains a whopping 16.8% of the total world population of 6055 million (census of India 2001) and is second only to 21.03% of China.

The population of our country in census year 1901 and 1951 stood at 238 million and 361 million respectively and/ or, rose to 1028 million by the turn of century (census year 2001). This implies that the progressive growth rate of population over population of 1901 and 1951 were 331.47% and 184.90% respectively. The country's population is expected to reach a level of around 1390 millions by 2025AD. To support population, agriculture which *inter alia* includes, raising of crops from the land, animal husbandry, agro-forestry and pisciculture has been practiced since time immemorial in India which has been pre-eminently an agrarian state. Till 1971, about 80% of India's population lived in rural areas and were dependent upon agriculture which contributed 45% of GDP at that time while today 65-70% of the population is dependent on agriculture which contributes nearby 25% of GDP, thanks to rapid developments of industry and other occupation like mining, manufacturing, transport and trade. But still the agriculture forms the hub of India's economy. With the advent of Green Revolution in the country, the production of food grains has increased from around 50 million tonnes in the fifties to about 208 million tonnes in the year 1999-2000. This will have to be raised to around 350 million tonnes by the year 2025 AD.

Thus the growing population has resulted in major consumptive use of water for agriculture in general and irrigation in particular while the gross irrigation potential is estimated to have increased from 19.5 million hectare at the time of independence to about 95 million hectare by the end of 2000 AD, further development of substantial order is necessary to meet the food and fiber need of our growing population.

1.1.1 India's Water Resource vis-à-vis Irrigation

Availability of natural resources, particularly land and water, for people of India is inequitable at global level. Presently, with 2.4% of land and 4% of water resources, India has to support 16.8% of world's population and 15% of livestock which essentially causes stress on available water resources. The water is available in two different forms, viz., surface water and ground water.

1.1.1.1 Surface Water

Surface water is available on the surface of the earth in the form of rivers, ponds, lakes, canal etc. However, the rivers constitute the most important source of surface water. In this respect the nature has showered bounties on India in so far as it is blessed with a large number of major, medium and small size rivers. As many as 13 of them are classified as major rivers, whose total catchment of 252.8 million hectares is about 83% of the total area of all drainage basins. Of the major rivers, the Ganga-Brahamputra-Meghna system is the biggest with a total catchment area of about 110 million hectare being about 43% of the catchment area of all other major rivers. The surface water resources in major river are shown in **Table-1.1**.

Table-1.1: Surface Water Resources in Major River Basins of India

Sl. No.	Basin	Av. Annual Run-off (km^3)	Utilizable Flow (km^3)	Storage Completed (km^3)
1.	Indus	73.00	46.00	14.52
2.	Ganga	501.00	250.00	37.40
3.	Brahmputra	537.00	24.00	1.09
4.	Barak-sub basin	60.00	-	-
5.	Mahanadi	67.00	50.00	8.93
6.	Brahmani	36.00	18.10	4.29
7.	Godavari	119.00	76.00	17.27
8.	Krishna	68.00	58.00	33.23
9.	Cauvery	21.00	19.00	7.25

10.	Penner	6.81	6.81	2.37
11.	Narmada	41.00	34.50	3.02
12.	Tabi	18.00	14.5	8.68
13.	Sabarmati	3.80	1.91	1.3
14.	Mahi	41.00	34.50	30.02

1.1.1.2 Ground Water

A part of the precipitation percolates in the rocks and soils and is available to us as ground water. According to the latest ground water statistics, 2003, Central Ground Water Board, Ministry of Water Resources, pp-I-II, the total replenishable ground water resources in the country is 432 BCM/year. Of this, the ground water available for irrigation is about 362.4 BCM/year and the balance is for domestic and industrial purpose. The stage of ground water development is 41.57% only. The ground water resource of India is shown in **Table-1.2**.

Table-1.2: Ground Water Resource of India as on March 31, 2003

Sl. No.	States	Total Replenishable Ground water Resource BCM/yr	Provision for Domestic, Industrial & Other uses BCM/yr	Available Ground water resources for Irrigation BCM/yr	Net Draft BCM/yr	Balance Ground water Resource for future use BCM/yr	Level of Ground water Development %
1.	Andhra Pradesh	35.29	5.29	30.00	8.57	21.43	28.56
2.	Arunachal Pradesh	1.44	0.22	1.22	Neg.	1.22	Neg.
3.	Assam	24.72	3.71	21.01	1.84	19.17	8.75
4.	Bihar	26.99	4.05	22.94	10.63	12.31	46.33
5.	Chattisgarh	16.07	2.41	13.66	0.81	12.85	5.93
6.	Goa	0.22	0.03	0.19	0.02	0.17	8.30
7.	Gujarat	20.38	3.06	17.32	9.55	7.77	55.16
8.	Haryana	8.53	1.28	7.25	8.13	0.00	112.18
9.	Himachal Pradesh	0.37	0.07	0.29	0.03	0.26	10.72
10.	Jammu & Kashmir	4.43	0.66	3.76	0.03	3.73	0.81
11.	Jharkhand	6.53	0.98	5.55	1.84	3.71	33.13
12.	Karnataka	16.19	2.43	13.76	4.76	9.00	34.60
13.	Kerala	7.90	1.31	6.59	1.46	5.13	22.17
14.	Madhya Pradesh	34.82	5.22	29.60	8.02	21.58	27.09

15.	Maharashtra	37.87	12.40	25.47	9.44	16.04	37.04
16.	Manipur	3.15	0.47	2.68	Neg.	2.68	Neg.
17.	Meghalaya	0.54	0.08	0.46	0.02	0.44	3.97
18.	Mizoram	1.4*	0.21*	1.19*	Neg.	1.19*	Neg.
19.	Nagaland	0.72	0.11	0.62	Neg.	0.62	Neg.
20.	Orissa	20.00	3.00	17.00	3.61	13.39	21.33
21.	Punjab	18.66	1.87	16.79	16.40	0.00	97.66
22.	Rajasthan	12.71	1.99	10.71	9.26	1.45	86.42
23.	Sikkim	0.07*	0.01*	0.06*	Neg.	0.06	Neg.
24.	Tamil Nadu	26.39	3.96	22.43	14.45	7.98	64.43
25.	Tripura	0.66	0.10	0.56	0.19	0.38	33.43
26.	Uttar Pradesh	81.12	12.17	68.95	32.33	36.62	46.89
27.	Uttaranchal	2.70	0.41	2.29	0.82	1.47	35.78
28.	West Bengal	23.09	3.46	19.63	7.50	12.13	38.19
	Total States	**433.04* (431.77)**	**71.14* (70.92)**	**361.98* (360.73)**	**149.70**	**212.78 (211.53)**	**41.53**
Union Territories							
1.	Andman & Nicobar*	0.326*	0.013*	0.313*	Neg.	0.31300	Neg.
2.	Chandigarh	0.030			0.025		
3.	Dadra & Nagar Haveli	0.042	0.006	0.040	0.000	0.031	12.81
4.	Daman & Diu	0.013	0.013	0.002	0.011	0.008	0.003
5.	Delhi	0.29	0.18		0.12		
6.	Lakshadweep	0.002	0.000	0.002	0.007	0.000	
7.	Pondicherry	0.029	0.004	0.024	0.116	0.000	
Total Uts		**0.732* (0.116)**	**0.025* (0.012)**	**0.384* (0.071)**	**0.160**	**0.348* (0.035)**	
Grand Total		**433.882* (431.886)**	**71.165* (70.932)**	**362.364* (360.80)**	**149.97**	**213.128* (211.56)**	**41.57**

Source: Ground water statistics, CGWB

1.1.2 Need for Irrigation

The geographical conditions, especially the nature of monsoon rainfall, in India make irrigation indispensable for sustainable agricultural development. Unfortunately rainfall in India is unevenly distributed with respect to time and space, over the country. It is uncertain, unreliable, irregular, variable, seasonal and unevenly distributed. The main rain

bringing south-west monsoon often fails to keep its date and thus disturb the crop calendar. The amount of rainfall also varies greatly from the normal. Excess rainfall may cause floods but less rainfall forces the farmers to resort to irrigation. Generally when the rainfall is in short of evapo-transpiration demand of a crop, the irrigation is immediately required to protect the plant from permanent wilting. Ironically the variability of rainfall is very high in areas of low rainfall like Rajasthan. The north western parts of the country, especially Punjab, Haryana, Rajasthan and the western parts of Uttar Pradesh often suffer from high variability of rainfall. Even during the monsoon months, about 50% of the total annual rainfall takes places within 15-20 days and in less than 100 hours. As far as spatial unevenness is concerned, the average rainfall in Meghalaya is 10900 mm, whereas, in Rajasthan it is as low as 100 mm against the national average annual rainfall of 1100 mm. Even during monsoon, the rainfall is interspersed with monsoon gaps which may exceed for two or more weeks and badly damage the crops which are entirely rain fed and have no other irrigation facilities. It is estimated that only one third of the cultivated area receives annual rainfall in excess of 1000 mm of which 75% falls during 3-4 months during monsoon while the remaining months are marked by dry seasons of long spell underlining the need for irrigation for successful growing of crops. Besides, the torrential nature of rainfall leaves little opportunity for soil to absorb water. This loss of water by wasteful flow has to be compensated by irrigation. Even in areas of high rainfall, irrigation facilities are needed for raising crops like rice, sugarcane, jute and cotton which require more water. With the introduction of HYV seeds requiring heavy input of chemical fertilizers, as a result of green revolution, irrigation has become a very important ingredient of agriculture.

1.1.3 Development of Irrigation in India

Irrigation has been practiced in India since ancient time from wells, tanks and small channels. The Hindu monarchs, the Mughal emperors and the British rulers exhibited great engineering feats to develop irrigation at different times in the Indian history. The Muslim emperor constructed a number of canals from Sutlej and Yamuna rivers. Major irrigation projects were built by British starting in the middle of the 19th century and the development was steady and gradual. The British constructed the great Ganga canal (now UGC), Lower Ganga Canal (LGC), the Eastern Yamuna Canal (EYC), Western Yamuna Canal (WYC), Sirhand Canal, Sarda Canal, Couvery Delta System, Godavari Delta system etc. Sustained and systematic programme for development of irrigation facilities were taken up with the advent of plan development in 1951. The irrigation potential created before the First Five Year Plan was 22.6 million ha which rose to 93.95 million hectare at the end of Ninth Plan. The main thrust on the Development Policy is towards achieving the assessed target of 113

million hectare of gross irrigation potential in the country by the year 2010 AD, out of which 58 million hectares will be by major/ medium schemes and the rest 55 million hectares by the minor schemes.

1.2 IRRIGATION POTENTIAL OF HIMACHAL PRADESH

Himachal Pradesh is a hilly state sharing international boundary with China on east and is bounded by the state of Jammu and Kashmir on north, Punjab plains in the west, state of Haryana on the south and Uttarakhand on east-south. It has a geographical area of 55.67 lac ha out of which the total culturable area is 5.83 lac ha being just below 10%. Except for some plain areas lying in districts Sirmour, Una and Kangra, the state has mountainous topography consequentially some of the culturable area lies in pockets/chunks and mainly in the form of terraced and/or sloping fields. This implies that scope of providing minor irrigation facilities is more as compared to medium and major irrigation schemes. That is why the area identified under minor irrigation schemes is 2.85 lac ha as compared to 0.50 lac ha identified under medium and major irrigation schemes.

1.3 IRRIGATION POTENTIAL CREATED

Upto the end of the March, 2010, combined area of 2.28 lac ha of culturable land has been provided with irrigation facilities by way of construction and commissioning of total 2056 schemes out of which medium, flow irrigation schemes (FIS), lift irrigation schemes (LIS) and tube wells are 4,960,542 and 550 respectively. The sector wise details are presented in **Table 1.3**.

Table 1.3: Sector wise break-up of Irrigation Potential Created

S. No.	Sector	Area covered upto 31.03.09 (Ha)		Total Area (Ha)
		I & PH	RDD	
1.	Minor Irrigation	1,12,649	93,196	2,05,845
2.	Medium Irrigation	12,897	0	12,897
3.	Major Irrigation	9755	0	9755
	Total	**1,35,301**	**93,196**	**2,28,497**

The commissioned irrigation schemes are (i) Giri Irrigation Project in district Sirmour, (ii) Balh valley Irrigation Project in district Mandi, (iii) and (iv) Babhur Sahib Phase I & II in district Una. The only major irrigation project nearing completion is Shah Nehar Irrigation Project in district Kangra. The minor irrigation schemes make optimum and economical utilization of water available in the stream from which these are diverted.

1.4 PROJECT PROFILE

Phina Singh, medium irrigation project, has been conceived with a view to harness water of Chakki Khad and Kalam Khad by constructing a 22 m high storage cum diversion dam across the former and supplementing the supplies by the tapping the latter through a system comprising of a trench weir and 849 m long feeder channel out falling into reservoir to be created in Chakki Khad. The water shall be diverted through 4.56 km long tunnel to 1.395 km long main canal and about 19 km long distribution system and 4.29 km long lift canal to provide gravity and lift irrigation to 2881 ha and 1144 ha CCA, respectively totaling 4025 CCA, covered under 60 villages falling under Nurpur-Sadwan area in tehsil Nurpur of district Kangra. The main canal shall be a contour canal with authorized head discharge of 3.27 cumecs to provide 100% irrigation intensities during Kharif and Rabi each besides 10.5% during Zaid crop. The estimated cost of the project, as per price level, September 2007, is Rs. 147.15 crore. The cost per hectare of gross irrigation is Rs. 1.76 lac and the benefit cost ratio has been assessed as 1.70:1. The project construction shall be undertaken in two phases to be completed in 4 to 5 years time frame. The index map and the general layout of the project are shown in **Figure 1.1**. A general view of proposed dam site on Chakki Khad and proposed trench weir site on Kalam Khad is shown in **Figure 1.2** and **Figure 1.3**. The photograph of the reservoir area towards end is shown in **Figure 1.4**.

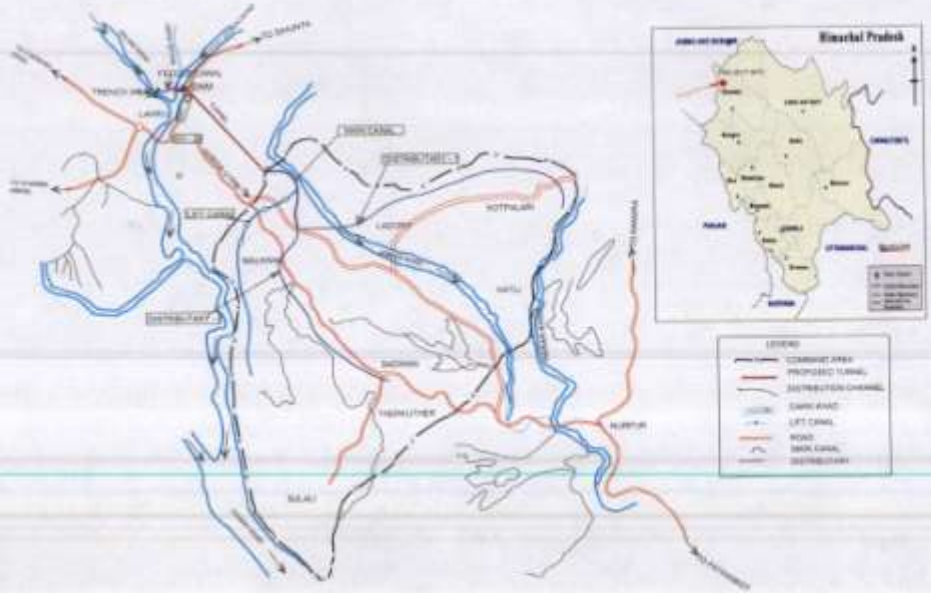


Figure 1.1: General Layout Plan of the Project

Figure 1.2: General View of Proposed Dam Site

Figure 1.3: General View of Proposed Trench Weir Site on Kalam Khad

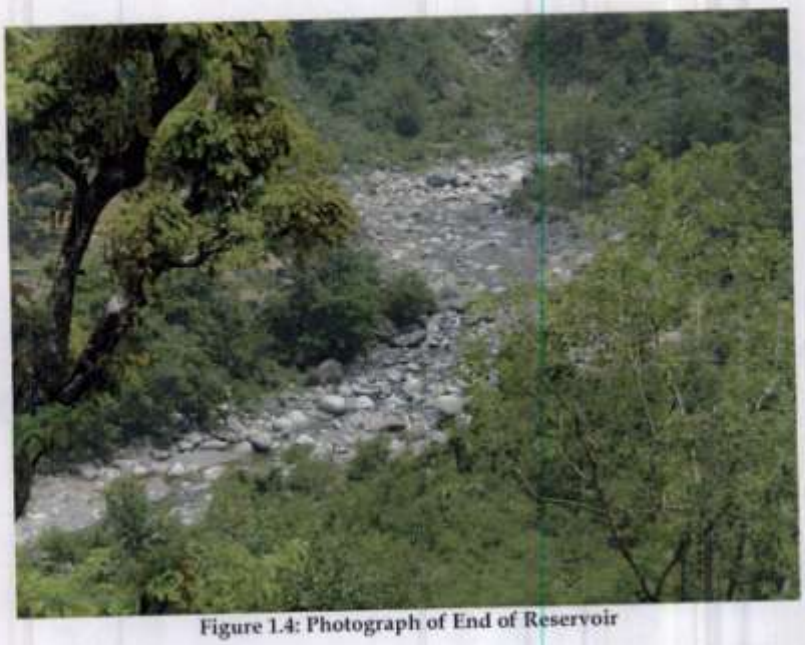


Figure 1.4: Photograph of End of Reservoir

1.5 PROJECT LOCATION

The project area encompassing the storage dam on Chaki Khad, the trench weir on Kalam Khad and the feeder channel and the reservoir lies under tehsil Chowari, district Chamba. The command area under the project falls on the left bank of Chaki Khad and on either banks of Jabber Khad in tehsil Nurpur, district Kangra. The geographic location of the command area is between latitude 32° 17' to 32° 25' N and longitude 75° 50' 30" to 75° 59' 30" E with average elevation of command being 700 above msl. The area is well connected by motorable roads and Pathankot-Joginder Nagar narrow gauge railways upto Jassur. The head works of the project is located near village Lahru on Nurpur-Lahru-Chamba SH-28, about 25 km from Nurpur and about 1 km on Lahru-Sihunta SH-43. The link road connecting command area is Nurpur-Dhanni-Malakwal road and Sodwan-Suliali road.

1.6 DEMOGRAPHIC DATA OF THE VILLAGE PANCHAYATS FALLING UNDER THE PROJECT AREA

There are 13 Panchayats consisting of 122 villages falling under the project area (Table: 1.4). As per the household survey conducted by this Institute, total population of these Panchayats is 12,848 (approximately). Maximum population is recorded in Khadret Panchayat (3500) followed by Raipar Panchayat (2580) and Manthua Panchayat (1005).

Survey was also conducted to assess the livestock number in 122 villages falling under 13 Panchayats falling in the project area (Table-1.5). Total population of livestock (Cow, Ox, Sheep, Goat, Buffalo, Horse/ Mule), in these Panchayats were 19637. The maximum population of the livestock i.e. 6034 was recorded in Jandroh Panchayat followed by Khadret (4117) and Raipar (1683).

Table-1.4: Panchayat-Wise Population Data

Panchayat	No. of Families	Total Population	Scheduled Caste	Scheduled Tribe	Other Backward Classes	Others	Total Male	Total Female	Total Children
1. Chowari	290	805	515	280	-	-	433	372	-
2. Manutha	196	1005	230	261	-	524	182	154	67
3. Parsiyara	98	457	66	99		292	243	214	
4. Khadret	740	3500	156	655	98	2590	1290	1290	843
5. Raipar	612	2580	446	2134			945	952	775
6. Sadal	97	292	-	-	-	292	121	101	63
7. Banet	115	405	-	-	-	405	174	145	86
8. Turakada	101	610	22	158		430		211	140
9. Jatroon	73	323	28	27	28	238	153	170	
10. Parsod	40	158	20	7		61	89	69	
11. Malunda-Kainthalli	173	967	34	43	0	487	254	258	453
12. Chowari-Malunda	177	809	207	342	-	260	279	214	314
13. Jandroh	0	937	937	-	-	-	471	466	-
Total	**2712**	**12848**	**2611**	**4006**	**126**	5579	4634	**4616**	**2741**

Table-1.5: Panchayat-Wise Livestock Data

Panchayat	Cow	Ox	Sheep	Goat	Buffaloes	Horse / Mule	Total
1. Chowari	130	123	82	246	43	20	644
2. Manutha	317	248	209	307	57	0	941
3. Parsiyara	88	178	66	398	49	0	903
4. Khadret	881	624	318	2019	243	32	4117
5. Raipar	163	396	348	980	0	0	1683
6. Sadal	95	94	44	119	14	0	366
7. Banet	145	145	115	200	39	0	651
8. Trukada	181	121	128	335	38	4	807
9. Jatroon	100	57	44	111	22	14	328
10. Parsod	30	18	13	55	4	14	134
11. Malunda-Kainthalli	206	270	409	494	109	4	1492
12. Chowari-Malunda	0	311	306	635	69	0	1537
13. Jandroh	390	248	2120	3200	76	0	6034
Total	2726	2833	4202	9099	763	88	19637

1.7 MANDATORY REQUIREMENT FOR SUBMISSION OF CAT PLAN

The project involves diversion of 28.23 ha of forest land lying in two ranges-one under Division Forest Officer, Dalhousie and other under Division Forest Officer, Nurpur under administrative control of Conservator of Forests, Chamba and Dharmshala Circles, respectively. Therefore, as per para 4.8 A added to Forest (Conservation) Act, 1980 vide MoEF circular No. 11-14/94-FC dated 1.11.2001, it has been made mandatory for project proponent to formulate and accompany CAT Plan for hydro-electric/river valley projects, while submitting proposal for diversion of forest land for non-forestry purpose and provide funds for its implementation. In the wake of this provision, the project proponent have allotted the work of preparation of CAT Plan to HFRI, Shimla, who after having carried out detailed field survey/Remote sensing have come up with an elaborate CAT Plan costing **Rs. 453 lac**.

CHAPTER-2

PHYSICAL ENVIRONMENT OF CATCHMENT AREA

2.1 INTRODUCTION

Catchment area of the proposed project, at the storage cum diversion dam site, comprises of the sub-watersheds of Chakki Khad, Balud Khad and Kalam Khad whose water shall also be diverted to augment the water availability for the project. It has been assessed as 155.85 sq. km. and is mainly rain-fed except for relatively small areas on the summits of Dhaula Dhar ranges on the north and north-east with altitude varying from 2441 m to 2772 m above msl, which experiences snow fall during winter. The shape of the catchment above the diversion dam site is like a fan and constitutes the upper catchment of Chakki Khad, which itself is a sub-basin of Beas basin.

2.2 CLIMATE

The altitudinal variations of the catchment area from Elevation 700 m above msl to 2771 m above msl give rise to micro-climate. In general, however, the various climatic zones range from sub-tropical (700 m – 900 m above msl) to warm temperate (900 m – 1800 m above msl), cool temperate (1800 m – 2400 m above msl) and cold high mountains (2400 m – 4000 m).

The climate of catchment area is affected by the tropical weather systems during the summers and the cold weather systems known as Western Disturbances during winter and per-monsoon months. The Western Disturbances have their origin near the Mediterranean Sea and move in the westerly wind regime along Himalayan latitudes during the winter season. These disturbances may be in the form of a depression or a low pressure area or an upper air cyclonic circulation or a trough in lower isobaric levels. They shift to more northernly latitudes as the summer season approaches.

Summer precipitation in the catchment area is mainly associated with the Southwest monsoon in the form of rainfall, which is dominant from June to September. Extreme rainfall floods are mostly experienced during this season.

Based on the available information, from different sources the project basin broadly experiences the following seasons.

- Winter : December to March
- Summer/pre-monsoon : April to May
- Monsoon : June to September
- Post-monsoon/Autumn : October to November

2.3 METEOROLOGICAL CHARACTERISTICS

Once pollutants are discharged in the atmosphere, the meteorological factors play an important role in transport, dispersion and diffusion within the environment. Since these factors show wide fluctuations with time, it was felt necessary and desirable as part of this study, to collect meteorological data for the period of thirty years at nearest IMD station viz. Dalhousie which is the nearest observatory to the project site. The climatological data is presented in **Table 2.1**. The principal determinants of weather and climatic conditions in the region include:-

1. Altitude and its physiographic completing.
2. Direction of the ridges and location on the windward and leeward sides.
3. Degree of slope and its aspect
4. Intensity of forest cover and
5. Proximity to water bodies and glaciers.

Table-2.1: Average Air Temperature, Rainfall, Relative Humidity and Mean Wind Speed data of IMD Dalhousie for the period of 30 years (1951-1980)

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

2.3.1 Rainfall

The catchment area receives summer precipitation mainly in the form of rains from the south west monsoon which is dominant from June to September. The western disturbances cause precipitation during winter and also pre-monsoon months. The rainfall is generally in the form of light and combined shower but sometimes extreme rainfall floods are experienced mostly during monsoon. Mean monthly rainfall data, based on daily rainfall data observed at rain gauge station at Jachh, near Nurpur, being maintained by Dr. Y. S. Parmar University of Horticulture and Forestry, Solan (H.P.), presented in **Table 2.2**, shows an annual mean rainfall of about 1366 mm, with 80% falling during June to September.

2.3.2 Relative Humidity

On the basis of observation of relative humidity, for the period 1987-2007, at Weather Station at Jachh, near Nurpur, being maintained by Dr. Y. S. Parmar University of Horticulture and Forestry, Solan (H.P.), which is nearest to the catchment area, the value of mean monthly maximum and minimum RH observed is 97% and 44% in August, 1998 and May, 1988 respectively. The statistics of mean monthly relative humidity is presented in **Table 2.3.**

2.3.3 Maximum and Minimum Temperature

The value of mean monthly maximum and minimum temperature observed is 44.1° C and 2.2° C in June, 2000 and January, 1997 respectively. The maximum and minimum temperature data is presented in **Table 2.4.**

Table 2.2: Mean Monthly Rainfall in mm

S. No.	Year	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1	1987	136.00	79.20	45.00	65.00	280.00	35.00	220.00	180.30	0.00	0.00	0.00	0.81	1041.31
2	1988	27.60	76.00	130.60	3.60	0.00	29.00	589.40	359.30	558.20	0.00	1.20	77.30	1852.20
3	1989	99.20	29.00	61.40	11.60	22.40	30.12	384.90	272.50	46.60	0.00	19.21	77.80	1054.73
4	1990	8.20	69.20	119.90	16.20	37.40	17.50	308.40	424.80	396.60	4.20	0.00	131.30	1533.70
5	1991	0.00	70.20	52.00	15.80	22.10	36.20	166.30	483.30	178.80	8.00	0.00	39.90	1070.60
6	1992	115.40	78.30	47.10	3.50	9.90	22.00	397.50	900.80	37.60	0.00	14.40	1.50	1628.00
7	1993	66.90	3.70	55.00	3.00	14.10	45.70	648.30	141.80	130.60	0.00	3.50	0.00	1112.60
8	1994	62.10	74.30	5.10	14.90	0.00	63.18	629.40	765.70	55.70	5.40	0.00	40.40	1716.18
9	1995	48.20	116.50	44.20	14.10	0.00	26.00	440.30	465.50	500.00	0.00	5.00	2.00	1661.80
10	1996	54.00	58.00	89.20	7.00	0.00	119.00	288.50	410.30	97.00	39.50	0.00	1.40	1163.90
11	1997	68.90	30.80	58.40	4.80	0.00	41.80	246.80	460.70	230.50	34.40	66.00	90.10	1333.20
12	1998	12.30	132.90	119.00	0.00	5.10	104.00	444.80	627.30	315.90	97.50	0.40	0.50	1859.70
13	1999	7.00	14.50	12.30	0.00	3.47	137.00	619.00	823.20	245.90	0.00	0.80	0.50	1863.67
14	2000	56.90	60.70	65.60	13.00	2.61	134.00	430.00	583.30	115.90	0.00	0.00	1.30	1463.31

S. No.	Year	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.	Total
15	2001	0.00	0.00	155.50	72.50	42.00	237.90	475.40	359.20	38.50	0.00	25.00	12.60	1418.60
16	2002	23.90	16.60	37.00	13.00	6.20	62.30	128.20	248.00	201.40	0.00	0.00	0.00	736.60
17	2003	31.40	117.60	79.00	6.90	8.50	70.90	266.40	396.90	343.30	0.00	9.60	28.70	1359.20
18	2004	126.60	21.80	0.00	10.50	34.00	162.20	406.50	305.30	75.70	115.50	12.20	26.50	1296.80
19	2005	56.50	195.30	92.10	23.30	13.20	0.00	450.60	165.80	132.00	0.00	0.00	0.00	1128.80
20	2006	31.90	11.40	57.00	30.50	34.80	99.00	159.20	389.10	148.00	27.60	3.80	22.50	1014.80
21	2007	0.00	121.30											
Total		1033.00	1377.30	1325.40	329.20	533.78	1472.80	7699.90	8763.10	3848.20	332.10	161.11	555.11	
Average		49.19	65.59	66.27	16.46	26.69	73.64	385.00	438.16	192.41	16.61	8.06	27.76	1365.81

Table 2.3: Mean Monthly Relative Humidity in Percentage

S. No.	Year	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
1	1987	88.00	85.00	72.00	67.00	62.00	63.00	85.00	78.00	65.00	66.00	66.00	91.00
2	1988	90.00	78.00	80.00	50.00	44.00	53.00	87.00	86.00	86.00	62.00	87.00	88.00
3	1989	91.00	85.00	80.00	67.00	52.00	55.00	63.00	86.00	86.00	61.00	81.00	78.00
4	1990	89.00	86.00	82.00	58.00	63.00	59.00	84.00	88.00	88.00	33.00	86.00	84.00

S. No.	Year	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
5	1991	65.00	84.00	82.00	69.00	47.00	51.00	83.00	85.00	85.00	78.00	83.00	90.00
6	1992	90.00	86.00	78.00	58.00	55.00	98.00	83.00	85.00	87.00	84.00	83.00	88.00
7	1993	75.00	87.00	76.00	65.00	44.00	58.00	88.00	87.00	88.00	87.00	85.00	67.00
8	1994	89.00	87.00	76.00	77.00	53.00	56.00	88.00	90.00	84.00	77.00	84.00	89.00
9	1995	90.00	87.00	83.00	74.00	55.00	59.00	87.00	82.00	87.00	81.00	76.00	90.00
10	1996	88.00	87.00	84.00	64.00	62.00	77.00	86.00	90.00	88.00	65.00	79.00	89.00
11	1997	85.00	80.00	75.00	60.00	51.00	79.00	87.00	92.00	87.00	80.00	71.00	81.00
12	1998	76.00	85.00	71.00	56.00	55.00	80.00	86.00	97.00	95.00	70.00	68.00	68.00
13	1999	65.00	77.00	74.00	59.00	54.00	68.00	88.00	91.00	82.00	65.00	65.00	50.00
14	2000	79.00	76.00	65.00	58.00	55.00	78.00	98.00	92.00	80.00	69.00	69.00	65.00
15	2001	65.00	55.00	86.00	68.00	62.00	71.00	85.00	89.00	81.00	68.00	69.00	68.00
16	2002	75.00	65.00	81.00	65.00	65.00	73.00	88.00	91.00	79.00	65.00	54.00	49.00
17	2003	77.00	75.00	76.00	84.00	81.00	71.00	88.00	91.00	75.00	55.00	59.00	77.00
18	2004	71.00	76.00	55.00	86.00	69.00	68.00	92.00	89.00	72.00	73.00	61.00	74.00
19	2005	76.00	78.00	74.00	88.00	70.00	69.00	95.00	87.00	79.00	55.00	51.00	52.00

S. No.	Year	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul	Aug.	Sep.	Oct.	Nov.	Dec.
20	2006	76.00	78.00	84.00	87.00	68.00	79.00	81.00	87.00	73.00	71.00	53.00	67.00
21	2007	75.00	79.00										
Total		1675.00	1676.00	1534.00	1360.00	1167.00	1365.00	1722.00	1763.00	1647.00	1415.00	1430.00	1505.00
Average		79.76	79.81	76.70	68.00	58.35	68.25	86.10	88.15	82.35	70.75	71.50	75.25

Table 2.4: Maximum and Minimum Temperature (Degree Celsius)

S. No.	Year	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	1987	19.8	5.3	22.6	7.5	25.3	12.0	32.7	15.4	33.6	17.2	37.4	21.0	38.8	21.1	33.8	21.6	34.0	20.1	32.4	15.3	24.7	6.0	23.2	4.1
2	1988	20.9	5.0	23.9	6.6	24.7	10.8	35.6	18.4	39.6	21.5	39.2	22.2	34.0	22.5	33.6	22.7	29.2	13.8	25.3	8.4	22.3	5.7	21.3	4.5
3	1989	18.9	4.0	20.8	5.4	28.5	9.0	30.2	12.2	37.2	21.5	37.7	27.7	36.0	22.3	30.0	22.5	31.8	21.3	30.8	11.5	25.6	9.1	19.5	6.8
4	1990	19.3	5.1	18.3	8.0	22.9	9.7	31.2	15.7	37.7	18.4	37.2	29.3	35.0	23.4	31.0	23.1	32.3	21.8	30.0	15.4	22.2	11.0	19.7	4.1
5	1991	17.2	3.0	20.8	9.7	25.0	11.4	30.1	15.0	37.3	21.9	39.7	25.4	34.0	24.0	32.0	22.8	31.6	19.3	28.9	15.4	25.0	6.6	17.7	4.8
6	1992	17.4	4.1	20.0	7.3	24.8	11.0	32.0	17.5	36.1	20.1	39.2	22.2	32.9	22.6	33.0	22.3	30.8	21.4	29.2	14.7	25.3	9.6	21.2	3.0
7	1993	15.4	4.0	21.9	6.3	23.6	9.0	29.7	14.0	38.3	18.4	38.3	23.2	32.4	21.1	37.0	22.7	30.4	19.5	28.8	12.3	24.6	7.5	20.5	3.5
8	1994	20.3	5.5	21.1	6.4	27.8	12.4	30.1	11.7	38.0	20.3	40.8	25.1	31.5	23.9	35.0	23.2	30.1	21.3	28.5	12.4	25.5	7.8	20.1	6.0

S. No.	Year	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
9	1995	17.6	6.0	21.2	6.9	25.1	12.3	32.3	19.7	39.0	20.9	41.5	22.8	36.6	23.3	38.0	22.2	33.4	21.1	30.8	16.0	26.0	7.5	20.7	4.5
10	1996	19.9	3.9	21.1	7.8	27.3	11.0	35.1	16.0	38.6	20.4	36.9	23.6	34.8	23.0	33.0	23.6	29.5	16.3	27.3	12.5	25.4	6.1	21.5	3.5
11	1997	19.0	2.2	22.7	5.6	28.5	10.5	33.1	16.5	39.2	21.1	42.2	26.4	39.8	23.4	35.4	22.5	31.8	21.3	30.8	11.5	25.6	9.1	18.9	6.3
12	1998	22.6	6.5	27.1	8.1	30.1	13.2	32.6	19.2	37.9	24.8	43.9	31.2	40.2	26.8	33.7	23.1	32.3	21.8	30.0	15.4	22.2	11.0	19.6	4.8
13	1999	23.0	3.2	24.2	7.4	26.9	12.6	35.0	17.7	40.6	26.1	42.7	31.5	38.7	25.3	29.1	22.8	31.6	19.3	28.9	15.4	25.0	6.6	16.7	4.1
14	2000	18.9	2.9	23.4	6.9	25.4	11.2	34.9	18.6	39.7	23.7	44.1	30.4	40.6	23.8	36.5	22.3	30.8	21.4	29.2	14.7	25.3	9.6	19.9	3.9
15	2001	18.4	8.0	23.9	6.7	28.5	9.9	32.7	19.1	36.9	22.2	32.3	23.7	31.4	24.8	32.3	24.3	31.6	17.1	30.7	16.9	24.1	10.7	20.2	6.9
16	2002	19.2	4.3	21.5	7.0	26.6	11.7	32.8	18.0	38.6	26.2	36.7	24.9	34.5	25.8	31.1	26.4	29.8	21.5	28.9	15.4	21.7	9.4	18.9	6.9
17	2003	16.1	4.1	18.8	9.5	23.2	11.6	30.2	16.2	33.9	20.8	36.2	25.3	32.4	24.7	30.6	24.2	30.4	23.1	27.9	15.6	23.4	10.5	18.9	5.8
18	2004	15.3	4.6	18.0	6.9	24.7	11.5	29.7	17.2	34.5	22.9	33.1	25.2	31.4	26.0	30.2	25.2	30.5	21.9	27.0	16.2	22.0	10.4	19.4	6.5
19	2005	16.2	3.8	17.2	6.3	22.3	11.3	31.5	14.3	33.1	18.8	38.0	23.3	31.5	21.6	31.8	24.4	29.3	21.8	29.7	15.7	24.8	7.8	20.8	4.4
20	2006	18.0	5.2	25.5	7.1	26.1	11.5	32.2	15.5	32.4	21.5	36.4	25.1	32.8	25.3	30.6	23.9	30.9	23.0	29.4	17.8	24.8	12.2	19.0	4.8
21	2007	19.1	2.8	19.6	8.3																				
Average		18.7	4.5	21.6	7.2	25.9	11.2	32.2	16.4	37.1	21.4	38.7	25.5	35.0	23.7	32.9	23.3	31.1	20.4	29.2	14.4	24.3	8.7	20.0	5.0

2.4 PHYSIOGRAPHY

The catchment area physiographically lies in Western Himalayan mountains of Himachal Pradesh and its geographic locations are longitude 75° 55' 12" to 76° 8' 48" E and latitude 32° 20' 6" to 32° 29' 46" N, forming a part of Tehsil Chowari, district Chamba. The catchment area is encompassed between Dhaula Dhar range on north and northeast, Dhadu Dhar on south and southeast, Kallnal Dhar and Sundla Dhar, on north and northwest. The Dhaula Dhar ranges overlook the catchment area lying in Shiwalik or outer Himalayas which constitute the outermost range of the Himalayas. These Shiwalik ranges overlook the plains of the Kangra valley. The elevation tends to increase from west to east and south to north.

2.5 TOPOGRAPHY

Topography of the catchment area is rugged mountainous marked by the presence of Dhaula Dhar range on north and northeast giving rise to various dhars or spurs with steep to gentle slopes. The elevation of the catchment varies from 705 m above msl at dam site to 2771 m above msl at Kharu Gala. The entire tract is mountainous with steep to gentle sloping areas and is drained mainly by Kalam and Chaki Khads and their tributaries, originating within the catchment. Forest is predominant land-use of the area followed by agriculture and settlement. Well terraced fields, for raising paddy and other crops, are existing within the catchment. The view of Chakki Khad near village Dadriyara, Kalam Khad near Chowari and Balud Khad at confluence with Chakki Khad are shown in **Figure 2.1** and **Figure 2.2**, respectively.

Figure 2.1: View of Chakki Khad near village Dadriyara

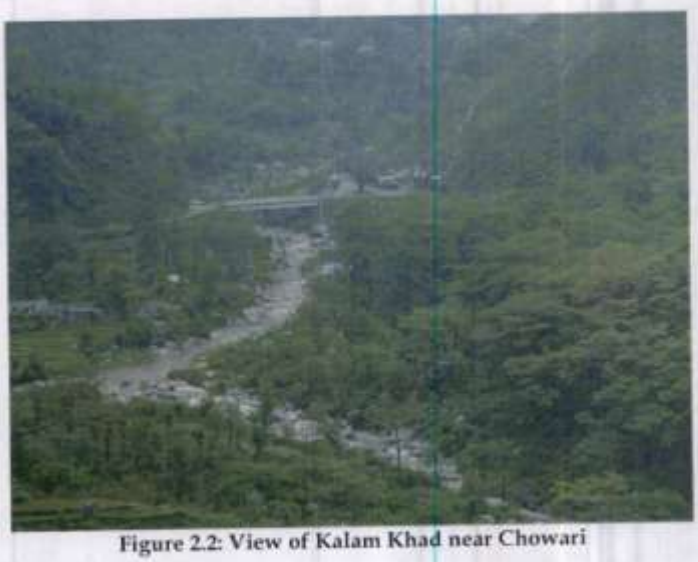


Figure 2.2: View of Kalam Khad near Chowari

2.6 REGIONAL GEOLOGY

The catchment area, encompassed by the project mainly lies in outer Himalayas (Shiwalik) surrounded by lesser Himalayas, Dhaula Dhar range, is characterized by steep to gentle sloping mountains and deep cut valleys. The rock types exposed in the area comprise conglomerate / quaternary deposits and sand rock of Shiwalik formations. The surrounding areas consist of sand stone, silt stone and shales of Dharamshala formations; quartzites, phyllites, limestone and intensive volcanics belonging to Sundernagar formations and granite-gneisses, phyllites of Jutogle formations.

The regional stratigraphic succession of the area after Srikantia and Sharma on the basis of systematic geological mapping is as follows:

Siwalik Formation – Conglomerates, Sand rock, Clay Stone

---------- Main boundary fault ----------

Upper Dharamshala : Thinly sand stone, silt stone with minor shale beds.
Lower Dharamshala : Mainly shales with sand stones.

---------- Muree Thrust ----------

Sundernagar Formation : Quartzites, phyllites, lime stones, volcanics

---------- Jutogh Thrust ----------

Jutogh Formation : Phyllites, granites and gneisses.

CHAPTER-3

CATCHMENT AREA TREATMENT PLAN

3.1 INTRODUCTION

Sedimentation of reservoir is a function of soil erosion rate of its catchment. It impinges upon the useful capacity of reservoir and the availability of water for its designated use. The erosion of top soil from land reduces its fertility and the vegetation growth. Thus, no water resource scheme of medium and major classification can be successful by keeping in seclusion from it the most interactive gradient of nature, i.e., land. Thus, it becomes imperative to evolve a plan based on scientific approach to prevent soil erosion to the extent possible. A study of erosion and sediment yield from the catchment is of utmost importance as the deposition of sediment in reservoir reduces its capacity, thus affecting the water available for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment also adversely affects agricultural production. Another important factor that adds to sediment load and which contributes to soil degradation is grazing pressure. The lack of proper vegetal cover is a factor that causes degradation and thereby results in severe run off/soil erosion, and subsequently premature siltation of the reservoir. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above-mentioned adverse causes and process of soil erosion. The catchment area treatment involves an understanding of the erosion characteristics of the terrain and suggests remedial measures to reduce the erosion rate. For this reason catchment of the directly draining rivers, streams, tributaries, etc. are treated and the cost is included in the project cost.

Watershed is the basic unit of a catchment. Watershed is a natural hydrological and geographic unit of spatial extent characterized by surface run-off confined to a defined course at a particular point. The boundary of the watershed is delineated by the line of water divide in a basin with reference to specific point drainage. The pre-requisite for a watershed management is the collection of multifarious data e.g., geology, geomorphology, topography, soil, land-use/ land-cover, climate, hydrology, drainage pattern, etc. The catchment of Phina Singh Project consists of three sub-watersheds. The multifarious data generated from various published sources and actual data collected from these watersheds on the above-mentioned parameters form the basis of the Action Plan for Catchment Area Treatment which is presented here.

A Catchment Area Treatment (CAT) Plan for the free draining catchment area of Phina Singh Medium Irrigation Project has been prepared for areas with high soil erosion intensity. The CAT Plan envisages overall improvement in the environmental conditions of the region. All the activities are aimed at treating the degraded and potential areas of severe soil erosion. The plan provides benefits due to biological and engineering measures, and its utility in maintaining the ecosystem health. The plan with objectives addresses issues such as prevention of gully erosion, enhancing the forest cover for increasing soil holding capacity and arresting total sediment flow in the reservoir and flowing waters.

3.2 OBJECTIVES

Integrated watershed management is aimed at minimizing the sedimentation of the reservoir. The main aim of the Catchment Area Treatment Plan is to rejuvenate various degraded ecosystems in the catchment area for longevity of the reservoir. For this purpose an action plan has been prepared with the following objectives:-

1. To facilitate hydrological functioning of the catchment and to augment the quality of water of the stream and its tributaries.
2. Conservation of soil cover and to arrest soil erosion, floods, and siltation of the stream along with its tributaries and consequent reduction of siltation in the reservoir of the project.
3. Prioritisation of watersheds for treatment on the basis of soil erosion intensity in the catchment area.
4. Rehabilitation of degraded forest areas through afforestation and bio-engineering thereby facilitating natural regeneration of plants.
5. Mitigation of landslides, landslips and rock falls.
6. Soil conservation through biological and engineering measures to reduce sediment load in stream and its tributaries incidentally to improving the quality of water.
7. Ecosystem conservation resulting from increased vegetal cover and water retaining properties of soil.
8. To meet the fuel wood and fodder requirements of local people.
9. Promotion of non-conventional energy device to reduce pressure on forest.
10. Employment generation through community participation and conservation.

3.3 CATCHMENT AREA

Hill streams, viz. Chakki Khad and Kalam Khad emanates from the Dhaula Dhar range near Kharu Gala (2771 m above msl) and Chhatrinal (2723 m above msl) respectively. Balud Khad, relatively a small hill stream, originates near Bintrudhan at Elevation 2361 m above msl. The upper reaches of the catchment experience snowfall during winter and thus remain covered under snow during winter. The length of Chakki and Kalam Khad up to the diversion dam and trench weir site is about 20 km and 17 km respectively with average bed slope 1:10 and 1:8.6 respectively. The total catchment area drained by these Khads/Streams up to the proposed diversion dam sites have been assessed as 155.8488 sq. km. The catchment is like a fan and is characterized by mountainous terrain with steep to gentle slope and is thickly populated in the lower reaches. As no other major or medium river valley project exists within the catchment, the free and directly draining catchment is the same. The satellite imagery of the free draining catchment is shown in **Figure-3.1**.

As per nomenclature given in the Watershed Atlas of India, 1990, the free draining catchment under study lies in water resource region-1 (Indus); Basin 1B (Beas), Catchment 1B1 (Whole Beas), sub catchment 1B1A (Lower Beas) and watershed 1B1A7 (Chakki & Jabbar Khad) falling totally in district Chamba of Himachal Pradesh. Catchment Area Treatment Plan has been formulated for the free draining catchment by using satellite data subset of IRS LISS-III. The free draining watershed 1B1A7 has been sub-divided further into three sub-watersheds, the aerial extent of which is shown in **Table 3.1** and depicted in **Figure-3.2**.

Table-3.1: Hydrological Units

Sl. No.	Watershed	Name of sub-watershed	Sub-watershed Code	Area (ha)	Elevation of the highest point in sub-watershed (m)
1.	Chaki and Jabbar Khad	Kalam Khad	1B1A7(1)	6740.36	2723
		Balud Khad	1B1A7(2)	1539.26	2361
		Chaki Khad	1B1A7(3)	7305.26	2771
			Total	**15584.88**	

Figure 3.1: Satellite Imagery of Free Draining Catchment

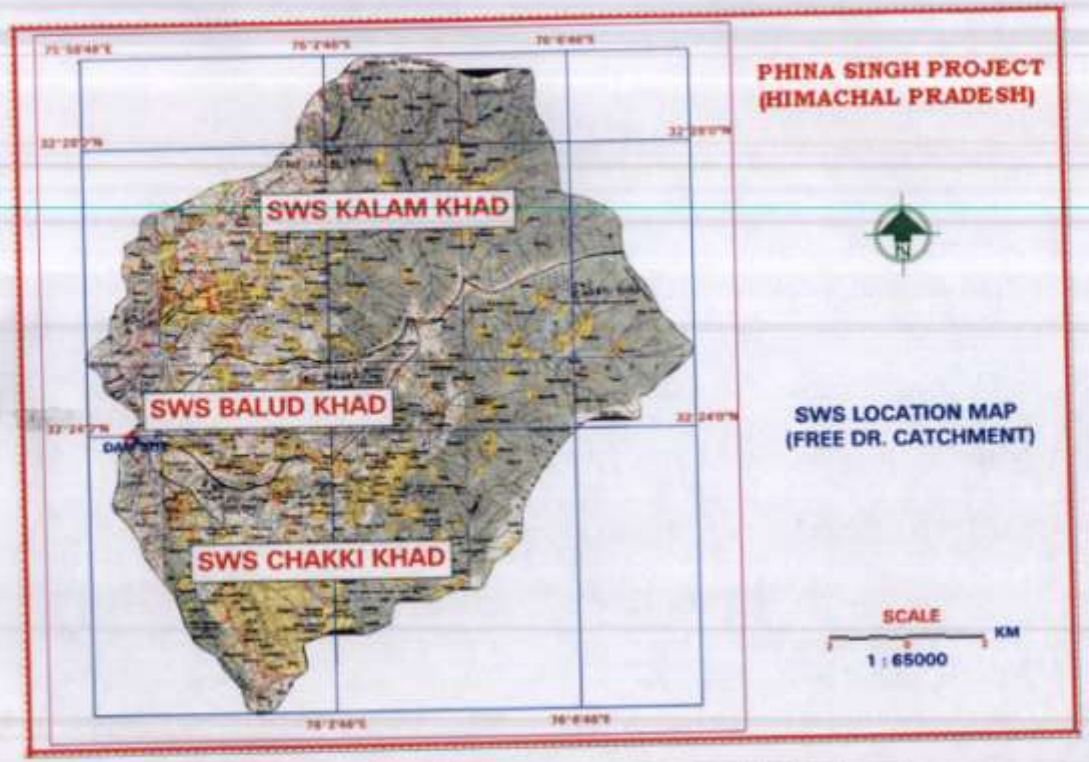


Figure 3.2: Sub-Watershed Location Map of Free Draining Catchment

3.4 DRAINAGE PATTERN

Drainage is the single most entity, which defines the network antecedent of the stream. The drainage pattern of the study area exhibits dendritic pattern as shown in **Figure 3.3**. The major tributaries to Chakki Khad, in free drainage area, confluencing with it from right are Balud Khad and Kalam Khad whereas Galed Nala meets it on left bank. The drainage pattern of the area may be classified into following classes.

3.4.1 Gross Trellis

The trellis drainage pattern is normally developed in the hillside slopes and usually aligned along the strike of the rock formation. The softer rocks like phyllitic slates exhibit such drainage. The trellis drainage pattern is well developed in the terraces and lower most reaches of the valley. The majority of the area possesses a dendritic to sub-dendritic drainage containing irregular branching of the smaller tributaries. The closeness of these small branches is depending on the permeability of the underlying rocks and the amount and nature of precipitation. It is the most common drainage pattern of hillside slopes of the study area.

3.4.2 Gross Radial, Local Annular

The radial drainage pattern is a characteristic feature of the high altitudinal zone specially the summit surfaces. Lithologically, these areas are constituted by the resistant and impervious rocks with steep slopes. The sub-parallel drainage pattern comprises a series of streams which run approximately parallel to each other. They are evolved in areas of uniformly dipping rocks.

3.4.3 Gross Sub-Parallel, Local Sub-Rectangular

The major river in the study area is antecedent in nature. The sinuosity, braiding and meandering in the stream course is generally noticed, although at some places, they are straight and narrow. Due to the increase of the drainage area and the discharge, the river valley becomes wider in downstream side with generally flattened gradient.

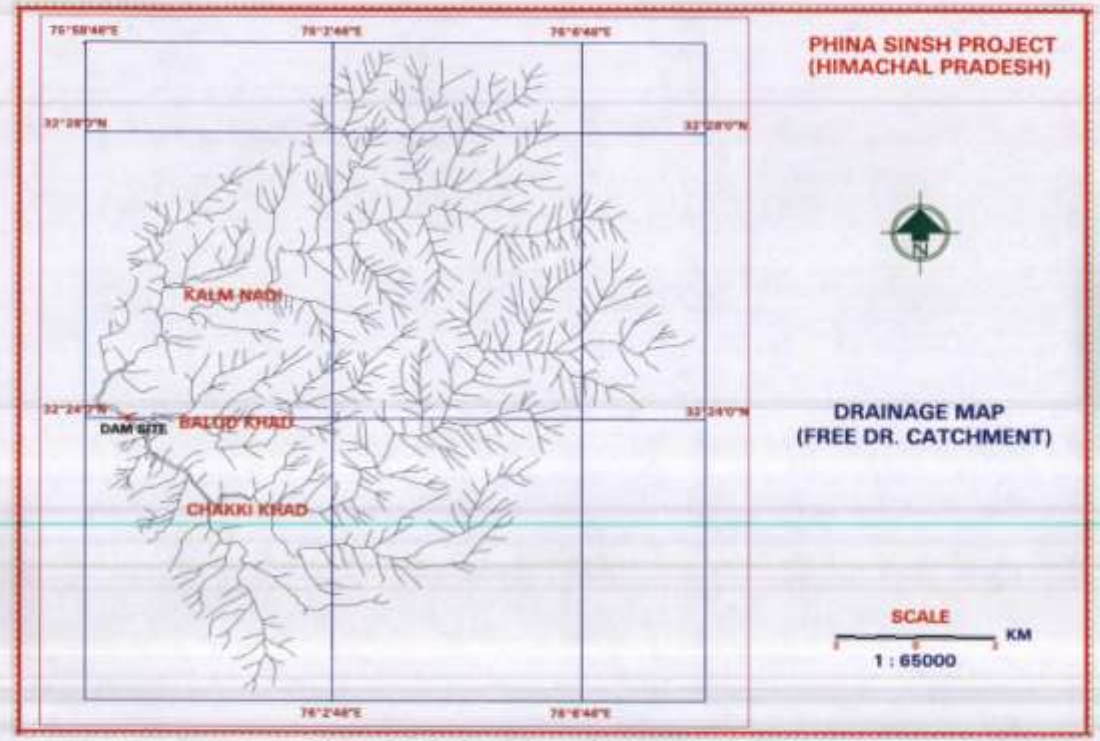


Figure 3.3: Drainage Map of Free Draining Catchment

3.5 SOIL

The soil resource map of Himachal Pradesh (NBSS Publication No. 58) has been used in the present study. The soil is predominantly coarse loamy to fine loamy. The soil map presented in **Figure 3.4** reveals that the soil of the area belongs to Lesser Himalayas having map unit 28 and 38, whose characteristics are described hereunder.

- **Soil belonging to Map Unit-28.**

  These are soils of summits and ridge tops. These are rock out crops (rocky cliffs) associated with shallow, well drained, coarse loamy soils on very steep slopes with loamy surface and very severe erosion. Taxonomically these soils belong to great group/sub group Typic Udorthents.

- **Soil belonging to Map Unit-38**

  These are soils of side/reposed slopes. These are shallow, somewhat excessively drained, thermic, fine-loamy calcareous soils on steep slopes with loamy surface and severe erosion, associated with rock outcrops. Taxonomically these soils belong to great group/sub group Typic Udorthents.

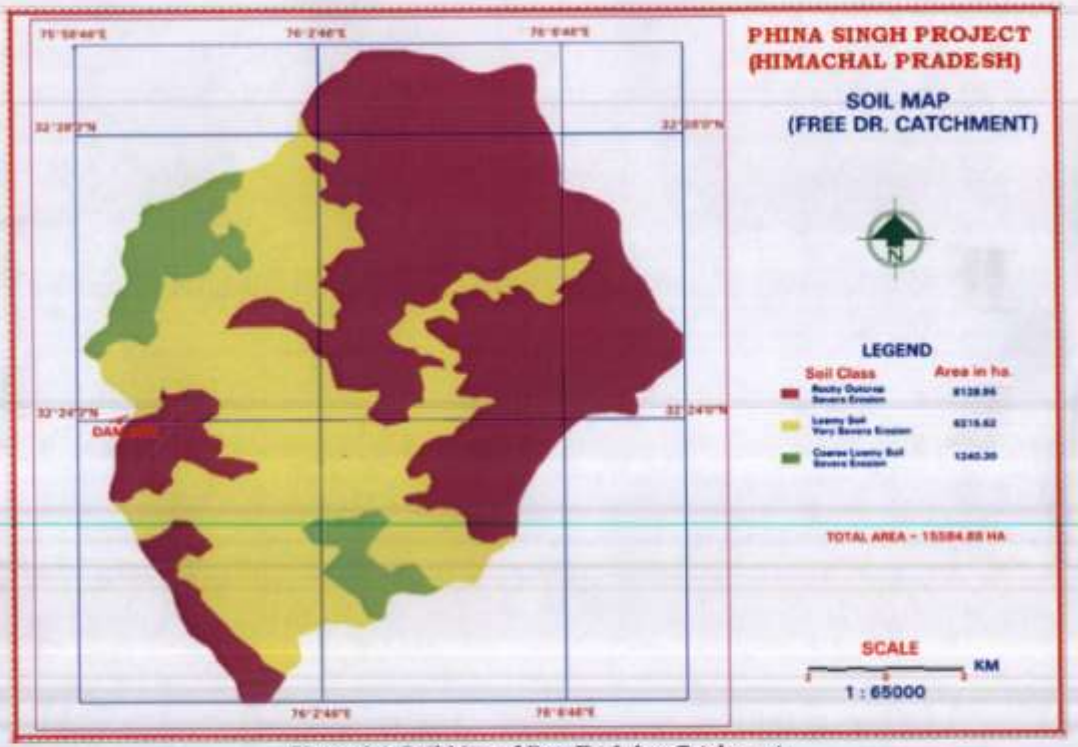


Figure 3.4: Soil Map of Free Draining Catchment

3.6 METHODOLOGY USED FOR THE STUDY

The digital satellite data of IRS P6 LISS-III was evaluated on ERDAS Imagine Software. The standard False Colour Composite (FCC) was generated by assigning blue, green and red colours to visible green, visible red and near infrared bands respectively. Expressing image pixel addresses in terms of a map coordinate base is often referred to as geo-coding. As various thematic layers were to be overlaid for this project, all the layers were geo-referenced to real world coordinates. The 1:50,000 scale topo-sheets No 52 D/3 and 43 P/15 of the catchment area were used for the purpose of geo-referencing. A large number of GCPs were selected for reasonably accurate geo-referencing/geo-coding. A map projection system (real world) was also defined.

Histogram of the scene under study has been generated to check the range of spectral values present in the scene. In order to use total grey range and to optimize the contract, the actual grey level ranges of three bands were linearly stretched independently. The zoomed images were studied wherever necessary. The interpretation key necessary for identifying different features has been developed systematically on the basis of image characteristics and associated elements viz. shape, size, shadow, pattern, colour/tone, texture, association, location and available ground truth. Among these characteristics, shape, size, shadow and pattern are basically dependent on the scale of the image whereas the colour/tone and texture depends upon the brightness, contrast and resolution of the image. Various land units were identified, delineated and the map was validated.

A detailed field survey was conducted for study of soil characteristics and erosion prone areas and landslides in the catchment area. The vulnerable and problematic areas were identified in different physiographic zones in the entire catchment area. The data was generated on physiographic, land-use/land cover, litho-logy, structure, drainage pattern, slope characteristics, landslides/slips, etc. These data sets were used for preparation of thematic maps, calculation of sediment yield index and Erosion Intensity Units in the catchment area according to the following procedures:

3.6.1 Land use-Land Cover Classification

- Prior to ground truth the satellite data was classified using unsupervised classification technique. Further, after collecting ground truth details maximum likelihood classification based on supervised classification method was used with remote sensing image data.

- After the supervised classification procedure a land-use map was prepared which the team at field verified and any errors or omissions were identified.
- A reclassification of the land-use categories implementing the details and corrections, if any, was done. The reclassification output was used for preparation of the final land-use classification map. As required this map after due verification was then composed and printed.
- The Land use map of the study area and free draining catchment area is presented in **Figure 3.5**. The land-use/land-cover details for free-draining catchment and its sub-watersheds are presented in **Table 3.2**.

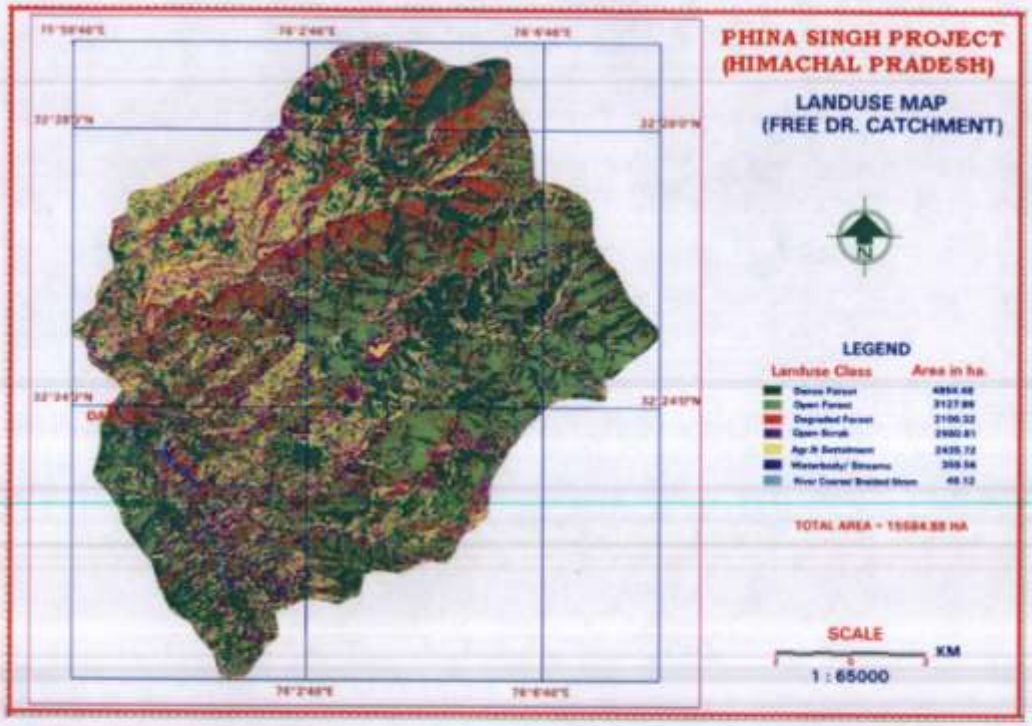


Figure 3.5: Land use Map of Free Draining Catchment Area

Table 3.2: Land Use Details of Sub-watersheds in the Free Draining Catchment

Sl. No.	Name of SWS and Code	Area Under Different Land Use Classes (ha)							Total Area (Ha)	Percentage of Total (%)
		Dense Forest	Open Forest	Degraded Forest	Open Scrub	Agriculture & Settlement	Sand & Flood Plains	River / Water Body		
1.	Kalam Khad, 1B1A7(1)	1908.39	1184.73	1127.34	1180.89	1208.19	8.50	122.32	6740.36	43.25
2.	Balud Khad 1B1A7(2)	354.98	302.52	203.06	324.54	307.03	5.08	42.12	1539.26	9.88
3.	Chakki Khad, 1B1A7(3)	2591.19	1640.61	769.92	1155.39	920.50	32.53	195.12	7305.26	46.87
Total		**4854.49**	**3127.86**	**2100.32**	**2660.82**	**2435.72**	**46.11**	**359.56**	**15584.88**	**100**
% of Total		**31.15**	**20.07**	**13.48**	**17.07**	**15.63**	**0.29**	**2.31**	**100.00**	

3.6.2 Slope Map Preparation

- Slope is a measure of change in the value of altitudes over distance, which in can be expressed in degrees or as a per cent (%). The first step in generation of slope map is to create surface using the elevation values stored in the form of contours or points. Surface is a representation of geographic information as a set of continuous data in which the map features are not spatially discrete, i.e., between any two locations, there are no clear or well defined breaks between possible values of the map feature. Models built from regularly or irregularly spaced sample points on the surface can represent surfaces.
- Slope map of the catchment area was prepared using the elevation information for the area from contour heights. Toposheets of the scale 1:50,000 were collected for the entire directly draining catchment area. These toposheets were then manually pasted together to form a seamless mosaic of the area and the directly drained catchment boundary for the proposed project was marked on them.
- After marking the catchment area all the contours on the toposheet were digitized. The output of the digitization procedure was the contours as well as point contour in the form of x, y and z points. (x and y are location while z is their elevation). All this information was in real world coordinates (latitude, longitude and height in meters above mean sea level).
- A Digital Terrain Model (DTM) of the area was then prepared, which was used to derive a slope map. The slope was divided in classes of slope percentages.
- The slope of a watershed plays an important role in controlling soil and water retention thereby affecting the land-use capability. The percentage of the slope in a watershed determines the soil erosion susceptibility and forms the basis for classifying different watershed into suitable capability classes for formulating suitable soil erosion conservation measures. Broadly, the following slope classes and ranges **(Table 3.3)** as per norms of All India Soil & Land Use Survey were adopted for the present study:

Table 3.3: Slope Class

Sl. No.	Slope Range (Degrees)	Description
1.	0-5	Very Gentle Slope
2.	6-15	Gentle Slope
3.	16-25	Moderate Slope
4.	26-35	Moderately Steep Slope
5.	36-50	Steep Slope
6.	Above 50	Very Steep Slope

The slope map of the free draining catchment is presented in **Figure 3.6**. The slope details are as presented under **Table 3.4**.

Table 3.4: Slope Categories in Respective Sub-Watersheds

Sl. No	SWS Code No	Slope												Total Area (Ha)
		0°-5°		6°-15°		16°-25°		26°-35°		36°-50°		>50°		
		Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	
1.	1B1A7(1)	223.60	3.46	1230.17	18.25	2426.37	36.00	2448.57	36.33	401.65	5.96	0.0	0.0	6740.36
2.	1B1A7(2)	52.94	3.44	382.32	24.84	632.22	41.07	450.56	29.27	21.22	1.38	0.0	0.0	1539.26
3.	1B1A7(3)	189.06	2.59	1651.99	22.61	3156.81	43.21	2001.54	27.40	305.86	4.19	0.0	0.0	7305.26
Total		**475.60**		**3264.48**		**6215.40**		**4900.67**		**728.73**		**0.0**		**15584.88**
% of Total F.D. Catchment			**3.050**		**20.95**		**39.88**		**31.44**		**4.68**		**0.0**	**100 %**

Figure 3.6: Slope Map of Free Draining Catchment Area Soil Loss Using Silt Yield Index (SYI) Method

3.6.3 Soil Loss Using Silt Yield Index (SYI) Method:

- The Silt Yield Index (SYI) Model) considering sedimentation as product of erosivity, erodibility and aerial extent was conceptualized in the All India Soil and Land Use Survey (AISLUS) as early as 1969 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units within river valley project catchment areas.
- Methodology for calculation of sediment yield index developed by All India Soil & Land Use Survey (Development of Agriculture, Govt. of India) was followed in this study.

(i) Erosion Intensity and Delivery Ratio

- Determination of erosion intensity unit is primarily based upon the integrated information on soil characters, physiography, slope, land-use/land-cover, lithology and structure. This is achieved through super-imposition of different thematic map overlays. Based upon the field data collected during the field survey and published data, weightage value and delivery ratio were assigned to each erosion intensity unit. A composite map for delineating different erosion intensity units was prepared through superimposition of the maps showing soil types, slope, and land-use/land-cover. This thematic mapping of erosion intensity for the entire catchment was done using the overlay and union techniques. Based on ground truth verification conducted during fieldwork and published data weightage and delivery ratio was assigned to each erosion intensity units. The composite erosion intensity map was then superimposed on the drainage map with sub-watershed boundaries to evolve CEIU for individual sub-watershed.
- Each element of erosion intensity unit is assigned a weightage value. The cumulative weightage values of the erosion intensity units represent approximately the relative comparative erosion intensity within the watersheds. A basic factor of K=10 was used in determining the cumulative weightage values. The value of 10 indicated an equilibrium condition between erosion and deposition. Any value of K (10+X) is suggestive of erosion intensity in an ascending order whereas the value of K (10-X) is suggestive of deposition intensity in descending order.
- The delivery ratios were calculated for each composite erosion intensity unit. The delivery ratio suggests the percentage of eroded material that finally finds entry into the reservoir or river/stream. Total area of different erosion intensity classes (composite erosion intensity unit) in each watershed was then calculated.

- The delivery ratio is generally governed by the type of material, soil erosion, relief length ratio, cover conditions, distance from the nearest stream, etc. However, in the present study the delivery ratio to the erosion intensity units was assigned upon their distance from the nearest stream (being the most important factor responsible for delivery of the sediments) according to the scheme presented in **Table 3.5**.

Table 3.5: Delivery Ratio (DR) Criteria Adopted for the Project

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

(ii) Sediment Yield Index and Prioritization of Sub-Watersheds

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

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

- The Silt Yield Index (SYI) is defined as the Yield per unit area and SYI value for hydrologic unit is obtained by taking the weightage arithmetic mean of the products of the weightage value and delivery ratio over the entire area of the hydrologic unit by using suitable empirical equation.
- Prioritization of smaller hydrological units within the vast catchments is based on the SYI of the smaller units. The boundary values of range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating the suitable braking point. The watersheds/sub-watersheds is subsequently rated into various categories corresponding to their respective SYI values.
- The application of SYI model for prioritization of sub-watersheds in the catchment areas involves the evaluation of:

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

- Data on climatic factors can be obtained for different locations in the catchment area from the meteorological stations whereas field investigations are required for estimating the other attributes.
- The various steps involved in the application of model are:
  - Preparation of a framework of sub-watershed through systematic delineation
  - Rapid reconnaissance surveys on 1:50,000 scale leading to the generation of a map indicating erosion-intensity mapping units.
  - Assignment of weightage values to various mapping units based on relative silt-yield potential.
  - Computing Silt Yield Index for individual watersheds/sub watersheds.
  - Grading of watersheds/sub-watersheds into very high, high, medium, low and very low priority categories.
- The area of each of the mapping units is computed and silt yield indices of individual sub-watersheds are calculated using the following equations:

Silt Yield Index

SYI = (Ai x Wi x Di) x 100/Aw **where i = 1 to n**

Where

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

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

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

(Refer pp 27-28 of AISLUS Bulletin-99)

Accordingly, the Sediment Yield Index was calculated for sub-watersheds and they were prioritized. In the free draining catchment very high and high priority were assigned to 1 and 2 sub-watersheds respectively. The calculation of SYI has been shown in **Table 3.6**.

Table 3.6: SYI and Priority Rating as per Erosion Intensity

SWS Code	Erosion Intensity Class	Area (ha)	Weightage	Weightage x Area	DR	Gross Silt (EXF)	SYI	Priority
A	B	C	D	E	F	G	H	I
1B1A7(1)	Negligible	327.29	10	3272.90	1.0	3272.90	1268	High
	Slight	1594.80	11	17542.80	1.0	17542.80		
	Moderate	4222.61	13	54893.93	1.0	34893.93		
	Severe	523.88	18	9429.84	0.9	8486.86		
	Very Severe	71.78	20	1435.60	0.9	1292.04		
	Total	**6740.36**				**85488.53**		
1B1A7(2)	Negligible	46.34	10	463.40	1.0	463.40	1363	Very High
	Slight	130.43	11	1434.73	1.0	1434.73		
	Moderate	1086.71	13	14127.23	1.0	14127.23		
	Severe	275.78	18	4964.04	1.0	4964.04		
	Very Severe	0.00	20	0.00	1.0	0.00		
	Total	**1539.26**				**20989.40**		
1B1A7(3)	Negligible	476.43	10	4764.30	1.0	4764.30	1281	High
	Slight	1180.20	11	12982.20	1.0	12982.80		
	Moderate	4905.34	13	63769.42	1.0	63769.42		
	Severe	738.64	18	13295.52	0.9	11965.97		
	Very Severe	4.65	20	93.00	0.9	83.70		
	Total	**7305.26**				**93565.59**		

3.7 CATCHMENT AREA TREATMENT PLAN

It is known that there are mainly five categories of land uses for which a proper treatment plan should be developed. First is the agricultural land as this activity can never be eliminated. It is also known that faulty agriculture activities result in heavy loss of fertile soil. Second is open forest land for obvious conservation reasons. Third is scrub or degraded land, which contributes heavily to the silt load. Possibilities exist to bring this area under pastures and other plantation to meet the local demand of fuel and fodder and thus decreasing biotic pressure on the forests and leading to environment friendly approach of sustainable development. The fourth and most important category is barren land because with practically no vegetal cover, the area produces huge amount of silt load. The fifth is dense forest land where soil conservation measures are required at few places. For treatment of catchment area, the areas requiring treatment have been delineated with the Composite Erosion Intensity Unit Map. The sum of weightage was reclassified as per **Table 3.7** below to subdivide the area as per the erosion intensity classes. The weightage for land use, slope and soil were summed to get the Erosion Intensity Classes.

Table 3.7 Erosion Intensity and Weightage

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

For all sub-watersheds, 100% area falling under erosion intensity category, would be taken-up for conservation treatment measures. In view of the fact that various soil conservation and afforestation activities in the catchment area are being carried out by various agencies, such as, Soil Conservation Department, Forest Department and under Block Development Schemes, only 30% of area falling under severe erosion intensity would be taken-up for conservation treatment measurers. In the present case, an area of 538 ha requires implementation of CAT. The Erosion Intensity Map of the free draining catchment is presented in **Figure 3.7** and statistics presented in **Table 3.8**.

Table 3.8: Erosion Intensity Categories in Sub-Watersheds

S. No	SWS Code No.	Area under different erosion intensity class (ha)					Total Area (ha)
		Negligible	Slight	Moderate	Severe	Very Severe	
1.	1B1A7 (1)	327.29	1594.80	4222.61	523.88	71.78	6740.36
2.	1B1A7 (2)	46.34	130.43	1086.71	275.78	0.0	1539.26
3.	1B1A7 (3)	476.43	1180.20	4905.34	738.64	4.65	7305.26
	Total	**850.06**	**2905.43**	**10214.66**	**1538.30**	**76.43**	**15584.88**

Considering the topographic factors, soil type, climate, land-use/land-cover in the catchment area following engineering and biological measures have been proposed to be undertaken with the aim to check the soil erosion, prevent/check siltation of reservoir and to maintain its storage capacity in the long run:-

3.7.1 Erosion and Land Use

Erosion acts differently in different land-use types. It is important to understand the nature of erosion in a particular land-use class to further plan for treatment.

3.7.1.1 Agricultural Land

Around 2435.72 ha area constituting 15.63% of the total free drainage catchment comes under this category. Well-planned and developed terraces were seen at most of the places. Almost 63% of the agricultural land is either properly levelled or has slope between 0-25^0. In general, at places sheet and rill type of soil erosion predominates with few gullies in early stage of its development. Very few or no measures are taken to conserve soil and tendency exists to interrupt the natural drainage due to faulty agricultural practices. Runoff often exceeds the safe velocity on long slope lengths. It is suggested to repair and better design agricultural terraces. In undulated plateau, contour cultivation on 2^0-5^0 slopes should be followed as it successfully controls soil erosion during low to medium intensity rainfall. Contour tillage with contour strip cropping is most effective. Cover crops should be grown off season as these provide adequate ground cover and also increase organic content in the soil thereby improving water infiltration and reducing the runoff.

Agro-forestry practices should be introduced. Contour hedgerow technology of agricultural practice should be followed. Temporary and semi permanent soil conservation structures like brushing dams, wiring woven, gabion check dams etc are proposed.

3.7.1.2 Open Scrub

Under the waste land category 2660.82 ha area constituting 17.07% of the free draining catchment is present. Waste land is characterized by highly degraded land surface and rock outcrops. Very little or no vegetation cover exists. Huge gullies, frequent land slips and high to extreme high erosion rates are other prominent features. Plantation is proposed for this land.

3.7.1.3 Degraded Forest

Around 2100.32 ha area constituting 13.48% of the free draining catchment area is classified under this land-use category. These areas are characterized by highly degraded land surface. Very little and only seasonal vegetation cover exists. Huge gullies, frequent land slips and high to extremely high erosion rates are other prominent features. Well planned plantations followed by Stream bank Protection works are suggested for such land-use category undergoing erosion. Silvi-pasture plantation and natural rejuvenation can also be done.

3.7.1.4 Waste Land

About 46.11 ha area constituting about 0.29% of the free draining catchment is present. The area which is mainly sand and flood plains boulder heaps and rocky sheets can not be given any type of treatment.

3.7.1.5 Open Forest Land

Under open forest category 3127.86 ha, constituting 20.07% of the free draining catchment, is present. Forest crown density ranges from 20-40% or on an average 30% crown density can be assumed to be present in the area. Soils have relatively good water holding capacity, humus and nutrients and have moderate to slight erosion rates on steeper slopes. Therefore, rill erosion pre-dominates which in due course leads to scrub lands formation with gullies. Plantation is suggested so as to increase the crown density by 30% in the area under treatment.

3.7.1.6 Dense Forest

Dense forest covers 4854.89 ha area constituting 31.15% of the free draining catchment forest crown density ranges above 60%. Soils are very good in water holding capacity, rich in humus and nutrients with no erosion. However, due to steeper slopes some areas require soil conservation measures. Under this model soil conservation measures have been proposed.

3.7.1.7 River and Water Body

Under this category 359.56 ha area constituting 2.31% of the catchment area exists. Stream bank protection is suggested in areas where the landslides have been visible from the bottom in river section.

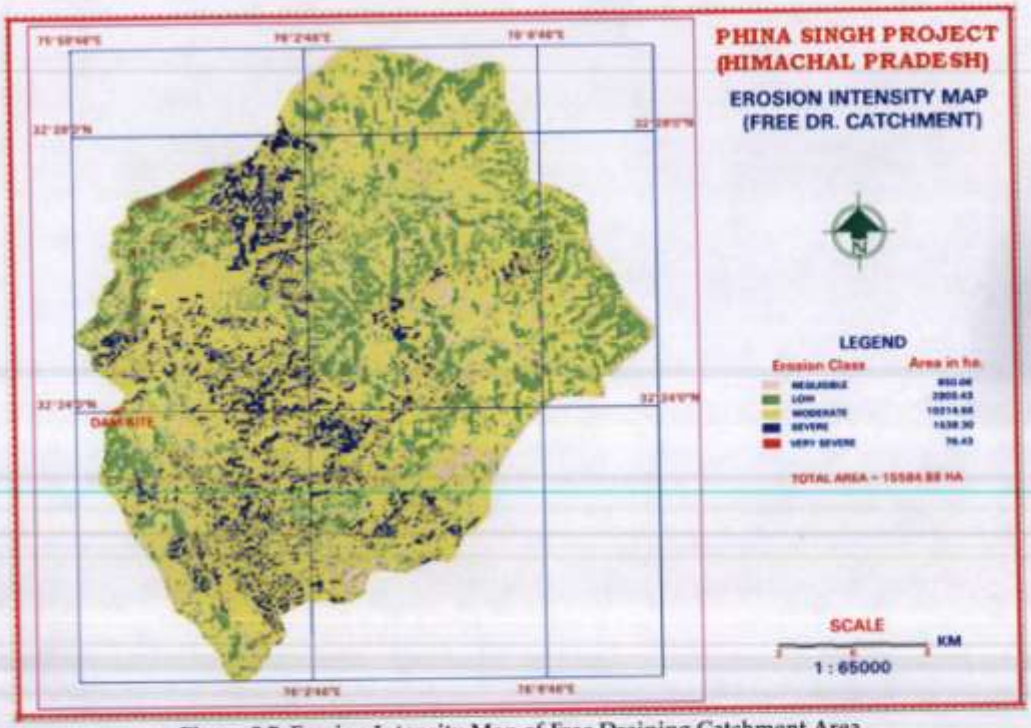


Figure 3.7: Erosion Intensity Map of Free Draining Catchment Area

3.7.2 Activities to be Undertaken

3.7.2.1 Afforestation

In critically degraded areas, plantation of locally useful diverse and indigenous plant species such as medicinal plant species, Bamboo, fodder, wild fruit bearing and fuel wood species would be undertaken. The afforestation will include planting of suitable local species in the steep and sensitive catchment areas of rivers/ streams with the objective of keeping such areas under permanent vegetative cover. Furthermore, degraded areas would also be brought under vegetation cover. Suitable trees of economic value to local people shall be raised in the degraded forest areas near to villages with the objective of supplementing livelihood of the villagers.

The area after removal of Lantana will be planted with Bamboo, medicinal value plant species, wild fruit bearing and other suitable indigenous species. No fencing will be involved instead a strip of Lantana bushes on the periphery of the plantation will serve as live fence with no maintenance. In the areas which are not infested with Lantana the normal Himachal Pradesh Forest Department model for plantation especially in temperate areas, if required will be followed. However, it is recommended that to protect the plantation, extra efforts of the local staff, involvement of local people, Self-Help-Groups will be required and will be very critical for survival of the plantations. The species to be planted will be, Bamboo, *Pinus roxburghii, Dalbergia sissoo, Quercus leucotrichophora, Albizia spp., Toona ciliata, Acacia catechu, Rhododendron arboreum, Juglans regia, Punica granatum, Phyllanthus emblica, Grewia optiva, Bauhinia variegata, Terminalia chebula, Sapindus mukrosii, Populus deltoides, Picea smithiana,Cedrus deodara,* etc.

3.7.2.2 Bio-engineering

Bio-engineering is state-of-the-art technique using the living vegetation, either alone or in conjunction with non-living plant material and civil engineering structures, to stabilize slopes and/or reduce erosion. Such measures utilize live plants and plant parts, either alone or in conduction with non-living plant material and hand measures usually referred to as civil engineering structures, where they provide additional mechanical support to soil, present barriers to earth movement, function as hydraulic drains, and act as hydraulic pumps. Bio-engineering system use live plant cuttings, rooted plants, and plant stems that are placed in the ground, or in earthen or other structures. Multi-layered vegetation is raised along with the soil conservation measures to stabilize and improve the area. The concept being that the area has to be stabilized with shrub and herb species along with minor soil conservation measures during the initial two years and during the third year, 500 plants per ha are to be planted to further stabilize the area, so it is able to support permanent vegetation in future.

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

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

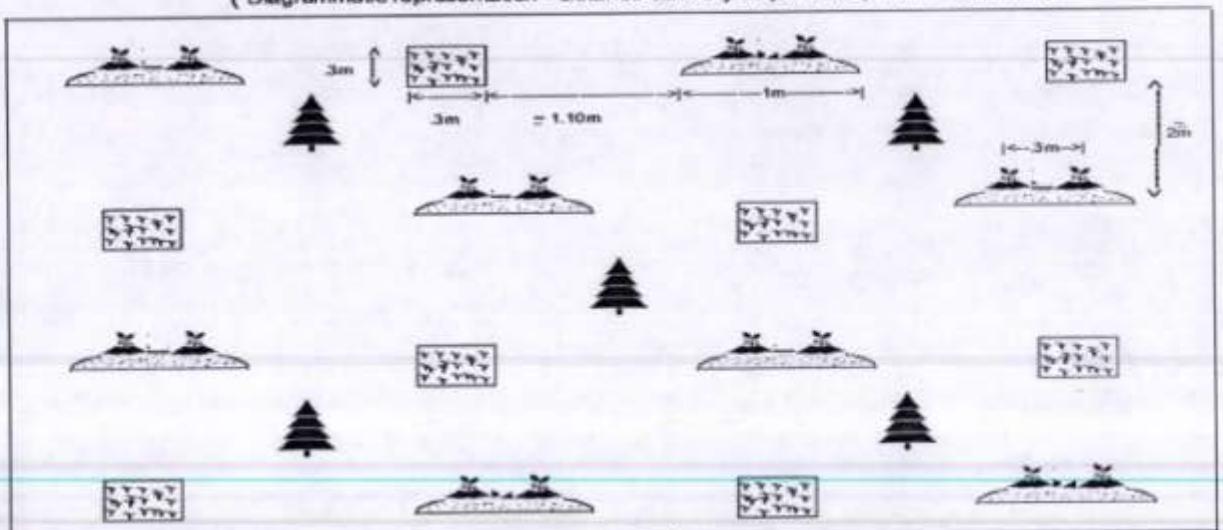
The successful results of bio-engineering techniques have been observed in gully control, waste land reclamation and slope stabilization. By for these have been observed to be economically desirable and most-effective for erosion control in degraded area.

Bio-engineering measures shall be adopted in degraded areas, landslide zones and area degraded due to road excavation. The work shall involve minor soil conservation works, fixing of brush wood check dams, patch sowing of grass and legume seeds, plantation of bio-engineering species of shrubs, herbs and trees i.e. @ 1400 shrubs and 500 trees/ ha, fencing of the area with live hedge and maintenance for 1 year of shrub species and 2 years for tree species. The diagrammatic representation of bio-engineering plantation model for degraded forest land is given in Figure: 3.8.

The most common method of hill and slope stabilization is the seeding of grass and shrub mixture. The bio-engineering works will be completed within first 3 years with subsequent maintenance support. On steeper slopes where it is necessary to cover the soil quality, a cover crop seeding is used. On the surface normal seed (5 g/sq. m.) are spread. Local indigenous woody perennials species (trees/ shrubs) to be planted will include, *Boerhavia regulosa, B. platyphylla, Dalbergia sisoo, Berberis spp., Adhatoda zeylanica, Vitex negundo, Zanthoxylum armatum, Asparagus adscendens, Indigofera heterantha, Colebrookia oppositifolia, Agave spp., Debregeasia hypoleuca, Woodfordia fruticosa, Murraya koenigii, Spiraea canescens, Rosa moschata, Ficus palmata, Ailanthus excelsa, Arundinaria falcata, Alnus nitida, Populus ciliata, Salix tetrasperma, etc.* The grass and perennial species for patch sowing/ turf planting will include from *Arundo donax, Thysanolaena maxima, Sachharum munja, S. spontaneum, Eulaliopsis binata, Cynodon dactylon, Cymbopogon citrates*, etc. The live-hedge fencing will be raised of woody perennials fast growing species having extensive root system, which includes species as *Berberis, Adhatoda, Vitex,. Asparagus, Zanthoxylum, Wikstroemia, Indigofera, Agave spp.*, etc.

Bio-engineering Plantation Model for Degraded Forest Lands

(Diagrammatic representation - distance can vary as per site specific conditions)



INDEX

- Trench mound (700 No./Per Hac) to be planted with pair of shrubs species (1400 No. Shrubs Per Hac).
- Patch /grass strip sowing of indigenous Grasses (700 patches Per Hac.)
- 500 Tree species per Hac. to be planted during 3rd Year

Other main features

-> Live hedge fencing of local species to be provided
-> One year maintenance for shrubs
-> Two Year maintenance for tree species i.e during 4th & 5th Year
-> Minor soil arresting /soil and moisture conservation operations as per requirement.
-> Total cost for 5year ₹ 50,000/- per Hac.

Figure: 3.8: Diagramitic representation of bio-engineering plantation model for degraded forest land

3.7.2.3 High Density Energy Plantation

In order to reduce the biotic pressure on the forest areas near the villages, high density energy plantation in forest areas and barren areas under the village can help in long way to solve the ever increasing problem of scarcity of fodder and fuel wood in hilly areas. To overcome the problem of scarce availability of fodder and fuel it is proposed to raise high density energy plantation having close spacing between trees and to bring substantial area by planting 3000 trees/ ha with suitable fast growing species. Species to be planted will be *Prunus padus, Robinia pseudoacacia, Populus deltoides, Melia azadirachta, Salix* spp., *Bauhinia variegata,* etc.

3.7.2.4 Rim Plantation along the Periphery of Reservoir

For control of erosion and siltation of the streams directly joining the reservoir a green belt is proposed to be developed within the reservoir rim in a width of 75 m and extending up to 1.5 km from dam site along Chakki Khad and 75 m width and extending up to 500 m from trench weir site on Kalam Khad. The strategy worked out for development of green belt consists of the following:

- Broad leaved trees growing above 10 m in height should be planted along the periphery of reservoir and approach roads.
- Plantation of trees should generally be undertaken in appropriate encircling rows @ 3000 plants per ha
- Local/indigenous trees / shrubs should be preferred i.e. *Dalbergia sissoo, Quercus leucotrichophora, Albizia spp., Toona ciliata, Acacia catechu, Punica granatum, Phyllanthus emblica, Grewia optiva, Bauhinia variegata, Terminalia chebula, Dabregeasia hypoleuca, Dodonaea viscosa, Cassia fistula, Alnus nepalensis, Prunus padus, Coriaria nepalensis, Vitex negundo, Melia azadirachta, Salix* spp., *Bauhinia variegata,* etc.
- The trees should be protected by plantation of non palatable shrub species to avoid browsing by animals
- Bamboo/Iron Tree Guards be provided to protect the young plants as per requirement.

In areas wherever private land falls along the periphery of the reservoirs the plantation will be done by distributing saplings free of cost to villagers, so that they are motivated to take up plantation in their land.

3.7.2.5 Nursery Support

In order the meet the huge requirement of saplings required under biological / bio-engineering measures and reservoir rim treatment support to the existing nurseries is essential to raise quality planting stock so as to

augment the supply of saplings for the works proposed. A provision of Rs. 29 lakh is being provided to strengthen the nurseries. A dedicated section within the Central Nursery shall exclusively raise quality saplings of Bamboo species for which 7 lakhs within Rs. 29 lakhs has been earmarked.

3.7.2.6 Engineering Measures

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

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

- **Slope Modification by Stepping or Terracing**

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

- **Bench Terracing**

  The area under moderately steep slope i.e. between 10^0-15^0 slope would be subjected to bench terracing. The local people would be convinced to follow this type of terracing for comparatively better yield and with minimum threat to erosion. Moreover, in a number of habitations in the catchment such practices are already visible. While making bench terraces, care will have to be taken not to disturb the topsoil by spreading earth from the lower terraces to higher terraces. The vertical intervals between terraces will not be more than 1.5m and cutting depth may be kept at 50 cm. The minimum average width of the terrace would be kept from 4 to 5 m in order to enable usage of prolong hinge. The shoulder bunds of 30 x 15 cm would also be provided. Staggered channels will drain off the excess water from the terraces.

- **Gully Control-Check Dams**

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

transport accessibility. Generally brush wood check dams are recommended to control the erosion in the first order basin/streams in upper reaches and dry random stone masonry check dam shall be provided in the lower reaches where discharge is higher. In such stream where discharge and velocity of flow are still higher gabion structure shall be provided. Lower down the sub-watershed, i.e., in the third order drainage silt retention dams in the form of gabion structure shall be provided.

- **Stream Bank Protection**

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

- **Contour Staggered Trenches**

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

- **Landslide Control**

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

- **Catch-Water Drains**

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

3.8 TREATMENT OF INDIVIDUAL SUB-WATERSHED

The area and type of treatment to be undertaken is based upon stream drainage pattern, extent of forest cover, accessibility of the area, land-use, soil profile and slope. Details of sub-watershed-wise treatment measures are described below:

3.8.1 Sub-Watershed: Kalam Khad 1B1A7 (1)

The sub-watershed is mainly drained by Kalam Khad whose two upper arms viz., Badhenal and Babledhnar originate from bridge of Dhauldhar ranges near Kainthali RF (Elevation 2723 m) and Khara Danda or Chamba Jot (Elevation 2441 m) respectively. Maradinal is another tributary meeting Kalam Khad on its right bank near Tipri. The sub-watershed has a geographical area of 6740.36 constituting 43.25% of the free draining catchment with Elevation varying from 725 m to 2723 m.

The predominant land- use is dense forest (1908.39 ha) followed by agriculture and settlement (1208.19 ha), open forest (1184.73 ha), open scrub (1180.89 ha), degraded forest (1127.34 ha) and rest other classes of land use. The very severe and severe erosion intensity prone area have been assessed as 71.78 ha and 523.88 ha respectively and the sub-watershed has been prioritized as high on the basis of SYI. The thematic map of sub-watershed is shown in **Figure 3.8**. It is proposed to treat 287 ha area by biological and engineering measures as per following:-

	Corrective Measures	Area in Ha
1.	Afforestation	68.00
2.	High Density Energy Plantation	16.00
3.	Bio-engineering Works	107.00
4.	Rim Plantation	20.00
5.	Engineering Measures (Ha/ Nos.)	76.00
	Sub Total	**287.00**

The treatment measures, under the sub-watershed, proposed to be carried out in beats of forest blocks under Chowari range are given in **Table-3.9**.

Table 3.9: Forest Block / Beat-wise Treatment Measures

Sl. No.	Forest Block / Beat	Afforestation / Plantation (Ha)	High Density Energy Plantation (Ha)	Bio-Engineering Works (Ha)	Rim Plantation Around Dam Site (Ha)	Engineering Measures (Ha/ No.)
A.	**Chowari Block**					
(i)	Lower Chowari	12	2	25	-	12
(ii)	Upper Chowari	8	2	10	-	12
(iii)	Lahru	10	4	18	20	8
B.	**Kainthali Block**					
(i)	Kainthali	18	4	26	-	20
(ii)	Khara Danda	20	4	28	-	24
	Total	**68**	**16**	**107**	**20**	**76**

Location-wise proposed afforestation/ plantation activities, bio-engineering works, high density energy plantation, rim plantation and soil conservation works for the beats under various forest blocks of the sub-watersheds have been marked in the Survey of India map together with agricultural, horticulture and animal husbandry practices followed in the area has been shown in **Annexure-I** along with photographs showing prominent erosion at some places under concerned forest blocks.

Figure 3.9: Thematic Map of SWS 1B1A7(1)

3.8.2 Sub-Watershed: Balud Khad 1B1A7 (2)

The sub-watershed is mainly drained by Balud Khad, a third order stream, originating from Bintrudhar (Elevation 2361 m), located in mixed jungle mainly pine. Balud Khad meets Chaki Khad upstream of Lahru and upstream of the proposed dam or the latter. The sub-watershed has a geographical area of 15.39.26 ha constituting 9.88% of the total catchment area with Elevation varying from 715 m above msl to 2361 m above msl. Predominant land use is dense forest (354.91 ha) followed by open scrub (324.54 ha), agriculture and settlement (307.03 ha), open forest (302.52 ha), degraded forest (203.06 ha) and rest other classes of land uses. The very severe and severe erosion intensity prone area has been assessed as 275.78 ha and the sub-watershed has been prioritized as very high on the basis of SYI. The thematic map of the sub-watershed is shown in **Figure 3.9**. It is proposed to treat 51 ha under the sub-watershed by biological and engineering measures as per following:-

	Corrective Measures	**Area in Ha**
1.	Afforestation	15.00
2.	High Density Energy Plantation	5.00
3.	Bio-engineering Works	5.00
4.	Rim Plantation	10.00
5.	Engineering Measures (Ha/ No.)	16.00
	Sub Total	**51.00**

The treatment measures, under the sub-watershed, proposed to be carried out in beats of forest blocks under Chowari range are given in **Table-3.10**.

Table 3.10: Forest Block / Beat-wise Treatment Measures

Sl. No.	Forest Block / Beat	Afforestation / Plantation (Ha)	High Density Energy Plantation (Ha)	Bio-Engineering Works (Ha)	Rim Plantation Around Dam Site (Ha)	Engineering Measures (Ha/ No.)
A.	**Raipar Block**					
(i)	Raipar	10	3	3	-	14
(ii)	Saloh	5	2	2	10	2
	Total	**15**	**5**	**5**	**10**	**16**

Location-wise proposed afforestation/ plantation activities, bio-engineering works, high density energy plantation, rim plantation and soil conservation works for the beats under various forest blocks of the sub-watersheds have been marked in the Survey of India map together with agricultural, horticulture and animal husbandry practices followed in the area has been shown in **Annexure-I** along with photographs showing prominent erosion at some places under concerned forest blocks.

Figure 3.10: Thematic Map of SWS 1B1A7(2)

3.8.3 Sub-Watershed: Chakki Khad 1B1A7 (3)

The sub-watershed is mainly drained by Chaki Khad whose first order streams originate from Kharu Gala (Elevation 2773 m) located in dense mixed jungle mainly deodar and its left bank tributary Rupned Khad, which is joined by Galed Nala a third order stream, emanating near Dhadu Dhar (Elevation 2300 m). The sub-watershed has a geographical area of 7305.26 ha constituting 46.87% of the total catchment area with Elevation varying from 2773 m to Elevation 705 m. Predominant landuse is dense forest (2591.19 ha) followed by open forest (1640.61 ha), open scrub (1155.39 ha), agriculture and settlement (920.50 ha), degraded forest (769.92 ha) and rest other classes of land uses. The very severe and severe erosion intensity prone areas have been assessed as 4.65 ha and 738.64 ha respectively and the sub-watershed has been prioritized as high on the basis of SYI. The thematic map of the sub-watershed is shown in **Figure 3.10**. It is proposed to treat 267 ha area under sub-watershed by biological and engineering measures.

	Corrective Measures	Area in Ha
1.	Afforestation	76.00
2.	High Density Energy Plantation	29.00
3.	Bio-engineering Works	116.00
4.	Engineering Measures (Ha/ No.)	46.00
	Sub Total	**267.00**

The treatment measures, under the sub-watershed, proposed to be carried out in beats of forest blocks under Chowari Range are given in **Table-3.11**.

Table 3.11: Forest Block / Beat-wise Treatment Measures

Sl. No.	Forest Block / Beat	Afforestation / Plantation (Ha)	High Density Energy Plantation (Ha)	Bio-Engineering Works (Ha)	Rim Plantation Around Dam Site (Ha)	Engineering Measures (Ha/ No.)
A.	**Raipar Block**					
(i)	Chakki	50	15	86	-	34
B.	**Manutha Block**					
(i)	Hathidhar	12	5	12	-	5
(i)	Manutha	12	8	15	-	5
(iii)	Parsiyara	02	1	3	-	2
	Total	**76**	**29**	**116**	**-**	**46**

Location-wise proposed afforestation/ plantation activities, bio-engineering works, high density energy plantation and soil conservation works for the beats under various forest blocks of the sub-watersheds have been marked in the Survey of India map together with agricultural, horticulture and animal husbandry practices followed in the area has been shown in **Annexure-I** along with photographs showing prominent erosion at some places under concerned forest blocks.

Figure 3.11: Thematic Map of SWS 1B1A7(3)

3.9 COST ANALYSIS OF DIFFERENT WORKS UNDER PLAN

3.9.1 Afforestation

Most of the area is heavily infested with Lantana and accordingly as suggested by the Himachal Pradesh Forest Department, the area after removal of Lantana will be planted with Bamboo, medicinal value plant species, wild fruit bearing and other suitable indigenous species. No fencing will be involved; instead a strip of Lantana bushes on the periphery of the plantation will serve as live fence with no maintenance. However, it is recommended that to protect the plantation, extra efforts of the local staff, involvement of local people, Self-Help-Groups will be required and will be very critical for survival of the plantations. The cost analysis per ha plantation @ 1100 plants/ha under afforestation has been worked out on the basis of norms fixed for arriving per hectare afforestation cost as per Himachal Pradesh Forest Department Memorandum, after incorporating labour and Lantana removal costs. No fencing is being provided as only a strip of Lantana in the periphery will be retained. Suitable species of the area as mentioned in para-3.7.2.1, mainly Bamboo will be planted. Out of the total stock to be planted under afforestation, 25% species shall be tree species having medicinal values. Beside this appropriate proportion of fruit bearing wild species useful to Wildlife shall also be planted. The cost analysis per hectare of afforestation for **Model-A**, inclusive of maintenance for three years at Rs. 29,000/- ha (excluding fencing) with maintenance cost is shown in **Table-3.12. Model-B** has been proposed for temperate areas and areas not infested with Lantana with Himachal Pradesh Forest Department norms given in Table-3.13.

Plantation under afforestation component shall be carried through **identified user groups in catchment area.** Plantations will be maintained for three years. For mobilization of user group provision of funds has been made under the Section-3.10.4.

The cost of works under afforestation component for three sub-watersheds has been assessed as Rs. 46.11 lac and is shown in **Table-3.14**.

Table 3.12: Per ha Cost Norm for Model Plantation Works

Model-A: Plantation

Sl. No.	Name of Scheme	Component	With B/ Wire
A	i) Afforestation Lantana removal (100% cutting and uprooting)	Lantana removal/ eradication with retaining of peripheral strip as live fence.	8726
		Planting cost	10286
		Sub Total-Wages	19012

		Cost of plants raised (Rs. 3.50 / Plant)	3850
		Total	**Rs. 22862**
		Norms per ha	**Rs. 23000**

B. Maintenance

B	Maintenance cost		
	First year Maintenance	Maintenance cost	3200
	Second year Maintenance	Maintenance cost	2000
	Third year Maintenance	Maintenance cost	800
		Total Maintenance	**Rs. 6000**

C	**Total Cost per Ha for Afforestation for Lantana infested area including maintenance for three years with 100% Lantana removal except peripheral strip as live hedge.**	**Rs. 29000**

Model-B: In the areas which are not infested with Lantana the normal Himachal Pradesh Forest Department model for plantation especially in temperate areas, if required will be followed with norms of Rs. 30,800 per ha including maintenances. The norms for Model – A & B are almost similar and minor site specific field adjustments in norms for Model-B can be made.

Table 3.13: Per Ha Cost Norms for Model Plantation Works

A] Plantation:

Sl. No.	Name of Scheme	Component	With B/ Wire
A	i) Afforestation ii) Re-afforestation of Scrub Area (1100 plants per ha)	Fencing cost Planting cost	5117 10286
		Sub-Total Wages	15403
		Material cost Other material cost Cost of plants raised (Rs. 3.50 / Plant for Non Tribal)	3500 1100 3850
		Total	23853
		Norms per ha	**Rs. 24000**

B] Maintenance:

Sl. No.	Name of Scheme	Component	With B/ Wire
B	**Maintenance Cost**		
	First Year Maintenance	Maintenance cost	3450
	Second Year Maintenance	Maintenance cost	2250
	Third Year Maintenance	Maintenance cost	1100
		Total Maintenance	**Rs. 6800**

Table 3.14: Cost Estimate for Afforestation Measures

SWS	Area under Afforestation (Ha)	Cost @ Rs. 29000/- Ha (Rs. in Lac)
Kalam Khad	68	19.72
Balud Khad	15	4.35
Chaki Khad	76	22.04
Total	**159**	**46.11**

3.9.2 Bio-engineering Works

Bio-engineering works shall involve minor soil conservation works, fixing of brush wood check dams, patch sowing of grass and legume seeds, plantation of bio-engineering species of shrubs, herbs and trees i.e. @ 1400 shrubs and 500 trees/ ha, fencing of the area with live hedge and maintenance for 1 year of shrub species and 2 years for tree species. The cost analysis per ha of bio-engineering works comprising of plantation, seed spraying, brush wood check dams, fencing cost and maintenance has been assessed as Rs. 50000/- and is given in **Table 3.15**. The cost of works under bio-engineering measures for three sub-watersheds has been assessed as Rs. 114.00 lac and is shown in **Table 3.16**.

Table 3.15: Cost Analysis per ha of Bio-Engineering Works

Bio-Engineering Cost Norms for Degraded Forest Lands (Per Hectare)

(Live Hedge Fencing)

A] First Year Operations:

Sl. No.	Detail of Works	Quantity	Rate (Rs.)	Amount (Rs.)
1	Survey and demarcation of plantation area, marking of sections, path and preparation of map.	1 Hectare	75/ Hectare	75
2	Preparation of inspection part.	200 Rmt.	8 per Rmt.	1600
3	Live hedge fencing with *Agave, Ipomoea, Dodonaea*, etc.	300 Rmt.	10 per Rmt.	3000
4	Preparation of gradonial trenches/ staggered trenches (1 X 0.3 X 0.3 m)	700 No./Rmt.	10.00/ Per Rmt.	7000
5	Digging of 1400 pits on mounds of trenches (2 pits per mound) 20 X 20 X 20 cms.	1400 Nos.	100/%	1400
6	Filling of pits 20 X 20 X 20 cms.	1400 Nos.	60/ %	840
7	Planting of 1400 nos. plants (P Bags) on mounds (2 pits per mound) inclusive of carriage of plants.	1400 Nos.	4/ %	5600

8	Preparation of patches of grass/ legume sowing (0.3 X 0.3 X 0.3 m) inclusive of carriage of plants.	700 Nos.	240/%	1680
9	Sowing of grass/legume seeds in patches	700 Nos.	70/%	490
10	Cost of raising plants [P. bags (6"x4")/Root trainers]in the Nursery	1400 Nos.	2 per plant	2800
11	Cost of grass/legume seed	10 Kg.	200 per Kg.	2000
12	Minor small soil conservation activities as Small gully plugging, brushwood check dams etc.	L/S	3000 per ha	3000
	TOTAL			29485 or say Rs. 29500

B] **Second Year Maintenance Operations:**

Sl. No.	Detail of Works	Quantity	Rate (Rs.)	Amount (Rs.)
1	Strengthening/ support to live-hedge fence (approx. 30%).	300 Rmt.	10 per Rmt.	3000
2	Minor small soil conservation activities as small gully plugging, brushwood check dams etc.	L/S	1100/ ha	1100
	TOTAL			4100

C] **Third Year Operations, Planting of 500 Plants:**

Sl. No.	Detail of Works	Quantity	Rate (Rs.)	Amount (Rs.)
1	Strengthening/ support to live-hedge fence (approximately 30%).	50 Rmt.	10 / Rmt.	500
2	Digging of pits (60 X 60 X 60 cm)	500 Nos.	700/ hundred	3500
3	Filling of pits (60 X 60 X 60 cm)	500 Nos.	280/ hundred	1400
4	Carriage of plants raised in Polythene Bags (P Bags) of size 4"*6", from nursery to roadside by road including loading & unloading over a distance of say 10 kms.	500 plants (1 trips)	1200/- per trip.	1200
5	Carriage of plants (P Bags) from roadside to plantation site by manual labour over a distance of 2 kms. (approximately 20% mortality replacement).	300 plants	160/%/ Km	480
6	Planting of P. Bags plants	500 Nos.	160/ hundred	800

7	Cost of raising plants in P. Bags.	500 Nos.	3.50/ plant	1750
8	Minor small soil conservation activities as Small gully plugging, brushwood check dams etc.	L/S	1000/ ha	1000
	TOTAL			**Rs. 10630**

D] Fourth Year Maintenance Operations:

Sl. No.	Detail of Works	Quantity	Rate (Rs.)	Amount (Rs.)
1	Re-digging of pits (60 X 60 X 60 cm) – 25% mortality.	125 Nos.	700/ hundred	825
2	Filling of pits (60 X 60 X 60 cm)	125 Nos.	200/ hundred	350
3	Carriage of plants raised in Polythene Bags (P Bags) of size 4"*6", from nursery to roadside by road including loading & unloading over a distance of say 10 kms.	125 plants	500/- per trip.	500
4	Carriage of plants (P Bags) from roadside to plantation site by manual labour over a distance of 2 kms.	125 plants	160/%/ Km	400
5	Planting of P. Bags plants	125 Nos.	160/ hundred	200
6	Cost of raising plants in P. Bags.	125 Nos.	3.50/ plant	440
7	Minor small soil conservation activities as Small gully plugging, brushwood check dams etc.	L/S	700/ ha	700
	TOTAL			3415 Or say **Rs. 3400**

E] Fifth Year Maintenance Operations:

Sl. No.	Detail of Works	Quantity	Rate (Rs.)	Amount (Rs.)
1	Re-digging of pits (60 X 60 X 60 cm) – 15% mortality.	75 Nos.	700/ hundred	525
2	Filling of pits (60 X 60 X 60 cm)	75 Nos.	280/ hundred	210
3	Carriage of plants raised in Polythene Bags (P Bags) of size 4"*6", from nursery to roadside by road including loading & unloading over a distance of say 10 kms.	75 plants	500/- per trip.	500
4	Carriage of plants (P Bags) from roadside to plantation site by manual labour over a distance of 2 kms.	75 plants	160/%/ Km	240

5	Planting of P. Bags	75 Nos.	160/hundred	120
6	Cost of raising plants in P. Bags.	75 Nos.	3.50/ plant	263
7	Minor small soil conservation activities as Small gully plugging, brushwood check dams etc.	L/S	500/ ha	500
	TOTAL			2358 Or say **Rs. 2360**

ABSTRACT

Sl. No.	Abstract	Amount (Rs.)
A	First Year Operations	29500
B	Second Year Maintenance Operations	4100
C	Third Year Operations, Planting of 500 Plants	10630
D	First year maintenance of plants planted in 3rd year	3415
E	Second year maintenance of plants planted in 3rd year	2360
	Total Cost per Ha	50005 **Or say Rs. 50000**

Table 3.16: Cost Estimate for Bio-Engineering Works

SWS	Area under Bio-engineering Works (Ha)	Cost @ Rs. 50000/- Ha (Rs. in Lac)
Kalam Khad	107	53.5
Balud Khad	5	2.5
Chaki Khad	116	58
Total	**228**	**114**

3.9.3 High Density Energy Plantation

The cost analysis per ha of plantation @ 3000 plants/ha under high density energy plantation has been worked out on the basis of norms fixed for arriving per hectare afforestation cost as per Himachal Pradesh Forest Department norms proportionally. The cost analysis of high density energy plantation per hectare of afforestation inclusive of maintenance @ Rs. 60000/ha is shown in **Table-3.17.** The cost of work measures for three sub-watersheds has been assessed as Rs. 30.00 lac and is shown in **Table-3.18.**

Table 3.17: Cost Analysis per ha of High Density Energy Plantation

A. Plantation

Energy / High Density Plantation Cost Norms Per Ha
(3000 plants per Ha with Barbed wire Fencing)

Sl. No.	Name of Scheme	Component	With B/ Wire (Rs.)
1	Energy/ High Density Plantations	Fencing Cost	5120
		Planting Cost	28064
		i. Sub Total-Wages	**33184**
		Material Cost	3500
		Other Material Cost	1100
		(ii) Sub Total- M&S	**4600**
		(iii) Cost of 2200 Plants raised in P. bags @ Rs. 3.50 /Plant	**10500**
		Total i+ii+iii (A)	**Rs. 48284**

B. Maintenance

2	Maintenance cost		
	First year Maintenance	Maintenance cost	5700
	Second year Maintenance	Maintenance cost	4000
	Third year Maintenance	Maintenance cost	2300
		Total Maintenance (B)	**12000**
		Total Cost per Ha (A + B)	**60284 Or say Rs. 60000**

Table 3.18: Cost Estimate for High Density Energy Plantation

SWS	Area under High Density Energy Plantation (ha)	Cost @ Rs. 60000/- ha (Rs. in Lakh)
Kalam Khad	16	9.6
Balud Khad	5	3.0
Chaki Khad	29	17.4
Total	**50**	**30**

3.9.4 Reservoir Rim Plantation

The cost analysis for per ha plantation @ 3000 plants/ha under reservoir rim plantation has been worked out on the basis of norms fixed for arriving per hectare afforestation cost proportionately after incorporating labour and material rates as per schedule of rates of Himachal Pradesh Forest Department. The cost per hectare of afforestation inclusive of maintenance at Rs. 68900/ha is shown **Table-3.19. Out of total area of 30 ha, approximately**

10 ha plantation will be done in Saloh beat of Raipur block in Balud Khad catchment and remaining 20 ha plantation will be done in Lahru beat of Chowari block in Kalam Khad catchment around the proposed reservoir. The cost of reservoir rim plantation in 30 ha area @ Rs. 68900/- works out to Rs. 20.67 lac.

Table 3.19: Per Ha Cost Norm for Rim Plantation Works

Sl. No.	Particulars of Work	Quantity	Rate (Rs.)	Amount (Rs.)
A. Fencing Work				
1	Survey and demarcation of plantation area including marking of sections, path and preparation of map	1 ha	74.89/ha	74.89
2	Fencing cost as per HPFD Norms			5117.00
3	Material cost as per HPFD Norms			3500.00
4	Other material cost as per HPFD Norms			1100.00
	Total Fencing Works Cost			**9791.89 Or say Rs. 9792.00**
	B-Planting			
1	Digging of pits 45 cm x 45 cm x 45 cm	3000 Nos.	699.86/hundred	20995.00
2	Filling of pits 45 cm x 45 cm x 45 cm	3000 Nos.	200.01/hundred	6003.00
3	Carriage of plants in P/bags over distance 2 km up hills	3000 Nos.	159.86/hundred/ Km	4795.80
4	Planting of entire plants raised in P/bags	3000 Nos.	160.05/hundred	4801.50
	Total Planting Cost			**36595.30 Or Say Rs. 36595.00**
	C-Material			
1	Nursery cost of plants @ Rs. 3.50 per plant			10500.00
	Total Material Cost			**10500.00**
	Grand Total (A + B + C)			**56887.00 Or Say Rs. 56900.00**

Sl. No.	Abstract	Amount (in Rs.)
	New plantation cost	56900.00
	I year maintenance cost	5700.00
	II year maintenance cost	4000.00
	III year maintenance cost	2300.00
	Total Plantation and Maintenance Cost	**68900.00**

3.9.5 Nursery Support

The cost of strengthening along with renovation of the existing nurseries for implementing nursery support and raising Quality Planting Stock has been assessed as Rs. 29 lakh. A dedicated section in the Central Nursery will be developed exclusively to raise Bamboo species. The nurseries to be strengthened include the following:

Sl. No.	Forest Nursery	Forest Block	Allocation (Rs. in Lacs)
1	Lahru	Chowari	6.00
2	Langhi	Manuhta	4.00
3	Chulla	Kantheli	4.00
4	Chowari	Chowari	5.50
5	Chakaharan	Rajpura	2.50
6	Establishment of dedicated section in Central Nursery for raising and improvement of relevant Bamboo species		7.00
		Total	**29**

The cost estimates are given in **Table 3.20**.

Table 3.20: Cost Estimates for Implementing Nursery Support

Sl. No.	Item	Amount (Rs. in Lac)
1.	Nursery equipments/ tools	1.00
2.	Barbed wire fencing with RCC post/ repair of barbed-wire fencing in existing nurseries.	1.00
3.	Preparation of additional beds in existing nurseries, soil layering in nurseries, establishment of Poly-house/ Poly-tunnels, soil working, establishment of compost and vermin-compost units, strengthening of irrigation facilities, providing insecticides, etc.	19.00
4.	Establishment of dedicated section in Central Nursery for raising and improvement of relevant Bamboo species	7.00
5.	Miscellaneous	1.00
	Total	**29.00**

3.9.6 Engineering Measures

The engineering measures are to be implemented over "Severe" and "Very Severe" erosion intensity areas to control the sediment flow and further degradation of the free draining catchment areas. Since the measures are to be carried out by construction of individual structures such as wire crate spurs, check dams, contour stagger trenches, catch water drains etc., the number of such structures to be raised were calculated in the entire area and accordingly the financial provisions were made. The analysis of rates is presented in **Table 3.21.**

Under engineering measures 22 wire crate boulder spurs, 149 DRSM check dams, 20 ha contour staggered terracing and 0.46 km catch water drains are proposed to be constructed. The overall cost of engineering measures is shown in **Table 3.22** and works out to Rs. 38.63 lac.

Table 3.21: Cost Analyses for Engineering Structures

Sl. No.		Quantity	Unit	Rate	Amount
1.	Dry Rubble Stone masonry (DRSM) Check Dam.				
(a)	Excavation in foundation with 50% soft rock & 50% E & B. 5m x 1.5 x 0.50	3.75	Cum	164.90	618.38
(b)	Labour charges for dry stone masonry with outer face stone dressed & 100 m lead.	17.03	Cum	203.50	3465.54
	I-Step 5 x 1.5 x 1.25 = 9.38				
	II – Step 7 x 1.0 x 0.75 = 5.25				
	Wing Walls 2 x 2x 0.6 x 1.6 = 2.40 17.03				
(c)	Carriage of boulder by mules beyond initial 100 m lead up to 1 km	17.03	Cum	580.88	9892.39
(d)	Collection of boulder	17.03	Cum	128.51	2188.53
				Total	16644.64
				Add 3% Contingencies	484.80
				Grand Total Rs.	16644.64
				Say Rs.	16600.00
2.	Wire Crate Check Dam				
(a)	Excavation in foundation with 50% Shale & 50% E & B -6 x 2 x 1	12	Cum	164.90	1978.80
(b)	Weaving of wire netting of G.I. Wire mesh size 15 cm x 15 cm.				
	Foundation Step -2 (6 x 2 + 6 x 1 + 2 x 1) = 40 cm2				
	I- Step - 2(6 x 1.9 + 6 x 1 + 2 x 1) = 38.8 m2				
	II- Step – 2(6 x 1.8 + 6 x 0.8 + 2 x 0.8) =34.4 m2				
	113.2 m2	113.2		15.95	1805.54

(c)	Filling of boulder and hand packing in wire crates Foundation 6.00 x 2.00 x 1.00 = 12.00 m^3 I-step 6.0 x 1.9 x 1.0 = 11.40 m^3 II-step 6.0 x 1.8 x 0.8 = 8.64 m^3 32.04 m^3	32.04	Cum	105.78	3389.19
(d)	Collection of boulder	32.04		128.51	4117.46
(e)	Carriage of boulder average lead 1 km by mules	32.04	Cum	580.88	18611.40
(f)	Cost of GI wire	2.25	Qtl	8000	18000.00
(g)	Carriage of GI wire to an average lead of 1 km ponies	2.25	Qtl	124.94	281.11
				Total Rs.	**48183.05**
				Add 3% Contingencies	**1445.50**
				Grand Total Rs.	**49629.00**
				Say Rs.	**49600.00**
3.	Wire crate boulder Spurs for stream bank protection				
(a)	Excavation in foundation with 50% soft rock & 50% E & B				
	3.5m x 2.5 x 0.5	4.375	Cum	164.90	721.44
(b)	Filling of boulder and hand packing in Wire crates 2.25m x 1.25m x 1.25 in three tiers i.e. 3 in first tier 2 each in second and third tier.				
	7 (2.25 x 1.25 x 1.25)	24.61	Cum	105.78	2603.25
(c)	Collection of boulder	24.61	Cum	128.51	3162.63
(d)	Carriage of boulder average lead 1 km by mules	24.61	Cum	580.88	14295.46
(e)	Cost of G.1 wire crates				
	7 x 15.10 sq m	105.70	Sqm	159.00	16806.30
(f)	Carriage of G.1. wire crate to an average lead of 1 km by ponies	3	Qtl	124.94	374.82
				Total	37963.90
				Add 3% Contingencies	1138.92
				Grand Total	39102.82
					Say Rs. 39100.00
4	Bench terracing / ha excavation	100	Cum	164.90	16490.00
5	Contour staggered trenches / ha excavation	75	Cum	164.90	12368.00
6.	Catch water drain / RM Average dimension = 1 m x 0.5 m x 0.5 m				
	a. Excavation (1.5 + 0.75) x 0.75	0.84	Cum	164.90	138.52
	b. Collection of boulder	0.50	Cum	128.51	64.26
	c. Carriage of boulder average lead 1 km by mules	0.50	Cum	580.88	290.44
	d. Labour charges for dry stone masonry	0.50	Cum	203.13	101.57
				Total Rs.	**594.79**
				Grand Total Rs.	**595.00**
				Say Rs.	**600.00/ m**

Table 3.22: Cost Estimate for Engineering Measures

SWS	Wire Crate Spurs.		DRSM Check Dam.		Contour Terracing		Catch Drain		Total Cost (Rs. in Lac)
	No.	Cost @ Rs. 39100/ No. (Rs. in Lac)	No.	Cost @ Rs. 16640/No. (Rs. in Lac)	Ha	Cost @ Rs. 12370/ Ha (Rs. in Lac)	Rm	Cost @ Rs 600/ M (Rs. in Lac)	
Kalam Khad	10	3.91	54	8.9856	06	0.7422	150	0.900	14.5378
Balud Khad	-	-	20	3.3280	04	0.4948	150	0.900	4.7228
Chaki Khad	12	4.692	75	12.4800	10	1.237	160	0.960	19.369
Total	22	8.602	149	24.7936	20	2.4740	460	2.760	38.6296
								Say Rs.	38.63

3.10 COST OF OTHER COMPONENTS OF CAT PLAN

Apart from the Forestry works and the drainage line treatment in the catchment area there are other aspects of the CAT plan to be addressed and their cost included in the overall plan. The eco-restoration works, livelihood support works, user group and social mobilization, documentation and publication, monitoring and evaluation are some of the integral ingredients which have been considered and included. The CAT plan has been formulated in the light of guidelines issued by the Department of Forest, Himachal Pradesh, vide Notification No. FFE-B-F-(2)-72/2004-Pt-II dated 30-09-2009.

3.10.1 Implementation of Support Infrastructure Cost

In order to execute the catchment area treatment plan, the forest department would be requested to establish a catchment area treatment cell for which the executing agency shall need necessary infrastructure support. Accordingly provision has been made for purchase of office equipments and inspection vehicle with O & M changes for 7 years as shown in **Table 3.23**.

Table 3.23: Cost Estimate for Support Infrastructure

Sl. No.	Particular	Quantity	Unit	Rate (Rs. in Lac)	Amount (Rs. in Lac)
1	Purchase of Computer with complete with accessories and Laser Printer	01	No.	0.50	0.50
2	Purchase of inspection vehicle/ maintenance of department vehicle/ hiring of private transport as per H.P. Government approved rates.	01	No.	5.00	5.00
3	O & M Charges for vehicle @ Rs 0.50 lac/year for 7 years	1 x 7	No.	0.50/year	3.50
				Total	**9.00**

3.10.2 Fuel Wood Saving Devices

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

i) For Women Headed Households : 90% subsidy and 10% cost sharing

ii) For Schedule Cast Households : 75% subsidy and 25% cost sharing

Identification of Women headed households and Schedule Cast households should be backed by data available with Panchayat Secretary and with local NGOs. An amount of Rs. 25 lacs is earmarked for this activity under the CAT Plan.

3.10.3 Training and Extension Programme

There is a need to keep local people in center stage in programme implementation so that they can play an active role in the implementation of the CAT plan by associating with the development work in their areas and carry the work in a scientific manner. For this purpose people have to be trained in respect of different measures especially for agriculture lands under the CAT with special thrust to the local technique making use of indigenous material without deteriorating the ecology. The technique of river training work needs to be explained properly so that desired results are achieved. For this purpose training programme has to be carried out at Range Headquarter at Chowari, for which a lump sum provision of Rs. **1.00 lac** is being made.

3.10.4 Provision for Mobilizing User Groups

Based on the ground truth reality in each of the Village Forest Development Committee or Society falling under the different sub-watersheds, mobilizing the user groups will be of utmost importance so as to involved them in afforestation and other agreed activities of the CAT Plan. For this purpose a provision of Rs. 0.50 lacs is being made.

3.10.5 Provision for Proper Documentation

Emphasis should be laid on the visual publicity of the work proposed under the plan and work carried out on annual basis so that transparency is maintained and the proper documentation of the work is also carried out for future reference and testing the efficacy of the work in due course of time. On this count a provision of **Rs. 0.50 lac** is being made. The documentation would *inter alia* include implementation report, progress reports, photography, videography etc. Publication for public awareness would be made and distributed to concerned panchayat and Village Forest Development Committees / Societies.

3.10.6 Propagation of Medicinal Tree Species under Afforestation

In keeping with the provision under para 4.6.2 of Himachal Pradesh Forestry Sector medicinal Plants Policy, 2006, efforts are required for conservation and enrichment activities related to medicinal plant sector. For this purpose under afforestation component, 25% medicinal tree species shall be planted.

3.10.7 Monitoring of Silt

The mandatory provision of silt observation posts and monitoring of silt is integrated within the overall monitoring and evaluation component of CAT Plan works in the Section-3.10.10.

3.10.8 Development of Eco-tourism

Obligatory amount for development of eco-tourism in the catchment area is provided under the Section-7.2 of Wildlife and Biodiversity Conservation Development and Management Plan. The development and protection of Rhododendron patch in the catchment area is expected to enhance eco-tourism potential of the area and shall also provide research options in the field of gene pool conservation of Rhododendron and other associated studies. It will also have positive impact upon the avifauna of the forests in the catchment area.

3.10.9 Provision for Bamboo Nursery

A provision of **Rs. 7.0 lac** is being made for establishment of Bamboo nursery. A specific portion dedicated in the **existing Central nursery** shall be earmarked for the establishment of Bamboo nursery. This will enable a focussed approach on propagation of relevant Bamboo species in the catchment. This activity will also provide options to undertake action research on Bamboo species. Special emphasis on development of Bamboo nursery is being laid in order to meet the demand of people of the catchment area.

3.10.10 Provision for Monitoring and Evaluation

As per the guidelines for preparing and implementation of CAT plans, issued by the Forest Department, Himachal Pradesh, vide letter Ft. 48-124/94 (FCA, a provision towards monitoring and evaluation activities @ 5% of the CAT plan outlay has to be earmarked on this count.

The success of implementation of a CAT Plan can be fathomed by the increase in vegetal cover over hill slopes and the enhancement in forest canopy. Various engineering and biological measures have been aimed at treating the degraded and potential areas of severe to very severe soil erosion by increasing the soil holding capacity and thus reducing the sediment flow in the flowing water. For monitoring and recording soil and silt data at regular interval, one small laboratory/ observatory each shall be established at Lahru, where the regular discharges of Chakki Khad shall be monitored.

A provision of **Rs. 22.60 lac** is being made for monitoring and evaluation activities under the CAT Plan.

3.10.11 Provision for Providing Environmental Services

As per guidelines issued in this direction, a provision @ 10% of the CAT plan outlay shall have to be earmarked on this count. A provision of **Rs. 50.00 lac** is being made under this sub-head for carrying out such works which enhance the environmental status and also reduce the adverse impact on the environment and ecology. Funds for identified and approved activities for Payment for Environmental Services have also been provided under this component. The scheme *inter-alia* includes construction of contour trenches, incentives for fire protection on private as well as on government land/forests, provision of funds for live hedge fence on private land and Payment for Environmental Services as per approved Himachal Pradesh Forest Department activities and norms.

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

1. Live hedge fencing of private lands. Payment shall be made @ kms after live hedge fence is established.
2. Contour trenches in private land – norms to be fixed in consultation with Agriculture Department.
3. Incentives for prevention of forest fires shall be provided village-wise.

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

- To prevent and tackle fire incidences awareness campaign against the fire hazards and involvement of local people in controlling and prevention of fire incidences to be ensured.
- Identification of sensitive hot-spots on past record and accordingly increased patrolling by deploying of appropriate manpower during fire-season.
- Maintenance of fire-lines as per the Working Plan.

- Winter control burning to be ensured as per the Working Plan.
- Strengthening of communication network to ensure timely and immediate response to tackle fire incidences.
- Enforcing fire rules and regulations especially during the fire season.
- Need based fire equipment be purchase and to be kept at appropriate places.
- Fire watch towers and fire huts to house equipment and manpower during fire season be constructed based on requirement after getting approval from the Conservator of Forests, Chamba.

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

3.10.12 Moisture Retentivity Interventions, Construction of Van Sarovars and Water Harvesting Structures

Moisture availability in the forest areas due to uncertain and erratic pattern of rainfall is going to be very important for the improvement of forest productivity and health of the forests. Need based Van Sarovars and water harvesting structures are proposed to be constructed at appropriate sites with an outlay of Rs. 15.00 lacs. The retentitive capacity of the soil/ starata is required to be analyzed and assessed properly before constructing the Van Sarovers as per the Himachal Pradesh Forest Department norms.

3.10.13 Wildlife Management and Bio-diversity Conservation Plan

A plan for conserving the biodiversity of the area, ecological rehabilitation, habitat, improvement, enrichment and protection of wildlife has been made in a separate Chapter-4. The cost of the plan has been assessed as **Rs. 7.50** lac. Some components enlisted in the Chapter shall be covered under Chapter-3 as plantation of fruit bearing wild species under afforestation, support to livelihoods under fuelwood saving devices and monitoring and evaluation activities as the catchment area have no wildlife protected area and staff.

3.10.14 Capacity Building

Since the effectiveness of the biological and engineering measures and their proper implementation will depend on the understanding and preparedness of the forest staff. It is important that the Forest Department makes efforts to sensitize the staff on implementation and management of plantation issues soil and moisture conservation, flood protection works and also provide guidance and encourage them to build requisite capacities. Capacity building can be achieved through training programmes for which a provision of **Rs. 2.50 lac** has been made in the plan. Capacity building training programme will be conducted by the Forest Training Institute, Sundernagar, District Mandi (H.P.)

3.11 INSTITUTIONAL MECHANISM

3.11.1 Role of Project Proponent

The forest department would implement the Catchment Area Treatment plan. The joint inspection group would be formalized which would include officers from Irrigation and Public Health Department, Himachal Pradesh and Forest Department. The management will have liaison with the forest officials as far as the financial disbursement is concerned. The soil conservation and afforestation program would evolve employment opportunities. Thus, people's participation should be encouraged and would involve mobilization of manpower for such activities. Experts and professionals competent in operating the plan need to be consulted from time to time.

3.11.2 CAT Plan Implementation

The executive engineer/environment officer of project proponent would coordinate with forest department for the implementation of the proposed plan. The executive engineer/environment officer would evaluate/ monitor financial aspects at site office. The modalities of financial disbursement every quarter in a year need to be taken care of. The implementing agency shall have to submit completion/ utilization certificate. The implementation of CAT Plan should have enough flexibility and should be subject to changes as per requirements and periodic gains. A monitoring committee as per the MOEF guidelines such as Phina Singh Irrigation Project CAT Plan Society with it's headquarter at Chowari should be instituted for the project for administrative guidance and smooth realization of targets.

3.11.3 Project Monitoring and Reporting Procedures

Meetings would be held every three months to resolve logistic problems in plan implementation. A Joint committee would be formed with the officers of IPH Department of Himachal Pradesh and State Forest

Departments team members to ensure the implementation and monitoring of the CAT works and reviews the progress from time to time. Quarterly progress reports and completion certificates would be submitted to IPH Department, for evaluation and disbursement of finance. In addition, the work done should be published through public awareness campaigns. Visual and print media need to be used to embark on maximum benefit by direct and indirect beneficiaries. Such efforts would resolve conflicts which otherwise are potential sources for project gestation.

3.12 SUMMARY OF COST OF WORKS

The cost of all the works proposed in the CAT plan has been assessed as Rs. 453.00 lac and is enumerated in **Table 3.24.** Year-wise break-up of CAT plan outlay is shown in **Table 3.25.**

Table 3.24: Cost Estimate of CAT Plan

Sl. No.	Particulars	Amount (Rs. in Lac)
1	Treatment works under free draining catchment.	
(a)	Afforestation (159 ha @ Rs. 29000/- per ha)	46.11
(b)	Bio-engineering works (228 ha @ Rs. 51000/- per ha)	114.00
(c)	High density energy plantation (50 ha @ Rs. 60000/- per Ha)	30.00
(d)	Rim plantation (30 ha @ Rs. 68900/- per ha)	20.67
(e)	Nursery support	29.00
(f)	Engineering measures	38.63
2	Implementation of Support Infrastructure Cost	9.00
3	Fuel wood saving devices	25.00
4	Training and Extension Programme	1.00
5	Mobilization of User Groups	0.50
6	Documentation	0.50
7	Provision for Monitoring and Evaluation Activities	22.60
8	Provision for providing Environmental Services	50.00
9	Moisture retentivity interventions, construction of Van Sarovars and Water Harvesting Structures	15.00
10	Wildlife Management and Biodiversity Conservation Plan	7.50
11	Capacity building	2.49
12	Cost escalation at 10% per year	41.00
	Grand Total	**453.00**

Table 3.25: Year-wise Break-up of CAT Plan Outlay

Sl. No.	Component	0 Year	1 Year	2 Year	3 Year	4 Year	5 Year	6 Year	7 Year	Total (Rs. in Lac)
1.	Treatment Works under Free Draining Catchment.									
(a)	Afforestation (159 ha with 1100 plants per ha @ Rs. 29000/- per ha). 1st Year – 50 ha, 2nd Year – 50 ha & 3rd Year – 59 ha with subsequent maintenance for 3 years – Plants to be raised in the nursery during 0 Year) for first year and onwards accordingly.	1.92	11.50	13.10	14.25	3.288	1.58	0.472	0.00	46.11
(b)	Bio-engineering Works (228 ha @ Rs. 50000/- per ha): 1st Year – 75 ha, 2nd Year – 75 ha & 3rd Year – 78 ha with subsequent maintenance for 2 years for tree species– Plants to be raised in the nursery during 0 Year for the first year and onwards accordingly.	2.10	22.12	25.28	31.87	13.73	12.62	4.44	1.84	114.00
(c)	High Density Energy Plantation (50 ha With 3000 plants per ha @ Rs. 60000/- per ha) 1st Year – 15 ha, 2nd Year – 15 ha , 3rd Year – 20 ha & 5 ha in 4th Year with subsequent maintenance for 3 years – Plants to be raised in the nursery during 0 Year for the first year and onwards accordingly.	1.58	7.2	8.58	8.95	2.09	1.14	0.46	0.00	30.00
(d)	Rim Plantation (30 ha with 3000 plants per ha @ Rs. 68900/- per ha) 1st Year – 15 ha & 2nd Year – 15 ha with subsequent maintenance for 3 years – Plants to be raised in the nursery during 0 Year for first year and onwards accordingly.	1.58	8.53	7.81	1.45	0.95	0.35	0.0	0.0	20.67
(e)	Nursery Support	10.00	9.00	2.00	2.00	2.00	2.00	2.00	0.00	29.00
(f)	Engineering Measures	0.00	20.00	18.63	0.00	0.00	0.00	0.00	0.00	38.63

Sl. No.	Component	0 Year	1 Year	2 Year	3 Year	4 Year	5 Year	6 Year	7 Year	Total (Rs. in Lac)
2.	Infrastructure Support	6.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00	9.00
3.	Fuel Wood Saving Devices	5.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	25.00
4.	Training and Extension Programme	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00
5.	Mobilization of User Groups	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
6.	Documentation	0.00	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.50
7.	Provision for Monitoring and Evaluation Activities	0.00	0.00	4.00	4.00	4.00	4.00	4.00	2.60	22.60
8.	Provision for Providing Environmental Services.	0.00	9.00	9.00	9.00	9.00	9.00	5.00	0.00	50.00
9.	Moisture retentivity interventions	0.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	15.00
10.	Wildlife Management and Biodiversity Conservation Plan	1.50	2.50	2.00	1.00	0.25	0.25	0.00	0.00	7.50
11.	Capacity Building	1.00	0.75	0.74	0.00	0.00	0.00	0.00	0.00	2.49
	Total	**31.68**	**106.70**	**106.74**	**78.12**	**35.908**	**31.54**	**16.872**	**4.44**	**412.00**
12.	Escalation									41.00
								Grand Total		**453.00**

NOTE: 1. Activities regarding treatment of private land have been incorporated under Payment for Environment Services under Chapter-3 (Section-3.10.11).
2. Medicinal tree species and wild fruit bearing species useful for wildlife shall be taken up under afforestation component under Chapter-3 (Section-3.9.1)
3. Monitoring of silt will be taken up under Monitoring & Evaluation under Chapter-3 (Section-3.10.10)
4. Protection against fires has been incorporated under Payment for Environmental Services under Chapter-3 (Section-3.10.11)
5. Mandatory eco-tourism component has been taken up under Chapter-4 (Section-7.2)

CHAPTER-4

WILDLIFE AND BIODIVERSITY CONSERVATION, DEVELOPMENT AND MANAGEMENT PLAN

4.1 GENERAL

Himalayas one of the youngest and fragile mountain formation supports varied forms of life and unique ecosystems with moderate to steep slopes, forests, snow clad peaks, glaciers, and alpine meadows. On the foothills of the Himalayas lie Shiwalik hills with undulating terrain having a rich reserve of life forms. Because of sharp zonation in altitude and vegetation along the Himalaya and Shiwalik, the region is a treasure of unique biodiversity.

4.2 LOCATION

The upper catchment of proposed Phina Singh medium Irrigation project lie in the Himalayan zone whereas the lower part lies in the Shiwalik range in the Chamba district of Himachal Pradesh. The vegetation is represented by coniferous and broad leaf forests on the upper areas and the lower Shiwalik zone comprises of Chir pine and associated broad leaf forests. The catchment area of Phina Singh Medium Irrigation Project is located, from altitude 652 m with latitude N 32°24'30.7" and longitude E 75°58' 46.6" to altitude 2507 m with latitude N 32°23'55.7" and longitude E 76°05'08.7" falling in Chowari Range of Dalhousie Forest Division.

4.3 FLORA OF THE CATCHMENT AREA

The vegetation of the catchment area is represented by mainly conifers on the upper strata where as broad leaf species along with Chir-Pine comprises the vegetation on the lower part of the catchment. Eighty seven medicinal plant species have been reported, out of which fifteen are threatened. In the catchment area species as *Cedrus deodara, Pinus wallichiana, Quercus leucotrichophora, Aesculus indica, Pinus roxburghii, Albizia, Emblica, Syzygium cumini, Acacias, Zizyphus*, etc. are present.

4.3.1 Forest Flora

4.3.1.1 Composition and Condition of the Crop

There is a pronounced variation in the crop composition as we move upwards along Shiwalik foot hills. In this altitudinal zonation, we come across scrub forests, partly comprising mixture of Khair, Shisham and other broadleaved species in the lower parts of Bhattiyat, Chowari, Bakloh, Dalhousie and Bhalai ranges particularly on the southern hotter aspects followed by Chil (*Pinus roxburghii*) forests. As we move higher,

Chil gives way to Ban Oak, which is the fore runner to Deodar and then Fir/ Spruce, which are more prominent on the colder aspects. The zonation culminates into Kharsu (*Quercus semecarpifolia*) and then the sub-alpine pastures.

4.3.2 Forest Types

Different forest types found in the tract covered under this plan according to "Revised Survey of Forest types of India" by Champion and Seth are briefly discussed below:

4.3.2.1 Type 9/CIB Upper or Himalayan Chir-Pine Forests

This type of forest has a major representation in Chowari Range. The elevation ranges from 1050 m – 1675 m. Annual rainfall averages 1400 mm. Though, there are some good forests of Chil but the overall quality is III, having an average density of 0.5 with an average height of 23 m. With adequate protection, the species regenerates naturally, profusely and easily anywhere in its ecological zone.

Towards its upper altitudinal limit, *Quercus incana* which comes up naturally and spontaneously replaces Chil on moist and cool situations, instances are found in Kalam D.P.F. of Chowari Range. Characteristic feature of Chil is its tendency to form pure crops with rarely any other tree reaching the top canopy. Such purity can be noticed in some RFs and old DPFs of Chowari range. In damp localities *Pieris ovalifolia, Rhododendron arboreum* are the prominent associates. Ban Oak shares the track more towards higher elevations. Among other trees found are *Mallotus philippinensis , Albizia stipulata, Grewia optiva, Toona ciliata, Pyrus pashia, Lannea grandis*, etc. Most common undergrowth comprises *Berberis spp., Dodonaea viscosa, Woodfordia fruticosa, Colebrookia oppositifolia, Rubus ellipticus, Prinsepia utilis, Plectranthus rugosus, Bauhinia vahlii, Rosa moschata*, etc.

In majority of DPFs, due to heavy burden of Timber Distribution and natural calamities like wind and fire damage, the density has considerably gone down.

4.3.2.2 Type 9/C1/DS1 Himalayan Sub-Tropical Scrubs

At places in the zone of Himalayan Chir-Pine forests, the tree cover is unable to come up either due to dry/ shallow soil or excessive grazing pressure. In such places bushy formations consisting of *Dodonaea viscosa, Woodfordia fruticosa, Lantana camara, Colebrookia oppositifolia*, etc. are found.

4.3.2.3 Type 9/ C1/DS2 Sub-Tropical Euphorbia Scrubs

Under this type *Euphorbia royleana* (Thor) forms associations, in the Himalayan Chir-Pine zone. Limited area is represented by this type.

4.3.2.4 Type 10/C1a *Olea ferruginea* Scrub Forests

It occurs at elevations ranging from 800 m – 1400 m. Annual rainfall averages about 1250 mm. *Olea ferruginea* (Kahu) in the admixture with other broadleaved species is distributed in the tract along some portions in Chowari range. Other associates are *Pistacia integerrima, Dalbergia sissoo, Albizia, Toona ciliata, Lannea grandis*, etc.

4.3.2.5 Type 12/C1a Ban Oak Forests

Ban Oak confines to the elevations ranging from 1500 m – 2000 m, where the annual precipitation varies from 1250 – 2250 m and winter snowfall is almost a regular feature. Because of its high utility as fodder, fuel-wood and for agricultural implements, it occupies a unique position in the fabric of agricultural economy in this tract. Unfortunately, the biotic interference over the area has always been of an increasingly high order, which has resulted in the retrogression of this climax species. This can be seen in the vicinity of habitation where these trees face a ruthless lopping thus, rendering the natural regeneration and propagation impossible. Many areas have simply dwarfish bushes of this important Oak due to indiscriminate lopping and browsing.

There, however, are some good forests of Ban Oak in Chowari Block. These forests have escaped the wrath of biotic factors and consist of typical large, low branching, wide crowned trees. The species is important for wildlife and water conservation. Natural regeneration in these forests is fairly good.

The two chief associates of Ban Oak, usually occurring below the main canopy are *Rhododendron arboreum* and *Pieris ovalifolia* both of which are unpalatable and have an equally bad calorific value as fuel. In damp situations intermingled are *Litsea umbrosa, Machillus* species, *Euonymus tringens*, etc. forming considerable part of the leaf canopy. Scattered trees of *Rhus semialata, Symplocos paniculata, Pyrus pashia* and groups of *Ilex dipyrena* are also found. There is generally a good deal of shrubby undergrowth consisting chiefly of *Viburnum cotonifolium, Myrsine africana, Rubus ellipticus, Desmodium tiliaefolium* and *Lonicera quinquelocularis*. Among climbers *Vitis* species and *Loranthus* are the most common.

4.3.2.6 Type 12/C1 C Moist Deodar Forests

This important type comes up in the altitudinal range of 1100 m – 2200 m. Annual rainfall varies from 1250 m to 2250 m, most of which is received in the rainy season. But precipitation in the form of snow during winter is considerable and important as well. The top canopy consists of nearly pure Deodar in its middle zone of altitudinal limits. But lower down Deodar occurs mixed with *Quercus incana*. The deciduous associates found especially in depressions are *Quercus dilatata, Litsea umbrosa, Celtis australis, Cedrella serrata, Populus ciliata, Carpinus spp., Ulmus villosa, Cornus macrophylla, Prunus padus*, etc. In damp localities *Ulmus wallichiana, Juglans regia* and *Aesculus indica* are met with. Undergrowth is scanty. The most frequently distributed species in undergrowth area *Virburnum cotonifolium, Indigofera heterantha, Desmodium tiliaefolium, Rubus ellipticus. Fragaria vesca, Lonicera quinquelocularis, Berberis lycium, Viola canescens, Artemisia vulgaris, Valeriana jatamansi, Jasminum humile, Clematis montana, Galium rotundifolium, Salvia glutinosa* and *Rosa moschata* are commonly found.

4.3.2.7 12/C 1d Western Mixed Coniferous Forests:

At elevations from 2000 m to 3500 m. there are mixed coniferous forests mainly of Silver fir and Spruce with some occasional admixture of Kail and Deodar. Pure Fir or Spruce forests are very nominal. Generally, it is Silver fir and Spruce combination. In depressions Fir constitutes more proportion along with other broadleaved species whereas Spruce is more on gentle/ moderate slopes with fairly good exposure. Deodar is generally seen scattered, single or in groups, along the crests of spurs and ridges. Associated with Fir/ Spruce and frequently forming considerable bits of deciduous forests in depressions and nallahs are the *Aesculus indica, Juglans regia, Acer* spp., *Celtis australis, Prunus padus, Ulmus wallichiana,* and *Morus serrata*. The under storey is generally absent. Bushy undergrowth of practically the same species as found in the Deodar type comes in and grows in varying mixture and density depending upon the aspect, altitude, drainage, overhead light and mixture of species in the canopy.

4.3.2.8 12/C 1/ DS1 Oak Scrub:

Owing to heavy biotic interference many Ban Oak forests in particular have been reduced to mere scrub formation. The stunted growth of Oaks is attributed to heavy grazing, indiscriminate lopping. Other inedible species like *Pieris ovalifolia, Rhododendron*, etc. also come up in abundance under this type.

4.3.2.9 12/ C1/ DS2 Himalayan Temperate Secondary Scrub:

In the elevation of 1000 m – 2800 m particularly on southern aspects, the tree cover is unable to develop due to dry conditions and shallow soil.

Excessive grazing on these aspects due to concentrated habitation also impedes tree cover. Shrubs of *Berberis, Indigofera, Rosa*, etc. are commonly found along with a few scattered trees of *Pyrus pashia*, etc.

4.3.2.10 12/ DS3 Himalayan Temperate Pasture:

Such portions are particularly near halting grounds of Gujjars. At places tree cover is unable to establish due to shallow soil and only grasses cover the area. Such lands are reduced to pasture status. They are found at elevations ranging from 1500 m – 3100 m on all aspects.

4.3.2.11 14/ DS1 Sub-Alpine Pasture:

In sub-alpine zone, at places where tree cover cannot exist due to shallow soil or snow, grasses/ shrubs take possession of ground. Many important medicinal herbs are found here like Banafsha (*Viola canescens*), Ban-Kakri (*Podophyllum hexandrum*), Mushakbala (*Valeriana jatamansii*).

4.4. FAUNA OF THE CATCHMENT AREA

4.4.1 General Description

The significance of the wildlife in the eco-balance has been well understood since times immemorial but this issue, in reference to enormous biotic intervention acquires new conceptual dimensions in the present day context. Himachal has remained abreast with the global and national developments as regards to the concern for wildlife management. With this spirit, the Wildlife Protect Act, 1972 was adopted in the state on 02-04-1973 and rules were made thereunder.

Varied climatic conditions and the resulting variation in the vegetation have a bearing upon the Wildlife occurrence in the tract, which supports a variety of Wild animals and birds. Some of the animals found in the catchment have been described below with their habits and habitats.

4.4.1.1 Black Bear (*Ursus thibetanus*):

It is an omnivore with a dominant sense of smelling. It prefers steep forested hills. During summer it is found near the limits of tree-line i.e. 3000 m – 3700 m, but in winter comes down to lower valleys about 1500 m and even lower. It is an expert climber. It usually lives singly but sometimes associates in small parties. It is much sought after animal by poachers for its medicinally valuable fats.

4.4.1.2 Leopard (*Panthera uncia*):

A carnivore of amazing strength is able to thrive everywhere like dense forests, open country, rocks and shrubs, etc. It also hunts during daytime, particularly when it fails to get food at night. It follows, roads or paths or the beaten tracks of animals through the forest or waits for its prey in the

hiding. It lives singly except for mating period. Due to loss of habitat and prey base it has been reported to intrude into the areas outside forest for food.

4.4.1.3 Ghoral (*Naemorhedus goral*)

It is a stocky goat like animal having short insignificant horns. It favours an elevation of 600 to 2750 m. It is an herbivore. It lives in small parties and gives loud hiss to alarm others against any danger. It is found on steep slopes with low tree cover, moderate shrubs and open grass banks interspersed with cliffs. Its height at shoulders is 65-70 cms and weighs about 25-35 kgs.

4.4.1.3 Muntjac or Barking Deer (*Muntiacus muntjak*)

It is found in scrub forests up to elevation of about 2000 m in all the ranges of this division. It feeds on grass, leaves and wild fruits. When heard from a distance, its call sounds like barking of a dog. The un-branched antlers are small, and measure 5-8 cms. As the forest are in lower elevation are honey-combed with cultivations and are also frequented by villagers, this animal has been gradually pushed to the interior valleys.

4.4.1.4 India Wild Boar (*Sus scrofa*)

Wild Boars are found in parts of Bhattiyat and Bakloh ranges only. It feeds on field crops, wild roots and tubers. Wild Boar is a prolific breeder and gives at least two litters in a year, one in the beginning of rains and the second after the rains. This animal causes damage to field crops and is in direct conflict with man.

4.4.1.5 Himalayan Pine Martin (*Martes flavigula*)

It is found up to an elevation of about 2500 m. Its distribution is not uniform, the number being more in coniferous forests than in the scrub forests at low elevations. They live in pairs. Called locally Gothu, it is very much valued for its Fur. It is predator and preys upon birds and their eggs and occasionally the young ones of Deer antelope family. It is reported to chase big animals too at times.

4.4.1.6 The Indian Porcupine (*Hystrix indica*)

This destructive rodent abounds in all areas of the area up to an elevation of 2500 m. It adapts itself to any type of land, but favours rock hill sides, where it lives in burrows dug by itself. The Porcupines are characterized by the spines, borne on the neck, back and hind quarters. They feed on field crops, fruit roots and tubers. Besides, being destructive to young plantation, they are very much harmful to field crops and gardens also when adequate food is not available in the forests. The young ones are usually born in spring.

4.4.1.7 The Indian Hare (*Lepus nigricollis*)

This rufous tailed animal is found all over the area in the lower elevations. It likes bushy forest growth and generally lives in the neighborhood of cultivations and villages. It is believed to give young ones, one to two in number, in early winter months. The animal is hunted for its flesh.

4.4.1.8 Flying Squirrel (*Petuarista inornatus*)

It is found from an elevation of about 1000 m to 3000 m. It is nocturnal in habit. Flying Squirrels are valued for their fur. They eat fruits of various forest tree species and also the insects hiding under the bark. The damage they do to forest crops is thus compensated by the help they render by eating injurious insects.

4.4.1.9 *Rhesus macaque*

It is closely associated with humans and is most widespread monkey of northern India. It is found in urban areas, deciduous and evergreen forests and also in scrub areas. It is an aggressive primate and is found in multi-male groups dominated by a single male. It is intelligent animal and its increasing numbers has become a threat to agricultural crops.

4.4.1.10 Monal (*lophophorus impejenus*)

Its habitat lies at high elevations above 2500 m extending up to snow-line in summer but descending to lower altitudes during winter. It is frequently found in Fir, Deodar, Kail and Oak forests but occasionally makes appearances in the vicinity of grassy glades. Monal is of moderate size with short, broad-tail. It is characterized by brilliant metallic green head, the glistening purple upper part, cinnamon coloured tail and velvety-black breast and crest of beautiful feathers. It breeds in May/ June. Monal eats tubers and seeds in alpine pastures. In autumn, it feeds on grubs, roots and young shoots of various shrubs, grass corns and berries.

4.4.1.11 Chakor (*Alectoris chukar*)

Chakor is found throughout the tract mainly between elevations of about 1500 m to 3000 m but descends down to lower elevation during winter in the vicinity of cultivated fields. It feeds on grain, tender shoots of grass, food crops and insects. It lives in small groups of four to five birds. It is moderate sized plump, pinkish-grey brown partridge having conspicuous rib like bars on flanks in buff and chestnut. The female is somewhat smaller, nesting ranges between April to June or even later sometimes. Seven to twelve eggs are laid at a time. Chakor is hunted for its meat.

4.4.1.12 Koklas (*Pucracia macrolopha*)

The Koklas Pheasant occurs between elevations of 2000 m to 4500 m. It lies flush to ground, keeping still and flies swiftly when disturbed as such it is hard to shoot. It relishes leaves and buds. The cock of species has dark green head. The breeding season is April to June.

4.4.1.13 Chir-Pheasant (*Catreus wallichii*)

It is a long-tailed West Himalayan Pheasant. These birds lack the color and brilliance of most pheasants, with buffy gray plumage and long gray crests. Its long tail has 18 feathers and the central tail feathers are much longer and the color is mainly gray and brown. The female is slightly smaller in overall size. The long narrow pointed laying down crest and the bright scarlet patch round the eyes confirms its identity. The bird sails across ravines on open motionless wings.

Other main bird species found in the catchment area, Hill Partridge (*Arborophila torqueola*), Red Jungle Fowl (*Gallus gallus*), Grey Headed Woodpecker (*Picus canus*), Great Barbet (*Megalaima virens*), Indian Roller (*Coracias benghalensis*), Slaty Headed Parakeet (*Psittcula himalayensis*), Oriental Turtle Dove (*Streptopelia orientalis*), Black Shoudered Kite (*Elanus caeruleus*), Common Kestrel (*Falco tinnuenculus*), Yellow Billed Blue Magpie (*Urocissa ornata*), Long Tailed Minivet (*Pericrocotus brevirostris*), Dark Throated Thrush (*Turdus nuficollis*), Bush Robin (*Tarsiger cyanurus*), Rufous Naped Tit (*Parus rufonuchalis*), Tickell's Leaf Warbler (*Phylloscopus affinus*), White Throated Laughing Thrush (*Grrulax albogularis*), etc.

5. SUMMARY OF THREATS TO WILDLIFE CONSERVATION

Biotic pressure and habitat destruction are main threats to the wildlife conservation in the sensitive Himalayan and Shivalik region. The domestic animals compete with the wild dwindling population of the mountain species resulting overgrazing, which has led to the degradation of wild areas and pastures. Due to biotic pressure, soil erosion and habitat fragmentation, efforts are required to protect and conserve wildlife so as to maintain the viability of the populations. Rehabilitation of the degraded areas, habitat improvement and corridor protection will lead to the enrichment of biodiversity of the region.

5.1 Socioeconomic Analysis

Villagers have right of grazing, fuel-wood collection, timber, minor forest produce collection, etc. Unsustainable pressure on the natural resources has lead to the degradation of the area in many parts of the area. Agriculture is the chief source of livelihood of the people of the region.

6. WILDLIFE MANAGEMENT AND DEVELOPMENT PLAN

6.1 Wildlife Management and Conservation

Himalayas along with Shiwaliks represent very sensitive ecosystems, inhabiting unique faunal and floral species. The key stone species sustaining the critical natural food web require appropriate management strategy and effective implementation of the plan. The management inputs have to be appropriate so as to allow nature to function within natural parameters. The preference of key stone species of the catchment area has to be analyzed for habitat manipulation and management intervention. More than 200 species of avifauna have been reported from the area. Following plan with site specific objectives and there under activities are proposed for the management and conservation of biodiversity and wildlife of the Catchment area.

6.2 OBJECTIVES:

This plan envisages the conservation of biodiversity of the catchment and contribution to sustenance of livelihoods as long term goals. A plan for conserving the biodiversity of the area, ecological rehabilitation of the tract by pasture development and enrichment, afforestation and land stabilization measures, improving water regime, control of illicit poaching are some of the steps to protect and preserve the biodiversity of the area.

Eco-development of the area in addition of aforementioned factors will include sustaining mountain livelihoods, eco-tourism promotion and protection of cultural values. To achieve these goals, with an overriding objective of wildlife conservation, the objectives of the plan are as under:

i. To improve the habitat and protect the species found in the catchment area.

ii. To support livelihood enhancing components so as to reduce the dependence of the local population on natural resources.

iii. To build capacity and impart professional training to the staff in Wildlife matters.

7. IMPLEMENTATION

The priority will be to conserve and protect the biodiversity of the catchment. To reduce the man-animal conflict, activities as habitat improvement, soil & water conservation activities, protection of unique habitats and support to mountain livelihood will be carried out under the project. Promotion of eco-tourism and creating environmental awareness will be the other key areas requiring varied management efforts to achieve the long-term goal. In order to achieve the above objectives, activities

under following components based on the objectives outlined above are required to be implemented. The activities mentioned hereunder will be carried in the villages which are adjacent to the forest having good potential to protect and conserve wildlife resources. The main criteria will be the willingness of people of the identified villages to help in wildlife protection and conservation of the biodiversity.

7.1 HABITAT IMPROVEMENT

Planting of Wild Fruit Trees, Shrubs and Native Grass Species: Improvement of alpine pastures and planting of indigenous useful species will be undertaken. Rotational grazing in alpine pastures and stocking by genetically superior and improved varieties of grass involving stakeholders will decrease overgrazing and pasture degradation. Alpine grass species like *Poa alpina, Trifolium repens, Agrostis gigantea* and legumes such as *Melilotus alba* and *Medicago falcata* will be taken up for pasture improvement under bio-engineering component in Chapter-3. Fruit bearing tall wild species will be planted under this plan such as *Quercus leucotrichophora, Aesculus indica, Phyllanthus emblica, Prunus armenica* (Wild Apricot), *Syzygium cumini, Myrica esculanta, Pyrus pashia etc.* No exotic grasses or plants to be planted. Promotion of this activity will be undertaken under afforestation component under Chapter-3, where suitable proportion of above species useful to wildlife will be planted.

7.2 PROTECTION OF RHODODENDRON AREA, SUPPORT TO GO-SADAN:

An identified patch of about 7 hectare of pure Rhododendron patch in Dabthedda (having GPS coordinates of N – 32° 25'21.5" and E – 76° 02'59") forest will be protected. Protection of the Rhododendron patch by effectively fencing and taking up regeneration activities of the species will help in conservation of the species. Further it will also enhance the eco-tourism potential of the area and have positive impact on the avifauna of the area.

An amount of Rs. 1.00 lakh is proposed to be utilized to support and strengthen the existing 'Go-Sadan' near Indora for accommodating and feeding the abandoned cattle of the area. A provision of **Rs. 6.5 lac** is being made for above activities under this section of the CAT Plan.

7.3 SUPPORT TO MOUNTAIN LIVELIHOODS

To support and enhance mountain livelihoods, efforts are proposed to be made to sustain the livelihoods of the local population. In order to reduce fuelwood impact on the forests, under fuelwood saving devices in Chapter-3, an amount of Rs. 25 lakhs has been earmarked. Supply of subsidized LPG Gas connection with cylinder to the identified families will reduce pressure on forests thereby improving health of the forests and ecosystem, which will be favourable towards conservation and preservation of wildlife in the catchment area.

7.4. CAPACITY BUILDING AND SKILL-UP GRADATION

For quality Wildlife management inputs, the capacity of the field staff deployed in the catchment area will be enhanced with appropriate training inputs in relevant fields at regular intervals. An amount of Rs. one lakh is proposed and it should be ensured that the local staff is trained with these funds. The training will be imparted in the Forest Training Institute, Sunderngar.

A mechanism to monitor and evaluate the objectives proposed under the plan will be established under the umbrella of 'monitoring' funds (Chapter-3) in the beginning for effective implementation. Monitoring wildlife population trends, non-timber forest produce shall be taken up on priority. An Implementation and monitoring committee is proposed to be constituted for implementation, monitoring and evaluation of the project components under Chapter-3, which will also monitor and evaluate the activities mentioned hereunder. Detailed financial cost for five years under Wildlife and Biodiversity Conservation, Management and Development Plan is as under:

Table 4.1 FINANCIAL ABSTRACT

Sl. No.	Component	Outlay (Rs. in Lakhs)
1	Planting of Wild Fruit Trees, Shrubs native Grass species	Funds provided under Section-3.9.1: Afforestation and Section-3.9.2: Bioengineering Subheads in Chapter-3.
2	Protection of Rhododendron area, support to Gow-Sadan	6.5
3	Support to sustainable mountain livelihoods, supply of LPG to poor identified households (Women Households and Scheduled Castes)	Funds provided under Section-3.10.2: Fuelwood Saving Devices Subhead in Chapter-3.
4	Capacity building and skill-up gradation (Wildlife) by FTI, Sundernagar	1.0
	Total	7.5

Table: 4.2: FINANCIAL ABSTRACT FOR FIVE YEARS

Sl. No.	Component	Year-wise Financial Outlay						
		0 Year	1 Year	2 Year	3 Year	4 Year	5 Year	Total (Rs. in Lakhs)
1	Planting of Wild Fruit Trees, Shrubs Native Grass Species and Preparation of Nursery	Funds provided under Section-3.9.1: Afforestation and Section-3.9.2: Bioengineering Subheads in Chapter-3.						
2	Protection of Rhododendrons Area, Support to Gow-Sadan & Awareness	1.00	2.00	2.00	1.00	0.25	0.25	6.50
3	Support to sustainable mountain livelihoods, procurement of LPG to identified poor (Women households & Scheduled Castes).	Funds provided under Section-3.10.2: Fuelwood Saving Devices, Subhead in Chapter-3.						
4	Capacity building and skill-up gradation (wildlife)	0.5	0.5	0	0	0	0	1.0
	TOTAL	**1.5**	**2.5**	**2.0**	**1.0**	**0.25**	**0.25**	7.50

Annexure-I

[A] PLANTATION (AFFORESTATION, BIO-ENGINEERING, HIGH DENSITY ENERGY PLANTATION AND RIM PLANTATION) ACTIVITIES UNDER CATCHMENT AREA TREATMENT (CAT) PLAN

[Sub-Watershed Kalam Khad – 1B1A7(1)]

Sl. No.	Name of Location & Area (Ha.)	GPS Coordinate of Location (Latitude, Longitude, Altitude)	Soil Type	Vegetation Indicator Species	Slope (Gentle/ Medium/ Steep)	Aspect	Causes of Degradation	Species Suggested for Plantation	Prioritized Treatment Measures a] Engineering Structres b] Vegetation Measures	Protection & Sustainability Aspects (Protection against Fire, Grazing, etc.)	Possibility of Water Harvesting Structure (Location with GPS Coordination
1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Lower Chowari									
B	Block:	Chowari									
C	Range:	Chowari									
D	District:	Chamba									
1.	Kulera (DPF) (Near Kalum Bridge), (6 ha.)	N 32°25'43.1" E 076°01' 24.7" 1021 m	Rocky Soil	*Dalbergia sissoo, Lantana camera, Dodonaea viscosa, Punica granatum and Berberis spp.*	Steep	Western	Rains and excavation works	*Dalbergia sissoo, Agave americana, Populus spp., Eucalyptus, Albizia lebbeck & Albizia stipulata*	a) Retaining wall along the road side b) Plantation of the plants like *A. americana, Ipomoea spp.*	Fencing of barbed wires	-
2.	Dodan (8 ha.)	N 32°25'17.1" E 076°01' 17.8" 1118 m	Rocky Soil	*Lantana camera, Bauhinia variegata, Celtis australis, Ficus palmata*	Steep	Northern -Western	Natural/ due to rains	*Agave americana, Bauhinia variegata, Populus spp., Eucalyptus, Dalbergia sissoo & Melia azaderach*	-	-	-
3.	Khabar (6 ha.)	N 32°26'13.7" E 076°02' 28.5" 1293 m	Sandy/ Silty	*Celtis australis, Bombax ceiba, Lantana camera, Toona ciliata & Albizia spp.*	Medium	Southern	Excavation works	*Albizia, Eucalyptus, Bauhinia variegata, Dalbergia sissoo*	a) To construct wall of stones b) To plant Agaves pp. so as to prevent soil erosion.	-	-

1	2	3	4	5	6	7	8	9	10	11	12
4.	Angrel Toranu (5 ha.)	N 32°26'42.7" E 076°00' 30.7" 1273 m	Sandy loamy	*Prunus padum, Albizia, Celtis australis, Rubus ellipticus*	Gentle	Eastern	-	*Dalbergia sissoo, Agave, Toona ciliata, Melia spp. Populus spp. Eucalyptus, Bauhinia variegata, Sapindus mukrosi & Terminalia chebula*	a) Plantation of fodder species *Celtis australis, Grewia optiva* b) Wire fencing to protect the plantation		
5.	Nehar Nalla/ Bachhannalla (7 ha.)	N 32°26'00.9" E 076°03' 12.4" 1691m	Silty loamy	*Rubus ellipticus, P. roxburghii, D. sissoo & D. hypoleuca*	Medium	Eastern	Natural	*Q.leucotrichophora, P. roxburghii & Toona ciliata*	a) Repair of footpath (8.5 Km.) from village Baret to Naaghentru temple, Naaghentru to Cuani Mata Temple (6 Km) b) Vegetative barriers	Fencing of barbed wire / cement post	-
6.	Gahar Nalla (3 ha.)	N 32°26'14.6" E 075°59' 56.0" 1012 m	Rocky	*Bombax ceiba, D.sissoo, Pyrus phasia*	Medium	Western	Rains	a) Constructions of check dams and crate works.	-	-	-
7.	Bukhru Nalla (Near Bukhru village Point No. (I) (2 ha.)	N 32°26'21.3" E 076°01'13.9" 1163 m	Silty	*P. roxburghii, Latana camera, Rubus ellipticus, Bombax ceiba, Berberis spp , Princepia utilis*	Medium	Eastern	Rain water	Construction of Check dams	*Albizia stipulata, Acacia catechu Dalbergia sissoo*	-	-
8.	Tornu Nala (2 ha.)	N 32°26'48.01" E 076°00'22.87" 1188 m	Rocky	*P. roxburghii, Bombax ceiba, D.hypoleuca, Albizia spp*	Medium	Eastern	Rainfed Nalas	Construction of check dams, Crate wall & crate wire, Construction of the small bridge over Tornu Nalla.	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Upper Chowari (Dhadu)									
B	Block:	Chowari									
C	Range:	Chowari									
D	District:	Chamba									
1.	Gurnal (12 ha.)	N 32°26'41.8" E 076°05'17.4" 2250 m	Loamy	*C. deodara, Q.leucotrichophora & P. wallichiana*	Medium	Southern	Grazing	*C. deodara*	-	-	-
2.	Fafradi (8 ha.)	N 32°27'03.0" E 076°04'09.6" 1600 m	Rocky, Clay	*P. roxburghii*	Steep	Western	Road Preparation	*Q. leucotrichophora*	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Kainthli**									
B	**Block:**	**Kainthali**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Fakroti (7 ha.)	N 32°28'18.1" E 076°03'35.5" 2221m	Loamy, Black, Rocky	*C. deodara* & *Q.lecucotrichophora*	Steep	East	Fire	*C. deodara*	-	-	
2.	Fakroti (7 ha.)	N 32°28'11.4" E 076°03'37.5" 2168 m	Rocky, Loamy	*Q.lecucotrichophora* & *Rhododendron spp.*	Steep	South-West	Fire	*C. deodara* and *Robinia pseudoacacia*	-	-	
3.	Bihali (6 ha.)	N32°27'31.7" E076°05'33.5" 1962 m	Loamy	*P. roxburghii* & *Q.lecucotrichophora*	Steep	South	Fire	*C. deodara*	Gulli-plugging Check wall Check dam	-	15Nos. 15Nos. 5Nos.
4.	Batoi DPF (6 ha.)	N 32°27'38.5" E 076°03'33.5" 1894 m	Loamy	*P. roxburghii* & *C. deodara*	Medium	South	Grazing	*C. deodara*	Check dam Check wall Gulli-plugging	-	5Nos. 6Nos. 10Nos.
5.	Ghat Nalla (12 ha.)	N 32°27'29.7" E 076°03'32.5" 1928 m	Loamy, Black	*P. roxburghii* & *Q.lecucotrichophora*	Medium	East	Rain	*C. deodara*	Fencing	-	-
6.	Drahllu (6 ha.)	N 32°27'41.9" E 076°03'47.3" 1948 m	Loamy, Clay	*Q.lecucotrichophora* *C. deodara*	Steep	East	Rain	*C. deodara* and *Salix spp.*	Fencing	-	-
7.	Kumbandi Jungle (6 ha.)	N 32°27'52.7" E 076°04'14.2" 1789 m	Black, Humus Rich	*C. deodara*, *Q.lecucotrichophora* *Listea umbrosa*	Medium	Southern-West	Grazing, Rain	*C. deodara*	Fencing	-	-

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Khara Danda**									
B	**Block:**	**Kainthali**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Matuni (1) (6 ha.)	N32°28'28.7" E076°02'54.1" 2258 m	Clay Sandy	*C. deodara*	Medium	South-East	Over grazing Pasture	*C. deodara* and *Q.leucotrichophora*	Check Dam Gulli-plugging		50 Nos.
2.	Bankot (5 ha.)	N32°29'01.0" E076°02'52.3" 2340 m	Clay Rocky	*C. deodara* and *Q.leucotrichophora*	Medium	South	Grazing Fodder and fuel	*C. deodara* and *Q.leucotrichophora*	Fencing		
3.	Khara Danda (8 ha.)	N32°29'01.0" E076°03'01.3" 2306 m	Rocky Sand	*C. deodara* and *P. smithiana*	Steep	South-East	Grazing	*C. deodara*	Gulli-plugging Fencing		30Nos.
4.	Reserve C-9 (10 ha.)	N32°29'01.0" E076°05'37.2" 2518m	Loamy, Black	*C. deodara* & *Q.leucotrichophora*	Steep	West	Grazing	*C. deodara*	Gulli-plugging Fencing		25 Nos.
5.	Reserve C-8 (7 ha.)	N32°28'20.2" E076°05'40.5" 2503 m	Loamy, Black	*C. deodara* and *P. smithiana*	Steep	South-West	Grazing	*C. deodara*	Fencing Gulli-plugging		20 Nos.
6.	Buddu Da Goth (Bangla Nala) (6 ha.)	N32°29'04.3" E076°04'30.0" 2295 m	Loamy, Black (Rock Present)	*P. smithiana, Q. eucotrichophora, Listea umbrosa*	Medium	East	Grazing	*C. deodara, Q.leucotrichophora, P. smithiana, & R.pseudoacacia*	Fencing		
7.	Bangla (3 ha.)	N32°29'07.2" E076°03'54.6" 2364 m	Loamy, Black	Salix spp.	Medium	West	Grazing	Salix spp.	Check dam		2 Nos.
8.	Dilri (7 ha.)	N32°28'28.7" E076°03'34.4" 2272 m	Loamy, Black Rocky	*C. deodara, Q.leucotrichophora*	Steep	East	Forest fire	*C. deodara, Q.leucotrichophora*	Fencing		

1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Lahru									
B	Block:	Chowari									
C	Range:	Chowari									
D	District:	Chamba									
1.	Kalighar (6 ha.)	N 32°24'46.2" E 075°59' 17.9" 1816 m	Sandy/ Silty	*Melia azedarach D.hypoleuca, D.sissoo, Toona ciliata & Rubus elipticus*	Steep	Western	Land sliding	*Agave americana, Vitex* spp. *Ipomoea* spp. *Dodonaea viscosa & Adhatoda vesica*	b) To plant the species like *Agave Americana & Ipomoea* for checking these soil erosion	Fencing of barbed wires/ Cement posts	-
2.	Naragada Nalla (6 ha.)	N 32°23'38.4" E 075°59' 25.6" 1771 m	Sandy/ Silty	*Pyrus pashia, Bombax ceiba, Carissa carandus, Zizyphus spp. & Dalbergia sissoo*	Steep	Western	Land sliding	*Agave americana, Ipomoea* spp. *Adhathoda vesica*	-	-	-
3.	Nagarada Nalla (Nadal Sabh No. 5) (6 ha.)	N 32°23'47.8" E 075°59' 33.3" 809 m	Sandy	*D.hypoleuca D.sissoo, Acacia catechu & Vitex* spp.	Medium	Western	Natural	a) Constructions of check dams and retaining walls			
4.	Jattroon Nalla Near Govt. Middle School (9 ha.)	N 32°25'29.7" E 075°59' 49.0" 975 m	Sandy silty	*P.roxburghii, Toona ciliata & Bombax ceiba*	Steep	Western	Excavation works	a) Constructions of check dams and crate works to prevent the sliding which block the main road. b)Vegetative barrier of Agave and Ipomoea	-	-	-
5.	Gahar Nala (3 ha.)	N 32°26'14.6" E 075°59' 56.0" 1012 m	Rocky	*Bombax ceiba, D.sissoo, Pyrus phasia*	Medium	Western	Rains	a) Constructions of check dams and crate works.	-	-	-
6.	**Rim Plantation around dam site (20 ha.)**		Sandy silty	*P.roxburghii, Toona ciliata & Bombax ceiba*	Steep	Western	Excavation works		-	-	-

[B] SOIL CONSERVATION WORKS

[Sub-Watershed Kalam Khad – 1B1A7(1)]

Sl. No.	Name of Location & Area (Ha.)	GPS Coordinate of Location (Latitude, Longitude, Altitude)	Soil Type	Vegetation Indicator Species	Slope (Gentle/ Medium/ Steep)	Aspect	Causes of Degradation	Species Suggested for Plantation	Prioritized Treatment Measures a] Engineering Structres b] Vegetation Measures	Protection & Sustainability Aspects (Protection against Fire, Grazing, etc.)	Possibility of Water Harvesting Structure (Location with GPS Coordination
1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Chowari									
B	Block:	Chowari									
C	Range:	Chowari									
D	District:	Chamba									
1.	Bukhrunalla (Near Bukhru village Point No. (I) 2 Ha.	N 32°26'21.3" E 076°01'13.9" 1163 m	Silty	*P. roxburghii, Latana camera, Rubus ellipticus, Bombax ceiba, Berberis spp , Prinspia utilis*	Medium	Eastern	Rain water	Construction of Check dams	*Albizzia stipulata, Acacia catechu Dalbergia sissoo*	-	-
2.	Bukhrunalla (Near Bukhru village) Point No. (II) 2 Ha.	N 32°26'31.1" E 076°01'13.7" 1186 m	Loamy	*P. roxburghii Latana camera , Rubus ellipticus, Berberis spp , Prinsepia utilis*	Medium	Eastern	Rain water	Constructions of checkdams, Crate wall & crate-wire	-	-	Location Slump Construction of water tank for irrigation N 32°26'36.8" E 076°01'04.1" 1341 m
3.	Tornu Nala 3 Ha.	N 32°26'48.01" E 076°00'22.87" 1188 m	Rocky	*P. roxburghii, Bombax ceiba, D.hypoleuca, Albizzia spp.*	Medium	Eastern	Rainfed Nalas	Construction of check dams, Crate wall & crate wire, Construction of the small bridge over Tornu Nalla.	-	-	-
4.	Solta (3 ha.)	N 32°25'08.7" E 076°02'16.8" 1632 m	Loamy	*Toona ciliata, D. hypoleuca, D. sissoo, A. catechu*	Medium	Eastern	Rainfed Nalllas	Construction of check dams Construction of Farm Pond (8mx6mx2m)	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
5.	Prungal Nalla (3 ha.)	N 32°25'54.6" E 076°03'16.6" 1733 m	Rocky	*P. roxburghii, D.sissoo & Toona ciliata*	Medium	Eastern	Natural / Rains	Construction of check dams			

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Upper Chowari (Dhadu)**									
B	**Block:**	**Chowari**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Jag Nalla (1) (2 ha.)	N 32°27'51.8" E 076°05'05.0" 1956 m	Rocky	*C. deodara*	Steep	Southern	Rain	Check dam & Check wall	-	-	5 Nos. 10 Nos.
2.	Jag Nalla (2 ha.)	N 32°27'39.5" E 076°05'06.9" 2150 m	Silty	*C. deodara*	Medium	Eastern	Rain	Water pond	-	-	10X10 ft^2
3.	Malunda (1) (0.2 ha.)	N 32°27'32.8" E 076°05'06.9" 1938 m	Rocky clay	*C. deodara*	Steep	Southern - East	Rain	Check wall	-	-	8 Nos. (Single spot)
4.	Malunda (2 ha.)	N 32°27'31.5" E 076°05'06.9" 1954 m	Rocky clay	*C. deodara*	Steep	Eastern	Rain	Check wall	-	-	3 Nos. (Single spot)
5.	Gauwalnu (1) (0.4 ha.)	N 32°27'90.8" E 076°05'24.9" 1967 m	Rocky clay	*Q.leucotrichophora & C. deodara*	Steep	Eastern	Rain flood	Check wall & Crate wall	-	-	2 Nos. 4 Nos.
6.	Gauwalnu (2) (1/2 ha.)	N 32°27'46.6" E 076°05'51.5" 2022 m	Rocky	*Q.leucotrichophora & C. deodara*	Medium	Eastern	Rain flood	Crate wall & Check dam	-	-	10 Nos. 10 Nos.
7.	Gauwalnu Bridge (3) (0.4 ha.)	N 32°27'41.7" E 076°05'44.6" 1956 m	Rocky	*Q.leucotrichophora & C. deodara*	Medium	Eastern	Rain flood	Crate wall & Check wall	-	-	6 Nos. 6 Nos.
8.	Bharua Nalla Bridge (0.2 ha.)	N 32°27'25.7" E 076°05'29.7" 1863 m	Silty Rocky	*Berberis aristata*	Medium	Eastern	Rain flood	Water Tank, Crate wall & Check wall	-	-	15X15 Nos. 3 Nos. 3 Nos.
9.	Bharua Nursery	N 32°27'32.2" E 076°05'18.9" 1975 m	Silty	*C. deodara*	Steep	Eastern	Rain	Water Tank,	-	-	8X8 ft.^{2}

1	2	3	4	5	6	7	8	9	10	11	12
10.	Khabtu	N 32°27'13.9" E 076°05'20.3" 1924 m	Silty	*P. smithiana, Listea umbrosa & Berberis aristata*	Gentle	Eastern	Rain flood	Check wall	-	-	8 Nos. (Single spot)
11.	Upper Nalla Gran (1) (1/2 ha.)	N 32°26'55.8" E 076°05'56.3" 2147 m	Clay silty	*Q.leucotrichophora, P. smithiana & Berberis aristata*	Gentle	Eastern	Rain flood	Check dam, Check wall & Gulli plugging	-	-	5 Nos. 5 Nos. 5 Nos.
12.	Upper Nalla Gran (2)	N 32°26'56.3" E 076°05'58.2" 2158 m	Clay	*Berberis aristata*	Steep	Eastern	Rain flood	Check wall	-	-	4 Nos. (Single spot)
13.	Thera (1)	N 32°26'58.0" E 076°06'95.7" 2274 m	Loamy silty	*P. smithiana C. deodara*	Gentle	Eastern	Rain & Snow	Water tank	-	-	1 No. 10X10 ft.^{2}
14	Thera (2)	N 32°26'53.8" E 076°06'13.4" 2252 m	Clay	P. smithiana	Steep	Eastern	Rain flood	Check wall	-	-	5 Nos. (Single spot)
15.	Kalam	N 32°26'52.1" E 076°06'14.3" 2992 m	Rocky	*P. smithiana*	Steep	Eastern	Rain & Snow	Crate wall & Water tank	-	-	10 Nos. 15X15 ft.^{2}
16.	Bilaspur	N 32°26'44.3" E 076°05'29.5" 2054 m	Clay	*P. smithiana*	Steep	Southern-east	Rain flood	Check wall	-	-	5 Nos. (Single spot)
17.	Kufru	N 32°26'50.7" E 076°05'33.8" 2082 m	Silty	*Berberis aristata*	Medium	Western	Rain flood	Check wall	-	-	10 Nos. (Single spot)
18.	Thera Nalla	N 32°26'55.2" E 076°05'36.0" 1992 m	Clay	*Listea umbrosa, Q.leucotrichophora & P. smithiana*	Medium	Western	Rain flood	Check wall	-	-	8 Nos. (Single spot)
19.	Dhadu Nursery	N 32°27'10.03" E 076°05'26.6" 1936 m	Clay	*Listea umbrosa, Q.leucotrichophora*	Gentle	Western	Rain	Pond	-	-	10X15 ft.^{2}
20.	Jhardi (1)	N 32°27'18.4" E 076°04'57.7" 1806 m	Clay	*Q.leucotrichophora*	Steep	Eastern	Rain flood	Crate wall & Check wall	-	-	20 Nos. 20 Nos. (1 ha.)

1	2	3	4	5	6	7	8	9	10	11	12
21.	Jhardi (2)	N 32°27'17.3" E 076°04'51.0" 1806 m	Loamy	*Q.leucotrichophora & Berberis aristata*	Medium	Southern – East	Rain & Harvest	Pond	-	-	15X15 ft.³
22.	Dhadu Near Road	N 32°27'18.0" E 076°04'54.3" 1806 m	Rocky clay	*Q.leucotrichophora*	Steep	Northern-West	Rain & Road	Crate wall	-	-	25 Nos. (Single spot)
23.	Jhardi Nalla (1) (0.2 ha.)	N 32°27'25.3" E 076°04'55.0" 1800 m	Clay	*Q.leucotrichophora Litsea umbrosa*	Medium	Eastern	Rain	Check dam & Check wall	-	-	4 Nos. 4 Nos.
24.	Jhardi Nalla (2)	N 32°27'25.8" E 076°04'55.0" 1803 m	Clay silty	*Litsea umbrosa, Q.leucotrichophora*	Steep	Southern – East	Rain	Gulli plugging	-	-	5 Nos. (Single spot)
25.	Dhanovdi	N 32°27'31.9" E 076°04'52.5" 1850 m	Loamy black	*Q.leucotrichophora*	Medium	Southern – East	Rain	Tank	-	-	1 No. 15X15 ft.³
26.	Jhardi Nalla (3) (On way of Chirwari)	N 32°27'15.3" E 076°04'37.6" 1783 m	Clay	*Q.leucotrichophora*	Steep	Northern	Rain flood	Crate wall	-	-	10 Nos. (Single spot)
27.	Kalam Nalla (1) (Karmog) (2 ha.)	N 32°27'05.8" E 076°04'35.2" 1777 m	Clay rocky	*P. roxburghii*	Steep	Southern	Rain flood	Crate wall	-	-	50 Nos.
28.	Kalam Nalla (2)	N 32°27'08.4" E 076°04'26.0" 1777 m	Rocky clay	*P. roxburghii*	Steep	Southern	Rain flood	Crate wall	-	-	20 Nos. (Single spot)
29.	Kalam Nalla (3) (2 ha.)	N 32°27'08.3" E 076°02'19.5" 1780 m	Rocky clay	*P. roxburghii*	Steep	Southern	Rain flood	Crate wall	-	-	50 Nos.
30.	Guyuel (1/2 ha.)	N 32°27'03.0" E 076°04'09.6" 1600 m	Rocky clay	*P. roxburghii*	Steep	Western	Rain, Flood & Road	Crate wall	-	-	20 Nos.

1	2	3	4	5	6	7	8	9	10	11	12
31.	Gurnal Nalla (1 ha.)	N 32°27'17.0" E 076°07'10.6" 1705 m	Rocky	*P. roxburghii*	Steep	Northern	Rain	Check dam & check wall	-	-	20 Nos. 10 Nos.
32.	Darela Nalla (2 ha.)	N 32°26'54.3" E 076°04'11.0" 1750 m	Rocky clay	*P. roxburghii*	Steep	Western	Rain & Flood	Crate wall	-	-	40 Nos.

1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Kainthali									
B	Block:	Kainthli									
C	Range:	Chowari									
D	District:	Chamba									
1.	Druber Dhar (1) (3 ha.)	N32°29'13.0" E076°03'46.0" 2456m	Loamy	*P. smithiana* & *Berberis aristata*	Gentle	Western	Grazing, Rain & Snow erosion	Gulli plugging	-	-	20Nos.
2.	Druber Dhar (2) (4 ha.)	N32°29'12.0" E076°04'10.0" 2443m	Rocky, Loamy	*P. smithiana* *Abies pindrow*	Gentle	Western	Grazing, Rain & Snow, wind erosion	Crate wall Check dam Gulli plugging	-	-	25Nos. 5Nos.
3.	Druber Dhar (3) (1/2 ha.)	N32°29'12.0" E076°04'10.0" 2443m	Loamy	*Abies pindrow* *P. smithiana*	Gentle	Western	Grazing, Rain & Snow, wind erosion	Water storage tank	-	-	1Nos. (15ft.X20ft.)
4.	Druber Dhar (4) (3 ha.)	N32°29'12.9" E076°04'19.2" 2449m	Loamy	*P. smithiana*	Gentle	Western	Rain erosion	Gulli plugging and check wall	-	-	35 Nos. 5 Nos.
5.	Druber Dhar (5) (2 ha.)	N32°29'13.8" E076°04'32.9" 2442m	Loamy	*Abies pindrow* *P. smithiana*	Gentle	Western	Rain and Flood	Gulli plugging and check wall	-	-	25 Nos. 3 Nos.
6.	Sat Kulera Dhar (1) (3 ha.)	N32°29'09.1" E076°04'40.3" 2484m	Loamy	Grasses	Gentle	Western	Grazing, Rain & Snow, wind erosion	Gulli plugging	-	-	35 Nos.
7.	Sat Kulera Dhar (2) (5 ha.)	N32°29'06.1" E076°04'45.9" 2475m	Loamy	*P. smithiana* and Grasses	Steep	Western	Grazing, Rain Snow & wind erosion	Check wall and Gulli plugging	-	-	12 Nos. 20 Nos.
8.	Sat Kulera Dhar (3) (1 ha.)	N32°28'59.2" E076°05'45.9" 2475m	Loamy	*P. smithiana* and Grasses	Steep	Western	Grazing, Rain, Snow & wind erosion	Check wall and Gulli plugging	-	-	15 Nos. 20 Nos.
9.	Sat Kulera Dhar (4) (1 ha.)	N32°23'55.7" E076°05'08.7" 2507m	Rocky Loamy	Tillah and Grasses	Medium	Western	Grazing, Rain, Snow & wind erosion	Pond	-	-	30 ft. X15 ft. 1 No.

1	2	3	4	5	6	7	8	9	10	11	12
10.	Kainthli Rest House (1) (1/4 ha.)	N32°28'18.6" E076°05'10.1" 1998m	Loamy Clay	*C. deodara*	Steep	Western	Rain flood	Crate wall	-	-	5 Nos.
11.	Kainthli Rest House (2) (1/4 ha.)	N32°28'21.6" E076°05'08.5" 2014m	Loamy Black	*Listea umbrosa* and *C. deodara*	Steep	Western	Rain flood & Snow erosion	Crate wire & Check wall	-	-	5 Nos. 4 Nos.
12.	Kainthli Rest House (2)	N 32°28'17.2" E 076°05'04.2" 2014m	Loamy Black	*Listea umbrosa* and *C. deodara*	Steep	Western	Rain flood & Snow erosion	Check wall	-	-	7 Nos. (Single spot)
13.	Badai (1) (1/4 ha.)	N 32°28'17.7" E 076°04'53.5" 2056m	Loamy Black	*Listea umbrosa C. deodara* & *Q.leucotrichophora*	Steep	Southern - West	Rain flood	Check wall	-	-	10 Nos.
14.	Badai (2) (1/4 ha.)	N 32°28'18.4" E 076°04'48.7" 2056m	Loamy Black	*Listea umbrosa, C. deodara* & *Q.leucotrichophora*	Steep	Southern - West	Rain flood	Check dam & Check wall	-	-	10 Nos. 10 Nos.
15.	C-1 Forest Path(1) (1/4 ha.)	N 32°28'17.3" E 076°04'37.9" 2048	Loamy Black	*Listea umbrosa, C. deodara* & *Q.leucotrichophora*	Steep	Southern	Rain flood	Check dam & Check wall	-	-	5 Nos. 10 Nos.
16.	Langa NDPF (1) (1/4 ha.)	N 32°28'16.3" E 076°04'35.4" 2092m	Loamy Black	*C. deodara* & *Q.leucotrichophora*	Steep	Southern	Rain flood	Check wall	-	-	6 Nos. (Single spot)
17.	Langa NDPF (2)	N 32°28'16.8" E 076°04'35.6" 2094 m	Loamy Black	*C. deodara* & *Q.leucotrichophora*	Steep	Southern	Rain flood & Snow erosion	Check wall	-	-	4 Nos. (Single spot)
18.	Langa NDPF Nalla (3)	N 32°28'27.5" E 076°04'39.0" 2118 m	Loamy	*Rhododendron spp, Listea umbrosa, C. deodara* & *Q. leucotrichophora*	Steep	Southern	Rain flood	Check wall	-	-	5Nos. (Single spot)
19.	Bangla Village Dhar (1/4 ha.)	N 32°28'48.9" E 076°03'48.8" 2118 m	Loamy	*P. smithiana*	Steep	Western	Rain flood & Public interferences	Check wall & Gulli plugging	-	-	20 Nos. 10 Nos.
20.	C-5 Water Fall	N 32°28'52.4" E 076°04'49.8" 2140m	Rocky	*C. deodara* & *Q.leucotrichophora*	Steep	Southern	Rain flood	Crate wall	-	-	10 Nos. (Single spot.)

1	2	3	4	5	6	7	8	9	10	11	12
21.	Bangla -Da-Nalla (1/4 ha.)	N 32°28'52.5" E 076°03'45.4" 2145m	Loamy	*P. smithiana, C. deodara & Q.leucotrichophora*	Steep	Southern	Rain	Crate wire	-	-	10 Nos.
22.	Banadu (1)	N 32°28'57.5" E 076°04'21.5" 2302m	Clay	*P. smithiana, & Q.leucotrichophora*	Medium	Eastern	Rain & Snow erosion	Check wall	-	-	10 Nos. (Single spot.)
23.	Bandali (2) (1/4 ha.)	N 32°28'58.0" E 076°04'20.5" 2308m	Clay	*P. smithiana, & Q.leucotrichophora*	Steep	Eastern	Rain & Snow erosion	Check wall & Gulli plugging	-	-	20 Nos. 10 Nos.
24.	Bangla Forest	N 32°29'04.7" E 076°04'12.2" 2328 m	Clay	*C. deodara, & Q.leucotrichophora*	Steep	Western	Rain flood	Check wall & crate wall	-	-	3 Nos. 8Nos. (Single spot)
25.	Bangle water source	N 32°29'07.2" E 076°03'54.6" 2364 m	Clay	*Salix spp.*	Steep	Western	Rain	Check dam	-	-	3 Nos. (Single spot)
26.	Khaproti (1) (2 ha.)	N 32°28'01.6" E 076°03'40.8" 2118 m	Clay	*Q.leucotrichophora*	Steep	Eastern	Rain flood & Snow erosion	Check wall & Gulli plugging	-	-	50 Nos. 40 Nos.
27.	Khaproti (2) (1/4 ha.)	N 32°27'59.0" E 076°03'43.5" 2109 m	Loamy	*Q.leucotrichophora*	Medium	Southern	Rain flood & wind erosion	Check wall & Gulli plugging	-	-	10 Nos. 10 Nos.
28.	Ghat Nala (1/4 ha.)	N 32°27'29.7" E 076°03'32.3" 1928 m	Silt Loamy black	*Q.leucotrichophora C. deodara*	Steep	Eastern	Rain water	Check wall, Crate wall, Gulli plugging &	-	-	10 Nos. 8 Nos. 3 Nos.
29.	Drahllu (1/2 ha.)	N 32°27'41.9" E 076°03'47.3" 1948m	Clay Loamy	*Q.leucotrichophora & C. deodara*	Steep	Eastern	Rain	Check wall & Gulli plugging	-	-	20 Nos. 25 Nos.
30.	Gher Jungle (Upper side of Bahlet)	N 32°27'49.6" E 076°03'50.8" 1855 m	Loamy	*P. roxburghii, Q.leucotrichophora Berberis aristata*	Steep	Southern - east	Rain flood	Crate wall & Check dam	-	-	15 Nos. 10 Nos. (Single spot)
31.	Kumbardi (1) (1/4 ha.)	N 32°27'52.7" E 076°04'14.2" 1789m	Black	*P. roxburghii, C. deodara & Q.leucotrichophora*	Medium	Southern-west	Rain & Grazing	Check wall	-	-	10 Nos.

1	2	3	4	5	6	7	8	9	10	11	12
32.	Kumbardi (2)	N 32°27'46.9" E 076°04'16.0" 1948 m	Black	*Listea umbrosa*, & *C. deodara*	Medium	Southern - west	Rain & Grazing	Check dam & Gulli plugging	-	-	3 Nos. 5 Nos. (Single spot)
33.	Kumbardi (3)	N 32°27'43.9" E 076°04'19.8" 1884m	Black	*Listea umbrosa*, & *C. deodara*	Medium	Southern -west	Rain & Grazing	Check wall & Check dam	-	-	3 Nos. 4 Nos. (Single spot)
34.	Batoi Nalla	N 32°27'45.8" E 076°04'37.5" 1820m	Black	*Q.leucotrichophora*, *Listea umbrosa*, & *C. deodara*	Steep	Southern	Rain	Check Dam	-	-	5 Nos. (Single spot)
35.	Jukani Nalla (Batoi)	N 32°27'46.9" E 076°04'41.9" 1858m	Clay	*P. smithiana* & *Q.leucotrichophora*	Medium	Southern	Rain flood, Public interferences	Check Dam & Check Wall	-	-	5 Nos. 6 Nos. (Single spot)
36.	C-1 Batoi Nalla	N 32°29'00.2" E 076°04'44.9" 1891m	Clay	*C. deodara* & *P. roxburghii*	Gentle	Eastern	Rain	Check Dam	-	-	5 Nos. (Single spot)
37.	C-2 Batoi Nalla (1/4 ha.)	N 32°28'03.0" E 076°04'52.3" 1917m	Rocky	*C. deodara* & *Berberis aristata*	Medium	Eastern	Rain	Check Dam & Check Wall	-	-	8 Nos. 10 Nos.
38.	Rest House Nalla (1/4 ha.)	N 32°28'12.9" E 076°05'08.9" 1905m	Rocky	*C. deodara*	Medium	Eastern	Rain	Crate Wall & Check Wall	-	-	5 Nos. 4 Nos.
39.	C-4 Path (Rest House) (1/3 ha.)	N 32°28'12.9" E 076°05'08.9" 1905m	Rocky	*C. deodara*	Medium	Eastern	Rain & Public interferences	Gulli plugging & check wall	-	-	10 Nos. 15 Nos.
40.	Batlet village	N 32°28'10.3" E 076°05'10.9" 1795m	Rocky	*Q.leucotrichophora* & *P. roxburghii*	Medium	Southern - East	-	Pond	-	-	10X15 ft.²
41.	Kaimbly Nursery	N 32°28'27.2" E 076°05'12.8" 2000m	-	*C. deodara*	Steep	Eastern	-	Water tank for nursery	-	-	10X10ft.²
42.	Nursery Nalla (1)	N 32°28'18.3" E 076°05'15.3" 2059m	Rocky	*C. deodara*	Gentle	Eastern	Rain	Crate wall	-	-	5 Nos. (Single spot)
43.	Nursery Nalla (3) (1/2 ha.)	N 32°27'17.3" E 076°05'18.3" 2100m	Loamy	*C. deodara*	Steep	Eastern	Rain & Public interferences	Gulli plugging & check wall	-	-	15 Nos. 10 Nos.

1	2	3	4	5	6	7	8	9	10	11	12
44.	Nursery Nalla (4)	N 32°28'17.3" E 076°05'18.6" 2250m	Rocky	*C. deodara*	Steep	Southern-East	Rain	Crate wall	-	-	15 Nos. (Single spot)
45.	C-7 Nalla Upper Temple (1/2 ha.)	N 32°28'23.8" E 076°05'34.0" 2110m	Loamy black silt like	*Listea umbrosa., Q.leucotrichophora & Cedrus deodara*	Steep	Eastern	Rain & Public interferences	Gulli plugging & check wall	-	-	20 Nos. 15 Nos.
46.	C-7 Nalla (1/2 ha.)	N 32°28'23.2" E 076°05'36.3" 2111m	Silt	*Listea umbrosa., Q.leucotrichophora & Cedrus deodara*	Steep	Eastern	Rain	Crate wall & check wall	-	-	10 Nos. 20 Nos.
47.	C-8 Reserve Nalla	N 32°28'19.8" E 076°05'39.0" 2398m	Rockys ilt	*C. deodara*	Medium	Southern-west	Rain	Crate wall	-	-	5 Nos. (Single spot)
48.	C-9 Reserve Nalla (1) (1/2 ha.)	N 32°28'23.9" E 076°05'35.0" 2325 m	Rocky silt	*C. deodara*	Medium	Southern-west	Rain	Crate wall & Gulli plugging	-	-	5 Nos. 20 Nos.
49.	C-9 Reserve Nalla (2) (1/2 ha.)	N 32°28'16.0" E 076°05'26.0" 2150 m	Rocky	*C. deodara*	Medium	Western	Rain	Crate wall	-	-	5 Nos.
50.	C-10 Khidri ka Goth (0.5ha.)	N 32°28'13.9" E 076°05'15.2" 2325m	Silt	*C. deodara*	Medium	Western	Rain	Check dam & Crate wall	-	-	5 Nos. 10 Nos.
51.	Goth Nada Nalla	N 32°28'09.6" E 076°05'04.2" 1935 m	Silt	*C. deodara*	Gentle	Eastern	Rain & public interferences	Gulli plugging check wall & Check dam	-	-	10 Nos. 3 Nos. 3 Nos.
52.	Badrala C-10	N 32°28'05.6" E 076°05'01.2" 1929 m	Rocky clay	*C. deodara*	Steep	Ea stern	Rain	Check wall	-	-	2 Nos.
53.	Badrala Nalla Nathrula C-10	N 32°28'02.1" E 076°05'02.3" .....m	Clay	*C. deodara*	Medium	Southern-west	Rain	Water tank	-	-	10X2 ft.^{2}
54.	Sapedi village C-10 (0.2 ha.)	N 32°27'54.2" E 076°05'01.5" 1916 m	Clay	*C. deodara*	Steep	Southern	Rain	Crate wall & Water Tank	-	-	4 Nos. 1 Nos. 10X12 ft.^{2}

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Khada Danda**									
B	**Block:**	**Kainthli**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Maturi (2) (7 ha.)	N32°28'28.6" E076°03'01.2" 2225 m	Clay, Sand	*C. deodara*	Medium	Southern-East	Grazing, Wind,Rain	Crate wall Check dam Gulli plugging	-	-	20 Nos. 80 Nos. 30 Nos.
2.	Bankot (2 ha.)	N32°29'01.0" E076°02'52.3" 2260 m	Rocky , Clay	*Q.leucotrichophora & C. deodara*	Medium	South	Grazing, Public interference	Crate wall Check dam Gulli plugging	-	-	15 Nos. 50 Nos. 100 Nos.
3.	Fafradi (1) (½ ha.)	N32°28'00.0" E076°03'42.6" 2015m	Clay	*Q.leucotrichophora & P. smithiana*	Gentle	Northern-West	Grazing, Public interference	Check wall Gulli plugging	-	-	15 Nos. 20 Nos.
4.	Dharmashala (3/4 ha.)	N32°27'56.3" E076°03'44.8" 2102 m	Clay, Sand	*Q.leucotrichophora & P. smithiana*	Medium	North	Rain, Flood	Crate wall Check dams	-	-	10 Nos. 20Nos.
5.	Bihali Village (2 ha.)	N32°27'46.8" E076°03'37.6" 2021 m	Loamy, Rocky	*Q.leucotrichophora*	Medium	West	Rain, Flood, Wind and Public interference	Check wall Gulli plugging	-	-	10 Nos. 20 Nos.
6.	Ban-da-goth Nala (3/4 ha.)	N32°29'02.9" E076°03'16.3" 2364 m	Sandy, Rocky	*P. smithiana C. deodara, Listea umbrosa & Rhododendron arboreum*	Steep	South	Rain, Flood	Check dam Crate wall	-	-	25 Nos. 20 Nos.
7.	Zuthe-di-vedi nala (1 ha.)	N32°29'03.2" E076°03'17.0" 2365 m	Sand, Rocky	*C. deodara*	Medium	South	Rain, Flood	Check dam Crate wall	-	-	25 Nos. 15 Nos.

1	2	3	4	5	6	7	8	9	10	11	12
8.	Jot (1) (3 ha.)	N32°29'14.1" E076°03'39.6" 2250 m	Sand, Rocky , Clay	-	Medium	South-East	Grazing, Rain and Snow Erosion	Gulli plugging Check Wall	-	-	120 Nos. 3 Nos.
9.	Jot(2) (1/4 ha.)	N32°29'12.0" E076°03'38.9" 2421 m	Loamy, Rocky	*Eugenia jambolana & Abies pindrow*	Steep	East	Rain, Flood Public interference	Check dam Check Wall	-	-	10 Nos. 8 Nos.
10.	Jot (3) Nursery (1/4 ha.)	N32°29'01.0" E076°03'39.9" 2283 m	Loamy	*Abies pindrow & C. deodara*	Steep	East	Rain, Flood Erosion	Water Storage Tank, Check dam	-	-	2 Nos. 5 Nos.
11.	Jot (4) Dobu	N32°29'05.2" E076°03'45.7" 2426 m	Loamy, Black	*C. deodara*	Steep	East	Rain	Check Wall	-	-	6 Nos. Singe Spot
12.	Jot (5) Dobu (1/4 ha.)	N32°28'55.7" E076°03'48.7" 2396 m	Black	*P. smithiana*	Medium	South	Grazing, Rain, Wind erosion	Check Wall	-	-	10 Nos.
13.	Jot (6) Dobu (1/4 ha.)	N32°28'50.9" E076°03'49.2" 2380 m	Black	*P. smithiana*	Medium	South	Grazing, Rain, Flood	Gulli plugging	-	-	18 Nos.
14.	Dobu (1 ha.)	N32°28'49.6" E076°03'49.8" 2373 m	Loamy Rocky	*P. smithiana*	Medium	West	Rainfall, Public interference	Gulli plugging Check Wall	-	-	20 Nos. 20 Nos.
15.	Bamuni (1/2 ha.)	N32°28'09.0" E076°02'52.1" 2242m	Rocky	*Q.leucotrichophora & C. deodara*	Steep	South-East	Rain	Check Wall, Crate wall, Water Storage Tank	-	-	10 Nos. 10 Nos. 1 Nos.
16.	Luhani (1/4 ha.)	N32°28'10.1" E076°02'53.3" 2203m	Clay	*Q.leucotrichophora & Cedrus deodar*	Steep	South-East	-	Crate wall, Check Wall	-	-	10 Nos. 12 Nos

1	2	3	4	5	6	7	8	9	10	11	12
17.	Chulha (1)	N32°27'59.0" E076°02'46.0" 2225m	Clay	*Q.leucotrichophora & Cedrus deodara*	Steep	East	-	Water Storage Tank Check Wall	-	-	1 No. 10X15ft 6 Nos Single spot
18.	Chulha (2) (1/2 ha.)	N32°27'57.8" E076°02'49.3" 2207 m	Clay Rocky	*Q.leucotrichophora & Cedrus deodara*	Steep	East	-	Check dam Check Wall	-	-	20 Nos. 27 Nos.
19.	Fafradi (1/2 ha.)	N32°28'10.9" E076°03'35.2" 2186m	Rocky , Loamy	*P. smithiana*	Steep	North	-	Gulli plugging Check Wall	-	-	10 Nos. 12 Nos.

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Lahru**									
B	**Block:**	**Chowari**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Gahar Nala (3-4 ha.)	N 32°26'14.6" E 075°59' 56.0" 1012 m	Rocky	*Bombex ceiba, D.sissoo, Pyrus pashia*	Medium	Western	Rains	a) Constructions of check dams and crate works.	-	-	-
2.	Jattroon Nalla) Near Govt. Middle School (4 ha.)	N 32°25'29.7" E 075°59' 49.0" 975 m	Sandy silty	*P.roxburghii, Toona ciliata & Bombax ceiba*	Steep	Western	Excavation works	a) Constructions of check dams and crate works to prevent the sliding which block the main road. b)Vegetative barrier of Agave and Ipomoea	-	-	-
3.	Parwot No.4 Near Tracker Hut (1 ha.)	N 32°24'30.7" E 075°58' 46.6" 652 m	Sandy	*D.sissoo, Toona ciliata, D. hypoleuca & Rubus ellipetus & Lantana camara*	Medium	Western	Rains	a) Constructions of check dams and retaining walls	-	-	-
4.	Nagarada Nalla (Nadal sabh No. 5) (3 ha.)	N 32°23'47.8" E 075°59' 33.3" 809 m	Sandy	*D.hypoleuca D.sissoo, Acacia catechu & Vitex spp.*	Medium	Western	Natural	a) Constructions of check dams and retaining walls			

[C] AGRICULTURE, HORTICULTURE CROPOS, ANIMAL HUSBANDRY AND AMEINITIES RELATED DATA

[Sub-Watershed Kalam Khad – 1B1A7(1)]

Sl. No.	Name of the Village	Panchayat/ Block	Main Agri-culture Crops Grown	Improvement/ Treatment Measures Suggested	Main Horti-culture Crops Grown	Improvement/ Treatment Measures Suggested	Category of Animals		Stock Improve-ment Measures Suggested	Veterinary Hospital (Distance in Kms from nearby Veterinary Hospital)	Dispensary/ PHC/ CHC Hospital (Distance in Kms from nearby Dispensary/ PHC/ CHC Hospital	Road Access (Distance From Road Head in Kms)	Possibility of Water Harvesting Structures (Location with GPS Coordinates)
							Cattle (Nos.)	Sheep/ Goat (Nos.)					
1	2	3	4	5	6	7	8		9	10	11	12	13
A	Beat:	Chowari											
B	Block:	Chowari											
C	Range:	Chowari											
D	District:	Chamba											
1.	Damreira	Turkada	Wheat, Maize, Barley, Rice & Sarson	Best quality seeds and measures for checking the monkey menace	-	Requirement of the seedlings of *Punica granatum, Prunus persica* Mango & Jamun	45	40	-	Chowari (2 Km.)	Chowari (2 Km.)	Road Head	-
2.	Chorana	Turkada	Wheat, Maize, Barley, Rice & Sarson	Best quality seeds and measures for checking the monkey menace	-	Requirement of the seedlings of *Punica granatum, Prunus persica* & Mango	21	25	-	Chowari (3 Km.)	Chowari (3 Km.)	Road Head	-
3.	Turkada-Dodan	Turkada	Wheat, Maize Barley, Rice & Sarson	Best quality seeds and measures for checking the monkey menace	-	Requirement of the seedlings of *Punica granatum, Prunus persica* & Mango	26	30	-	Chowari (4.5 Km.)	Chowari (4.5 Km.)	1 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
4.	Kulera	Turkada	Maize, Wheat & Barley	Plantation of fodder yielding species	-	Requirement of the seedlings of the species like Peach, Khurmani & Plum	120	60	Hybrid varieties yielding more wool	Chowari (8 Km.)	Chowari (8 Km.)	Road Head	-
5.	Mandriyar	Turkada	Maize, Wheat & Barley	-	-	-	50	18-20	-	Chowari (9 Km.)	Chowari (2 Km.)	Road Head	Irrigation Tank for harvesting the rain water. N 2°24'51.2" E 07° 1'43.9"
6.	Gagar	Turkada	Maize, Wheat & Barley	-	-	-	110	70	Hybrid variety yielding more wool	Chowari (12 Km.)	Gagar (1 Km.)	1Km.	-
7.	Kaimblee	Turkada	Maize, Wheat & Barley	Plantation of the fodder species	-	-	70	80	-	Chowari (8-9 Km.)	Mandriyar (2 Km.)	Road Head	-
8.	Prungal	Banet	Maize, Wheat & Barley	Plantation of the fodder species	-	-	80	150	-	Chowari (7 K.m)	Chowari (7 Km.)	3 Km from road head	-
9.	Jatoon	Banet	Maize, Wheat & Barley	Plantation of the fodder species	-	-	50	120	-	Chowari (4 Km)	Chowari (4 Km.)	0.5 Km from road head	-
10.	Banet	Banet	Maize, Wheat & Barley	Plantation of the fodder species	-	-	75	60	-	Chowari (3.5 Km.)	Chowari (3.5 Km)	1 Km. from the raod head	-

1	2	3	4	5	6	7	8		9	10	11	12	13
A	Beat:	Upper Chowari (Dadhu)											
B	Block:	Chowari											
C	Range:	Chowari											
D	District:	Chamba											
1.	Bhadkha	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	KhurmaniA Adoo	-	12	22	-	Chowari 16 km	Chowari 16 km	8 Km.	-
2.	Dhanudi	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	KhurmaniA Adoo	-	28	39	-	Chowari 15 km	Chowari 15 km	8 Km.	-
3.	Malunda	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	KhurmaniA Adoo	-	70	106	-	Chowari 15 km	Chowari 15 km	8 Km.	-
4.	Guwalnu	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani Aadoo	-	53	70	-	Chowari 15 km	Chowari 15 km	8 Km.	-
5.	Bhorua	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	KhurmaniA adoo	-	68	139	-	Chowari 15 km	Chowari 15 km	8 Km.	-
6.	Khalotu	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	KhurmaniA adoo	-	48	58	-	Chowari 14 km	Chowari 14 km	7 Km.	-
7.	Dhadu (1)	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	56	30	-	Chowari 14 km	Chowari 14 km	7 Km.	
8.	Dhadu (2)	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	28	15	-	Chowari 13km	Chowari 13 km	6 Km.	

1	2	3	4	5	6	7	8		9	10	11	12	13
9.	Jhandi	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	55	70	-	Chowari 14km	Chowari 14km	7 Km.	
10.	Lagwal	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	17	10	-	Chowari 16km	Chowari 15km	8 Km.	
11.	Chalela	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	3	5	-	Chowari 14km	Chowari 14km	7 Km.	
12.	Samnot (1)	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	24	30	-	Chowari 12km	Chowari 12km	5 Km.	
13.	Samnot (2)	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	32	30	-	Chowari 12km	Chowari 12km	5 Km.	
14.	Gyeul	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	16	20	-	Chowari 11km	Chowari 11km	4 Km.	
15	Bulaspur	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	12	120	-	Chowari 15km	Chowari 15km	8 Km.	
16	Rhoun	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	15	125	-	Chowari 20km	Chowari 20km	12 Km.	
17	Kalam	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	39	183	-	Chowari 25km	Chowari 25km	18 Km.	
18	Theda	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	16	28	-	Chowari 22km	Chowari 22km	15 Km.	

1	2	3	4	5	6	7	8		9	10	11	12	13
19	Khalotu	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	10	15	-	Chowari 14 km	Chowari 14 km	7 Km.	
20	Chourhdu	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khurmani, Aadoo	-	18	25	-	Chowari 16 km	Chowari 16 km	9 Km.	
21	Kotla	Malunda (Chowari)	Maize, Wheat, Rajmah, Jo	-	Khumani, Aadoo	-	8	10	-	Chowari 18 Km.	Chowari 15 km	8 Km.	
22	Kia-da-Kot	Malunda (Chowari)	Maize, Wheat, Jo	-	Khumani, Aadoo	-	7	12	-	Chowari 15 Km.	Chowari 15 km	8 Km.	
23	Upperla-Gran	Malunda (Chowari)	Maize, Wheat, Jo	-	Khumani, Aadoo	-	10	30	-	Chowari 20 Km.	Chowari 20 km	13 Km.	
24	Gahli	Malunda (Chowari)	Maize, Wheat, Jo	-	Khurmani, Aadoo	-	28	35	-	Chowari 12 Km.	Chowari 12 km	7 Km.	
25	Gurnal	Malunda (Chowari)	Maize, Wheat, Jo	-	Khumani, Aadoo	-	15	50	-	Chowari 18 Km.	Chowari 18 km	5 Km.	
26	Darehla	Malunda (Chowari)	Maize, Wheat, Jo	-	Khumani, Aadoo	-	12	25	-	Chowari 11 Km.	Chowari 11 km	4 Km.	

1	2	3	4	5	6	7	8	9	10	11	12	13
A	Beat:	Kainthali										
B	Block:	Kainthali										
C	Range:	Chowari										
D	District:	Chamba										
1.	Satkulera	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani Aadoo,	-	26	25	-	Chowari 30km	Kut 12km	3 Km.	-
2.	Badai	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani Aadoo,	-	70	130	-	Chowari 20km	Kut 20km	12 Km.	-
3.	Sufeli	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani Aadoo,	-	9	10	-	Chowari 20km	Kut 20km	12 Km.	-
4.	Bhadrala	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani Aadoo,	-	15	22	-	Chowari 20km	Kut 20km	12 Km.	-
5.	Bablet	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, kulth, Jo	-	Khurmani & Aadoo	-	76	103		Chowari 15km	Kut 15km	8 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
6.	Bangla	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth,	-	Khurmani & Aadoo	-	42	62		Chowari 18km	Kut 12km	3 Km.	-
7.	Kumhardi	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth,	-	Khurmani & Aadoo	-	14	27		Chowari 15m	Kut 16m	5 Km.	-
8.	Bhatui	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth,	-	Khurmani Juglans regia, Aadoo & Apple	-	13	22		Chowari 16km	Kut 16km	5 Km.	-
9.	Zukani	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth,	-	Khurmani Juglans regia, Aadoo & Apple	-	24	32		Chowari 15km	Kut 18km	5 Km.	-
10.	Drubbar	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth,	-	Khurmani Juglans regia, Aadoo & Apple	-	12	00		Chowari 26km	Kut 13km	8 Km.	-
11.	Ghat nala	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani Juglans regia, Aadoo, Apple	-	26	32	Chowari 15km	Kut 12km	3km	-	-
12.	Darelu	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani Juglans regia, Aadoo & Apple	-	76	107		Chowari 15km	Kut 12km	3 Km.	-
13.	Fakroti	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Jo	-	Khurmani Juglans regia, Aadoo & Apple	-	23	28		Chowari 18 km	Kut 13km	5 Km.	-

1	2	3	4	5	6	7	8	9	10	11	12	13
A	**Beat:**	**Khara Danda**										
B	**Block:**	**Kainthali**										
C	**Range:**	**Chowari**										
D	**District:**	**Chamba**										
1.	Chulha	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	24	47	-	Chowari 20 Km.	Kut 8 Km.	3 Km.	Water Tank 10X10m
2.	Banuni	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo & Apple	-	70	105	-	Chowari 20 Km.	Kut 6 Km.	0.5 Km.	Storage Tank
3.	Luhani	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	62	150	-	Chowari 22 Km.	Kut 8 Km.	2 Km.	-
4.	Dhanoodi	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	53	76	-	Chowari 17 Km.	Kut 5 Km.	200 m	-
5.	Maturi	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	45	70	-	Chowari 21 Km.	Kut 8 Km.	150 m	-
6.	Fafradi	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	40	69	-	Chowari 26 Km.	Kut 15 Km.	5 km	-

1	2	3	4	5	6	7	8		9	10	11	12	13
7.	Ban Goth	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	24	36	-	Chowari 21.5 Km.	Kut 8.5 Km.	100 m	-
8.	Dobu	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	46	70	-	Chowari 24 Km.	Kut 11 Km.	1 Km.	-
9.	Bihali	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	25	42	-	Chowari 25 Km.	Kut 11 Km.	5 km	-
10.	Tiri	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	27	34	-	Chowari 8 Km.	Kut 8 Km.	2 Km.	-
11.	Tappa	Baneth (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	24	35	-	Chowari 8 Km.	Kut 8 Km.	2 Km.	-
12.	Baglotra	Baneth (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani/ *uglans regia*, Aadoo, Apple	-	62	105	-	Chowari 5 Km.	Kut 5km	0 Km.	-
13.	Jot	Baneth (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	35	49	-	Chowari 25 Km.	Kut 15km	0 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
14.	Lammibhi	Baneth (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	9	13	-	Chowari 18 Km.	Kut 9km	5 Km.	-
15.	Saroundli	Malunda (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	8	15	-	Chowari 20 Km.	Kut 4km	0.5 Km.	-
16.	Bhulki	Baneth (Kainthali)	Maize, Wheat, Potato, Rajmah, Kulth, Jo	-	Khurmani *Juglans regia*, Aadoo, Apple	-	12	18	-	Chowari 5 Km.	Kut 5km	1 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
A	**Beat:**	**Lahru**											
B	**Block:**	**Chowari**											
C	**Range:**	**Chowari**											
D	**District:**	**Chamba**											
1.	Sulera	Parsod	Maize, Wheat & Barley	Plantation of fodder spp.	-	-	50	30	-	-	-	-	-
2.	Bagoth	Parsod	Maize, Wheat & Barley	Plantation of fodder spp.	-	-	110	70	-	-	-	-	-
3.	Brampala	Jatroon	Maize, Wheat & Barley	Plantation of fodder spp.	-	-	60	35	-	-	-	-	-
4.	Naragada	Parsod	Maize, Wheat & Barley	Plantation of fodder spp.	-	-	50	180	-	-	-	-	-
5.	Ladibhatti	Parsod	Maize, Wheat & Barley	Plantation of fodder spp.	-	-	90	40	-	-	-	-	-
6.	Trimath	Committee Area Chowari	Maize, Wheat & Barley	Plantation of fodder spp.	-	-	250	130	-	-	-	-	-

[A] PLANTATION (AFFORESTATION, BIO-ENGINEERING, HIGH DENSITY ENERGY PLANTATION AND RIM PLANTATION) ACTIVITIES UNDER CATCHMENT AREA TREATMENT (CAT) PLAN

[Sub-Watershed Balud Khad – 1B1A7(2)]

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Raipar**									
B	**Block:**	**Raipar**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Phagot village/ Phagot c1 (2 ha.)	N 32°23'19.4" E 076°02' 17.1" 1432 m	Loamy	*P. roxburghii*	Medium	Southern - west	Rains & excavation works, grazing, fire &human interferences	*P. roxburghii, Dalbergia sissoo, Agave americana & Ipomoea spp.*	Plantation of suggested spp. as vegetative measures	Fencing of barbed wires, Protection from fire, grazing & human interfrences	-
2.	Loharka (1 ha.)	N 32°23'17.1" E 076°02' 09.3" 1325 m	Loamy	*P. roxburghii*	Medium	Southern - west	Natural/ due to rains	*P. roxburghii, Dalbergia sissoo, Agave americana Ipomoea spp., Adhatoda vasica & Juglans regia*	Plantation of suggested spp. as vegetative measures	Fencing of barbed wires, Protection from fire, grazing & human interfrences	-
3.	Chelli Village / Harnala C2DPF (2 ha.)	N 32°24'06.7" E 076°02' 09.3" 1633 m	Loamy	*P. roxburghii, Q. leucotrichophora & Rhododendron arboreum*	Medium	Western	Excavation works	*Albizia, Eucalyptus, Dalbergia Sissoo, Q. leucotrichophora Rhododendron arboreum*	Plantation of suggested spp. as ve getative measures	Fencing of barbed wires, Protection from fire, grazing & human interfrences	-
4.	Baloh (2 ha.)	N 32°24'10.8" E 076°02' 54.8" 1625 m	Loamy	*P. roxburghii, Q. leucotrchophora, & Rhododendron arboreum*	Steep	Southern-East	Natural	*P. roxburghii, Juglans regia Rhododendron arboreum, Q. leucotrichophora*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interfrences	-
5.	Baloh Village/ Baloh Forest (1.5 ha.)	N 32°24'21.4" E 076°02' 33.5" 1416 m	Loamy	*P. roxburghii*	Steep	Southern-East	Natural	*Albizia stipulata, P. roxburghii & Juglans regia*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interfrences	-
6	Baloh DPF (1.5 ha.)	N 32°24'37.3" E 076°02' 33.5" 1452 m	Loamy	*P. roxburghii*	Steep	Northern - West	Natural	*Albizia stipulata, P. roxburghii & Juglans regia*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interfrences	-

1	2	3	4	5	6	7	8	9	10	11	12
7.	Dundan Village/ Baloh Forest (1.5 ha.)	N 32°24'15.2" E 076°02' 47.8" 1513 m	Loamy	*P. roxburghii*	Medium	Southern-East	Natural	*Q.leucotrichophora, P. roxburghii , Toona ciliata, Agave americana, Ipomoea spp.,*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interfrences	-
8.	Kuddi Village/ Harnala DPF (1.5 ha.)	N 32°24'03.0" E 076°02' 20.4" 1442 m	Loamy	*P. roxburghii*	Medium	Southern – West	Natural	*Albizia stipulata, P. roxburghii & Juglans regia*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interfrences	-
9.	Gharani Village/ Gharani Forest (1.5 ha.)	N 32°23'44.6" E 076°02' 21.3" 1432 m	Loamy	*P. roxburghii*	Medium	Northern-East	Natural	*Albizia stipulata, P. roxburghii & Juglans regia*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interfrences	-
10.	Kaloh village / Phagot NDPF (1.5 ha.)	N 32°23'21.5" E 076°03' 09.8" 1243 m	Loamy	*P. roxburghii*	Steep	Southern – West	Natural	*Albizia stipulata, P. roxburghii & Juglans regia*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interfrences	-

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Saloh**									
B	**Block:**	**Raiper**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Leedar (1.5 ha.)	N 32°25'19.6" E 076°00' 36.8" 1160 m	Rocky	*Prunus padum, Albezie, Acacia catechu & Toona ciliata*	Medium	Northern	-	Albizia, *Acacia catechu*, Eucalyptus spp.	-	-	-
2.	Saloh (1.5 ha.)	N 32°23'17.03" E 076°01' 24.3" 1120 m	Rocky	*Dalbergia sissoo, Acacia catechu & Albizia spp.*	Gentle	Northern	-	*Bauhinia vahlii, Agave americana & D.sissoo,*	-	-	-
3.	Near Raiper Plant Nusery (1.5 ha.)	N 32°24'47.09" E 076°01' 09.6" 1156 m	Sandy	*Adhatoda vesica, Vitex spp. Albezia and Melia spp.*	Medium	Eastern	-	*Adhatoda vesica, Ipomoea spp., Albizia & Bauhinia variegata*	-	-	-
4.	Tatru (1.5 ha.)	N 32°24'36.02" E 076°00' 47.3" 1064 m	Sandy	*Acacia catechu, Albezzia, Melia and D.sissoo*	Medium	Western	-	*Vitex spp. Agave americana, Bauhinia vahlii, D.sissoo*		-	-
5.	Nadal Flow Forest (1.5 ha.)		Sandy	*Acacia catechu, Albezzia, Melia and D.sissoo*	Medium	Western	-	*Vitex spp. Agave americana, Bauhinia vahlii, D.sissoo*		-	-
6.	Burha Forest (1.5 ha.)		Sandy	*Acacia catechu, Albezzia, Melia and D.sissoo*	Medium	Western	-	*Vitex spp. Agave americana, Bauhinia vahlii, D.sissoo*		-	-
7.	**Rim Plantation around dam site (10 ha.)**		Sandy silty	*P.roxburghii, Toona ciliata & Bombax ceiba*	Steep	Eastern	-	*Adhatoda vesica, Ipomoea spp., Albizia & Bauhinia variegata*	-	-	-

[B] SOIL CONSERVATION WORKS

[Sub-Watershed Balud Khad – 1B1A7(2)]

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Raipar**									
B	**Block:**	**Raipar**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Phagot Village/ Phagot C1	N 32°23'15.1" E 076°02'12.6" 1346 m	Loamy	*P. roxburghii, Lantana camera, Rubus ellipticus , Bombax ceiba, Berberis spp , Princepia utilis*	Medium	Eastern	Rain water	Construction of check dams as engineering structure	*Agave americana, Ipomoea spp. Adhatheda vesica P. roxburghii, Dalbergia sissoo*	-	-
2.	Loharka	N 32°23'15.8" E 076°02'11.5" 1335 m	Loamy	*P. roxburghii Lantana camera , Rubus ellipticus , Berberis spp , Princepia utilis*	Medium	Southern East-	L&sliding	Construction of check dams as engineering structure	*P. roxburghii, Dalbergia sissoo*	-	-
3.	Drumka village/ Phagot NDPF C1 Nala	N 32°23'27.5" E 076°02'23.4" 1521 m	Loamy	*P. roxburghii, Bombax ceiba, Debregasia hypoleuca, Albizia spp*	Medium	Southern-West	Rainfed Nallas	Construction of check dams as engineering structure	*P. roxburghii, Dalbergia sissoo, & Juglans regia*	-	-
4.	Bhater Village / Phagot NDPF C1	N 32°23'31.9" E 076°02'31.7" 1565 m	Loamy	*Toona ciliata, D. hypoleuca, D. sissoo, Acecia catechu*	Medium	Western – North	Rainfed Nallas	Construction of check dams as engineering structure	*Ficus palmata, P. roxburghii & Juglans regia*	-	-
5.	Phagot village/ Marad DPF	N 32°23'51.5" E 076°02'52.7" 1640 m	Loamy	*P. roxburghii, Dalbergia sissoo, Toona ciliata*	Medium	Western – North	Natural / Rains	Construction of check dams as engineering structure	*Ficus palmata, P. roxburghii & Juglans regia*	-	-
6.	Marad Village/ Marad Forest	N 32°23'57.9" E 076°03'09.9" 1630 m	Loamy	*P. roxburghii, Rhododendron arboreum*	Steep	Northern – West	Natural / Rains	Construction of check dams as engineering structure	*Ficus palmata, P. roxburghii Juglans regia* & Khumani	-	-

1	2	3	4	5	6	7	8	9	10	11	12
7.	Marad Village/ Marad Forest	N 32°23'57.2" E 076°03'10" 4 1633m	Loamy	*P. roxburghii, Rhododendron arboreum*	Steep	Northern West	Natural / Rains	Construction of check dams as engineering structure	*Ficus palmata, P. roxburghii, Juglans regia* & Khumani	-	-
8.	Chelli Village / Harnala C2DPF	N 32°23'57.2" E 076°02'54.3" 1645 m	Loamy	*P. roxburghii, Rhododendron arboreum & Q. leucotrichophora*	Steep	Northern West	Natural / Rains	Construction of check dams as engineering structure	*P. roxburghii & Juglans regia*	-	-

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Saloh**									
B	**Block:**	**Raiper**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Tatru (3 Ha.)	N 32°24'36.02" E 076°00' 47.3" 1064 m	Sandy	*Acacia catechu, Albezzia, Melia* and *D.sissoo*	Medium	Western	-	-	*Vitex* spp. *Agave americana, Bauhinia vahlli, D.sissoo*	-	-
2.	Baag (Burja Jungle) (3-4 Ha.)	N 32°23'03.03" E 076°01' 47.8" 1122 m	Rocky	*Salix, Bamboo ceiba, Acacia catechu. D.hypolucca & Celtis australis*	Steep	Eastern	Land sliding due to rains	a) Construction of retaining walls b) Plantation of *Agave americana* & *Ipomoea*	*Leucaenia* ssp. *Vitex* spp. *Salix* spp.	-	-
3.	Baag Nalla (1 Ha.)	N 32°23'14.05" E 076°01' 50.1" 1134 m	Rocky	*D.sissoo, Acacia catechu, Berberis* spp. , *Toona ciliata*	Steep	Eastern	Due to rainfed nallas	a) Construction of check dams and crate works	-	-	-
4.	Lar (2 Ha.)	N 32°23'25.01" E 076°01' 11.0" 1175 m	Rocky	*D. sissoo, Albizia, Melia Pyrus pashia & Toona ciliata*	Medium	Western	Rains	Construction of check dams and crate work	*Grewia optiva, Albizia* spp.	-	-

[C] AGRICULTURE, HORTICULTURE CROPS, ANIMAL HUSBANDRY & AMINITIES RELATED DATA

[Sub-Watershed Balud Khad – 1B1A7(2)]

1	2	3	4	5	6	7	8	9	10	11	12	13
A	Beat:	Raipar										
B	Block:	Rapiar										
C	Range:	Chowari										
D	District:	Chamba										
1.	Baloh	Raipar	Maize, Rice, Wheat & Barley, Sarson	Best quality seeds & measures for checking the monkey menace	-	Improved high-yielding varieties seeds of main crops	140	123	Fully equipped Veterinary facilities required	Dariyada (8 Km)	Dadriyada (8 Km.)	2 Km	-
2.	Phagot	Raipar	Maize, Rice, Wheat & Barley, Sarson	Best quality seeds & measures for crop improvements required	-	Improved high-yielding varieties seeds of main crops	41	260	Well equipped Veterinary Hospital facilities required	Dariyada (5 Km)	Dadriyada (3 Km)	2 Km	-
3.	Gharani	Raipar	Maize, Rice, Wheat & Barley, Sarson	Best quality seeds & measures for crop improvements required	-	Improved high-yielding varieties seeds of main crops	10	73	Fully equipped Veterinary facilities required	Dariyada (1.5 Km.)	Dadriyada (2 Km)	7 Km	-
4.	Chelli	Raipar	Maize, Rice, Wheat & Barley, Sarson	Best quality seeds & measures for crop improvements required	-	Requirement of the seedlings of horticulture species	20	158	Milk yielding Hybrid varieties of cow & buffaloes	Dariyada (7 Km.)	Dadriyada (7 Km.)	7 Km	-
5.	Kuddi	Raipar	Maize, Rice, Wheat & Barley, Sarson	Best quality seeds & measures for crop improvements required	-	Requirement of seedlings of horticulture species like *Khurmani, Amla*	26	200	Wool yielding varieties of Goats/ Sheeps	Dadriyada (4 Km.)	Dadriyada (3 Km.)	2 Km.	
6.	Bainka	Raipar	Maize, Rice, Wheat & Barley	Best quality seeds & measures for crop improvements required	-	Requirement of the seedlings of horticulture species	12	65	Hybrid varieties yielding more wool	Dadriyada (2 Km.)	Dadriyada (2 Km.)	2 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
7.	Jariyee	Raipar	Maize, Rice, Wheat & Barley	Requirement of HYV	-	Requirement of seedlings of horticulture species	35	94	Hybrid varieties yielding more wool	Dadriyada (10 Km.)	Dadriyada (10 Km.)	14 Km.	-
8.	Narbelu	Raipar	Maize, Rice, Wheat & Barley	Requirement of HYV	-	Requirement of the seedlings of horticulture species	19	138	Well equipped veterinary dispensary required	Dadriyada (3 Km.)	Dadriyada (3 Km.)	500 meter from road head	-
9.	Marad	Raipar	Maize, Rice, Wheat & Barley	Requirement of HYV	-	Requirement of the seedlings of horticulture species	26	64	Fully equipped veterinary dispensary required having facilities like artificial insemination	Dadriyada (3 Km.)	Dadriyada (4 Km.)	2 Km.	-
10.	Chahuaa	Raipar	Maize, Rice, Wheat & Barley	Requirement of HYV	-	Requirement of the seedlings of horticulture species	8	17	Required good quality feed for milk yielding cattles	Dariyada (8 Km.)	Dadriyada (8 Km.)	10 Km.	-
11	Pared	Raipar	Maize, Rice, Wheat & Barley	Requirement of HYV	-	Requirement of the seedlings of horticulture species	8	25	Required good quality feed for milk yielding cattles	Dadriyada (7 Km.)	Dadriyada (7 Km.)	5 Km.	-
12	Bhagdan	Raipar	Maize, Rice, Wheat & Barley	Best quality seeds & measures for crop improvements required	-	Good horticulture crops should be planted	6	30	Wool yielding varieties of Goats/ Sheeps	Dadriyada (4 Km.)	Dadriyada (5 Km.)	4 Km.	-
13	Bhated	Raipar	Maize, Rice, Wheat & Barley	Best quality seeds & measures for crop improvements required	-	Required seedlings of horticulture species	10	45	Hybrid varieties yielding more wool	Dadriyada (3 Km.)	Dadriyada (5 Km.)	4 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
14	Loharka	Raipar	Maize, Rice, Wheat & Barley	Requirement of HYV	-	Required seedlings of horticulture species	18	60	Hybrid varieties yielding more wool	Dariyada (3 Km.)	Dadriyada (3 Km.)	100 Mtr.	-
15	Drumka	Raipar	Maize, Rice, Wheat & Barley	High-yielding varieties of traditional crops		Required seedlings of horticulture species	4	20	Well equipped veterinary dispensary required	Dariyada (3 Km.)	Dadriyada (3 Km.)	100 Mtr.	-
16	Dadhoon	Raipar	Maize, Rice, Wheat & Barley	HYV of Maize, Rice, Wheat		Required seedlings of horticulture species	12	35	Fully equipped Veterinary facilities required	Dariyada (5 Km.)	Dadriyada (5 Km.)	5 Km.	-
17	Draman	Raipar	Maize, Rice, Wheat & Barley	Good quality of seeds are required		Required seedlings of horticulture species	10	55	Well equipped Veterinary Hospital facilities required	Dariyada (3 Km.)	Dadriyada (4 Km.)	4 Km.	-
18	Batolan	Raipar	Maize, Rice, Wheat & Barley	HYV of Maize, Rice, Wheat		Required seedlings of horticulture species	2	15	Wool yielding varieties of Goats / Sheeps	Dariyada (3 Km.)	Dadriyada (4 Km.)	4 Km.	-
19	Dhamnadi	Raipar	Maize, Rice, Wheat & Barley	HYV of Maize, Rice, Wheat		Required seedlings of horticulture species	25	60	Hybrid varieties yielding more wool	Dariyada (5 Km.)	Dadriyada (5 Km.)	3 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
A	Beat:	Saloh											
B	Block:	Raipar											
C	Range:	Chowari											
D	District:	Chamba											
1.	Lar	Sadal	Wheat, Maize, Sarson & Barley	Construction of Pakkas Danga along the contours of fields	-	-	60	85	-	Sadal 3.5 Km.	Sadal 4 Km.	Road head	-
2.	Mahnu	Sadal	Wheat, Maize, Sarson & Barley	Construction of Pakkas Danga along the contours of fields	-	-	25	30	-	Sadal 5 Km.	Sadal 3 Km.	Road head	-
3.	Sadna	Jatroon	Wheat, Maize & Barley	-	-	-	70	130	-	Chowari 2 Km.	Chowari 2.5 km.	Road head	-
4.	Chhoga	Jatroon	Wheat & Maize	-	-	-	20	15	-	Chowari 4.5 Km.	Chowari 4 km.	1 Km from road head	-
5.	Kurnar	Sadal	Wheat & Maize	Plantation of fodder species like *Grewia* & *Celtis*	-	-	35	20	-	Sadal 5 Km.	Sadal 5 Km.	1 Km from road head	Water storage tank Al. in the village N 32°24'41.04" E 076°08' 45.8" 1110 m
6.	Kalein	Sadal	Whaet & Maize	Plantation of fodder species like *Grewia* & *Celtis*	-	-	45	60	-	Sadal 3.5 Km.	Sadal 3.5 Km.	1 Km from road head	-
7.	Kothi	Palada	Maize & Wheat	-	-	-	40	75	-	Sadal 6.0 Km.	Sadal 5 Km.	2.5 km from head	-
8.	Rairid	Sadal	Maize & Wheat	-	-	-	80	130	-	Sadal 4.5 Km.	Sadal 5 Km.	1 Km from road head	-

[A] PLANTATION (AFFORESTATION, BIO-ENGINEERING, HIGH DENSITY ENERGY PLANTATION AND RIM PLANTATION) ACTIVITIES UNDER CATCHMENT AREA TREATMENT (CAT) PLAN

[Sub-Watershed ChhakiKhad – 1B1A7(3)]

1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Chakki									
B	Block:	Raipar									
C	Range:	Chowari									
D	District:	Chamba									
1.	Aaru Ka Fer (8 ha.)	N 32°23'41.4" E 076°03'57.3" 1399 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Medium	Southern	Fire, Grazing, Heavy rain/ natural	*P. roxburghii*, *Juglans regia* & Khurmani, *Adhatoda vasica*, *Agave americana*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
2.	Baserid (12 ha.)	N 32°23'57.2" E 076°04'11.8" 1480 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Medium	Southern – West	Fire, Grazing, Heavy rain/ natural	*P. roxburghii*, *Juglans regia* & Khurmani,	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
3.	Chihun (8 ha.)	N 32°23'56.0" E 076°04'12.6" 1464 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Northern	Fire, Grazing, Heavy rain / natural	*P. roxburghii*, *Juglans regia* & Khurmani,	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
4.	Chihun (8 ha.)	N 32°24'09.6" E 076°04'32.5" 1514 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Eastern	Fire, Grazing, Heavy rain / natural	*P. roxburghii*, *Juglans regia* & Khurmani,	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
5.	Kutt (8 ha.)	N 32°24'18.0" E 076°04'35.0" 1574 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Northern	Fire, Grazing, Heavy rain / natural	*P. roxburghii*, *Juglans regia*, Khurmani, *Agave americana*, *Ipomoea spp.* *Adhatoda vesica*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	

1	2	3	4	5	6	7	8	9	10	11	12
6.	Kutt (8 ha.)	N 32°24'03.7" E 076°04'25.9" 1562 m	Loamy	*P. roxburghii*	High steep	Northern	Fire, Grazing, Heavy rain / natural	*P. roxburghii, Juglans regia*, Khurmani, *Agave americana, Ipomoea spp. Adhatoda vesica*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
7.	Rathbhonra (15 ha.)	N 32°23'59.2" E 076°04'41.7" 1494 m	Loamy	*P. roxburghii & Dalbergia sissoo*	Steep	Southern-East	Fire, Grazing, Heavy rain / natural	*P. roxburghii, Juglans regia* & Khurmani, *Rubus spp.*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
8.	Upper Kutt (12 ha.)	N 32°24'18.8" E 076°04'29.0" 1595 m	Loamy	*P. roxburghii, Rhododendron arboreum* & *Q. leucotrichophora*	Medium	Southern-West	Fire, Grazing, Heavy rain / natural	*P. roxburghii, Juglans regia* & Khurmani, *Rumex spp.*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
9.	Batli Behi (15 ha.)	N 32°24'36.4" E 076°04'45.4" 1712 m	Loamy	*P. roxburghii, Rhododendron arboreum* & *Q. leucotrichophora*	Steep	Southern-West	Fire, Grazing, Heavy rain / natural	*P. roxburghii, Juglans regia, Agave americana, Ipomoea spp.* & Khurmani	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
10.	Aahan (7 ha.)	N 32°24'38.1" E 076°04'49.9" 1775 m	Loamy	*P. roxburghii, Rhododendron arboreum* & *Q. leucotrichophora*	Medium	Northern-East	Fire, Grazing, Heavy rain / natural	*P. roxburghii , Agave americana, Ipomoea spp. Juglans regia* & Khurmani	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
11.	Theda (15 ha.)	N 32°24'24.3" E 076°04'18.2" 1830 m	Loamy	*P. roxburghii, Rhododendron arboreum* & *Q. leucotrichophora*	Medium	Northern-East	Fire, Grazing, Heavy rain / natural	*Agave americana, Ipomoea spp. P. roxburghii , Juglans regia* & Khurmani,	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
12.	Thesla (12 Ha.)	N 32°24'14.0" E 076°04'22.8" 1695 m	Loamy	*P.roxburghii, Rhododendron arboreum* & *Q. leucotrichophora*	Steep	Western-North	Fire, Grazing, Heavy rain / natural	*Agave americana, Ipomoea spp. P. roxburghii, Juglans regia* & *Khurmani*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	

1	2	3	4	5	6	7	8	9	10	11	12
13.	Dabbar (8 Ha.)	N 32°23'58.6" E 076°04'34.2 1447 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Medium	Southern-West	Fire, Grazing, Heavy rain / natural	*P. roxburghii*, *Juglans regia* & Khurmani, *Agave americana*, *Ipomoea spp.* *Adhathoda vesica*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
14.	Thandi Their (8 Ha.)	N 32°23'52.0" E 076°04'22.4" 1448 m	Loamy	*P. roxburghii*	Medium	Southern - West	Fire, Grazing, Heavy rain / natural	*P. roxburghii*, *Juglans regia* & Khurmani, *Agave americana*, *Ipomoea spp.* *Adhathoda vesica*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	
15.	Kuldhar (12 Ha.)	N 32°23'02.5" E 076°03'14.6 1261 m	Loamy	*P. roxburghii*	Medium	Eastern	Fire, Grazing, Heavy rain / natural	*P. roxburghii*, *Juglans regia* & Khurmani, *Agave americana*, *Ipomoea spp.* *Adhathoda vesica*	Plantation of suggested spp. as vegetative measures	Protection from fire, grazing & human interferences etc.	

1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Hathidhar									
B	Block:	Manhuta									
C	Range:	Chowari									
D	District:	Chamba									
1.	Mundi (6 ha.)	N 32° 22' 00.9" E 076° 00' 43.8" 1068 m	Loose Sandy	*Juglans regia, Terminalia chebula & Acacia catechu*	Steep	Eastern	Grazing pressure & forest fire	*Terminalia bellirica, Terminalia chebula* Amla, *Sapindus mukrosii, Acacia catechu & Pyrus pashia*	Vegetative measure	fencing wire with cement poles	No
2.	Bane Da Nalla (9 ha.)	N 32° 21' 57.7" E 76° 01' 00.2" 1038 m	Sandy	*P. roxburghii, Dalbergia sissoo & Acacia catechu*	Steep	Western	Landsliding during rainfall	*Agave Americana, Populus deltoides, Leucaena leucocephala & Acacia catechu*	Plantation & construction work	Not required	No
3.	Garnayara (4 ha.)	N 32° 22' 56.9" E 76° 00'28.0" 866 m	Loose sandy	*Vitex negunda, Dalbergia sissoo, Albizia stipulata & Grewia optiva*	Gentle	Western	Grazing pressure & Heavy rainfall cause erosion	*Dalbergia sissoo, Acacia catechu, Pyrus pashia, Agave americana, Albizia lebbeck*	Construction of check dam (No. 10)	Not required	No
4.	Luni (4 ha.)	N 32°21' 45.7" E. 76° 00' 54.3" 1076 m	Sandy	*Dalbergia sissoo, Albizia stipulata, Mango & Juglans regia*	Gentle	Western	Grazing pressure	Amla, *Acacia catechu & Pyrus pashia*	-	Not required	Yes (6x6x2m)
5.	Bhatolo Ki Lunn (4 ha.)	N 32° 21' 40.3" E. 76° 00' 57.6" 1072 m	Sandy	*Acacia catechu, Q. leucotrichophora Terminalia chebula & Terminalia bellirica*	Gentle	Western	Grazing pressure	Amla, *Populus detoides, Picia smithiana, Acacia catechu & Pyrus pashia*	Crate wire spur construction 15x3m (4 No.) 6x3m (8 No.)	Not required	No

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Manhuta**									
B	**Block:**	**Manhuta**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Saasan (5 ha.)	N 32°22'09.3" E 076°02' 51.0" 1233 m	Sandy	*Dalbergia sissoo, Albizia stipulata & Grewia optiva*	Gentle	Western	Grazing pressure, Forest fire	*Sapindus mukrosi*, Amla, *Bauhinia purpurea, Acacia catechu & Bauhinia variegata*	Plantation work	Fencing wire with cement poles	No
2.	Gurmuh (5 ha.)	N 32 22' 39.4" E 076° 02'11.7" 1177 m	Sandy	*Dalbergia sissoo, P. roxburghii & Phoenix spp.*	Steep	Westren	Grazing pressure, Forest fire	Broadleaved fodder plants *Grewia optiva*, Amla, *Sapindus mukrosii & Dalbergia sissoo*	Plantation work	Fencing wire with cement poles	No
3.	Gumu (10 ha.)	N 32° 22' 20.4" E 076° 01' 37.1" 1156 m	Sandy	Small shrubs	Steep	Eastern	Landsliding during Rainfall	*Bombex ceiba, Balbergia sissoo Terminalia chebula, Grewia optiva, Albizia stipulata* & Amla	Plantation work	Fencing with barbed wire	No
4.	Manhuta-II (4 ha.)	N 32° 21' 33.7" E 076° 02' 40.7" 1299 m	Sandy	Mango, *Albizia stipulata, Dalbergia sissoo* & Amla	Gentle	Northern	Grazing pressure, Forest fire	*Terminalia Chebula, Cassia fistula* & Amla	Plantation work	Not required	Yes
5.	Godra (4 ha.)	N 32° 23' 20.8" E 076° 02' 37.0" 1156 m	Sandy	Senall shrubs	Steep	Eastern	Landsliding during Rainfall	*Bombex ceiba, Balbergia sissoo Terminalia chebula, Grewia optiva, Albizia stipulata* & Amla	Plantation work	Fencing with barbed wire	No
6.	Talai (5 ha.)	N 32° 20' 33.5" E 076° 01' 40.5" 1298 m	Sandy	Mango, *Albizia stipulata, Dalbergia sissoo* & Amla	Gentle	Northern	Grazing pressure, Forest fire	*Terminalia Chebula, Cassia fistula* & Amla	Plantation work	Not required	Yes

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Parsiyara**									
B	**Block:**	**Manhuta**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Juhar Draman (5 ha.)	N 32° 22' 36.5" E 076° 04' 18.3" 1664 m	Dharumad	*Dalbergia sissoo, Juglans regia, P. roxburghii & Albizia stipulata*	Gentle	Eastern	Forest fire & grazing peessure	*Q. leucotrichophora*, & *C. deodara*	Plantation work	Fencing of area	No

[B] SOIL CONSERVATION WORKS

[Sub-Watershed Chhaki Khad – 1B1A7(3)]

Sl. No.	Name of Location & Area (Ha.)	GPS Coordinate of Location (Latitude, Longitude, Altitude)	Soil Type	Vegetation Indicator Species	Slope (Gentle/ Medium/ Steep)	Aspect	Causes of Degradation	Species suggested for Plantation	Prioritized Treatment Measures a] Engineering Structures b] Vegetative Measures	Protection & Sustainability Aspects (Protection against Fire, Grazing, etc.)	Possibility of Water Harvesting Structure (Location with GPS Coordinates)
1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Chakki									
B	Block:	Raipar									
C	Range:	Chowari									
D	District:	Chamba									
1.	Lahad	N 32°23'36.1" E 076°03'57.1" 1384 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Eastern-South	Rains	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhatoda vesica P. roxburghii, Dalbergia sissoo*	-	-
2.	Kutt	N 32°24'15.0" E 076°04' 27.2" 1572 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Medium	Northern	Excavation works	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhatoda vesica P. roxburghii, Dalbergia sissoo*	-	-
3.	Kutt	N 32°24'16.1" E 076°04'27.6" 1585 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Southern-West	Rains	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhatoda vesica P. roxburghii, Dalbergia sissoo*	-	-
4.	Batli Behi	N 32°24'45.4" E 076°04' 38.0" 1899 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Southern-West	Natural	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhatoda vesica P. roxburghii, Dalbergia sissoo*	-	-
5.	Batli Behi	N 32°24'47.9" E 076°04' 33.4" 1928 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Western-North	Rains	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhatoda vesica P. roxburghii, Dalbergia sissoo*	-	

1	2	3	4	5	6	7	8	9	10	11	12
6.	Batli Behi	N 32°24'48.8" E076°04' 26.5" 1908 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Northren	Natural	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	
7.	Batli Behi	N 32°24'49.1" E 076°04' 24.4" 1912 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Northren	Rains	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	
8.	Aahan	N 32°24'40.7" E 076°04' 48.8" 1778 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Western	Natural	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	
9.	Theda	N 32°24'34.8" E 076°04' 24.2" 1908 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Northren-Eastern	Natural	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	
10.	Chihun	N 32°24'08.6" E 076°04' 30.7" 1568 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Eastern	Natural	Constructions of check dams &plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	
11.	Jhanjhar Nala	N 32°23'57.9" E 076°04' 42.7" 1497 m		*P. roxburghii* & *Dalbergia sissoo*	Steep	Southren	Rains	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	
12.	Thandi Their	N 32°23'51.6" E 076°04' 23.6" 1425 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Medium	Southren-West	Natural	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	
13.	Chalon	N 32°23'47.4" E 076°04' 14.1" 1403 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Medium	Southren-West	Rains	Constructions of check dams & plantation of soil binding suggested spp.	*Agave americana, Ipomoea spp. Adhathoda vesica P. roxburghii, Dalbergia sissoo*	-	

1	2	3	4	5	6	7	8	9	10	11	12
14.	Gufa Nalla	N 32°24'40.5" E 076°03' 26.5" 1401 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Eastern-South	Natural	Constructions of check dams &plantation of soil binding suggested spp.	*Agave americana*, *Ipomoea* spp. *Adhatoda vesica* *P. roxburghii*, *Dalbergia sissoo*	-	
15.	Batala Nalla	N 32°22'43.3" E 076°03' 19.8" 1304 m	Loamy	*P. roxburghii* & *Dalbergia sissoo*	Steep	Northen-West	Natural	Constructions of check dams &plantation of soil binding suggested spp.	*Agave americana*, *Ipomoea* spp. *Adhatoda vesica* *P. roxburghii*, *Dalbergia sissoo*	-	

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Hathidhar**									
B	**Block:**	**Manhuta**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Garnayara (5 Ha.)	N 32° 22' 56.9" E 76° 00' 28.0" 866 m	Loose sandy	*Vitex negundo, Dalbergia sissoo, Albizia stipulata & Grewia optiva*	Gentle	Western	Grazing pressure & Heavy rainfall cause erosion	Construction of check dam (No. 10)	*Dalbergia sissoo, Acacia catechu, Pyrus pashia, Agave americana, Albizia lebbeck*	Not required	No
2.	Luni (4 ha.)	N 32°21' 45.7" E 76° 00' 54.3" 1076 m	Sandy	*Dalbergia sissoo, Albizia stipulata, Mango & Juglans regia*	Gentle	Western	Grazing pressure	-	Amla, *Acacia catechu & Pyrus pashia*	Not required	Yes (6x6x2m)
3.	Bane Da Nalla (10 ha.)	N 32°21' 53.7" E 76° 01' 00.2" 1038 m	Loose sandy	*P. roxburghii, Acacia catechu & Grewia optiva*	Steep	Eastern	Heavy rain cause erosion &landslide	Crate wire spur to be constructed (15x3m (50 No.) 8x3 (8 No.) in 10 ha. Area	*Agave americana, Leucaena leucocephala, Dalbergia sissoo, Acacia catechu & Populus deltoides*	Not required	No
4.	Bhatolo Ki Lunn (5 Ha.)	N 32° 21' 40.3" E 76° 00' 57.6" 1072 m	Sandy	*Acacia catechu, Q. leucotrichophora Terminalia chebula & Terminalia bellirica*	Gentle	Western	Grazing pressure	Crate wire spur construction 15x3m (4 No.) 6x3m (8 No.)	Amla, *Populus deteoides, Picia smithiana, Acacia catechu & Pyrus pashia*	Not required	No

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Manhuta**									
B	**Block:**	**Manhuta**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Bataal (5 ha.)	N 32° 20' 38.9" E 076° 02' 0.007" 1220 m	Sandy	*Albizia stipulata, P. roxburghii & A. catechu*	Gentle	Eastern	Grazing pressure & landsliding due to rain	Construction of check dam 3sa/2x1 m (No. 25)	Amla, *Acacia catechu & Populus deltoides*	Not required	No
2.	Lahdi (3 ha.)	N 32° 22' 17.1" E 076° 02' 50.9" 1189 m	Sandy	*Bauhinia purpurea, Grewia optiva & Albizia stipulata*	Steep	Northern	Grazing pressure & heavy rain fall	Construction of crate wire spur 6x1/2x2m (No. 2) Spur wall 3x1/2x2 m (No. 3)	Amla, *Juglans regia, Sapindus mukrossi & Bauhinia variegata*	Not required	No
3.	Lahdi II Forest (5 ha.)	N 32° 22' 20.6" E 076° 02' 35.1" 1244 m	Sandy	*Dalbergia sissoo, P. roxburghii, Acacia catechu &Pyrus pashia*	Medium	Eastern	Landsliding during monsoon	Construction of crate wire spur 3x1/2x2 m (No. 10)	*Celtis australis, Pistacia integrimma, Toona ciliata,* Amla & *Bauhinia variegata*	Not required	No
4.	Gurmuh (3 ha.)	N 32° 22' 39.4" E 076° 02' 11.7" 1179 m	Sandy	*Acacia catechu, P. roxburghii, Pyrus pashia & Albizia stipulata*	Steep	Eastern	Landsliding during rain fall	Construction of crate wire spur 1st 7x3x6 m 2nd 6x3x6 m other four 3x3x3 m	*Populus deltoides, Dalbergia sissoo, Bauhinia variegata & Juglans regia*	Not required	No
5.	Greli (Bella Forest) (5 ha.)	N 32° 22' 28.7" E 076° 02' 35.5" 1180 m	Loose rocky sandy	*P. roxburghii Dalbergia sissoo & Toona ciliata*	Medium	Eastern	Landsliding & grazing pressure	Crate wire spur wall per construction (No. 10) 3x1x2x1	*Agave Americana, Ficus palmata, Juglans regia, Acacia catechu & Dalbergia sissoo*	Not required	No

1	2	3	4	5	6	7	8	9	10	11	12
A	**Beat:**	**Parsiyara**									
B	**Block:**	**Manhuta**									
C	**Range:**	**Chowari**									
D	**District:**	**Chamba**									
1.	Sarho (3 Ha.)	N 32° 22' 20.2" E 076° 03' 49.4" 1563 m	Rocky Sandy	*P. roxburghii, Dalbergia sissoo & Acacia catechu*	Medium	Northern	Sliding during heavy rain	Construction of retaining wall & check dam 3.5x1.5x1 m (No. 20)	*P. roxburghii, Albizia stipulata* & Amla	Not required	No
2.	Kut Gamrar (DPF) (5 ha.)	N 32° 22' 24.0" E 076° 04' 24.1" 1585 m	Loose rocky sandy	*P. roxburghii, Salix spp. Pyrus pashia &* Mango	Gentle	Eastern	L&sliding during rainy season	-	*Pyrus pashia, Acacia catechu,* Amla, *Q. leucotrichophora, & Dalbergia sissoo*	Not required	Construction of water tank (3.5x3x2.5m) 1 No.
3.	Nihar (3 ha.)	N 32° 22' 22.0" E 076° 04' 14.7" 1463 m	Sandy	*P. roxburghii, Salix spp. Pyrus pashia &* Mango	Medium	Eastern	Soil erosion during monsoon	Construction of crate wire spur (3X3X2 m) (No. 3)	*Juglans regia, Grewia optiva &* Amla	Not required	No

1	2	3	4	5	6	7	8	9	10	11	12
A	Beat:	Parsiyara									
B	Block:	Manhuta									
C	Range:	Chowari									
D	District:	Chamba									
1.	Sarhu (3 Ha.)	N 32° 22' 20.2" E 076° 03' 49.4" 1563 m	Rocky Sandy	*P. roxburghii, Dalbergia sissoo & Acacia catechu*	Medium	Northern	Landsliding during heavy rain	Construction of retaining wall & check dam 3.5x1.5x1 m (No. 20)	*P. roxburghii, Albizia stipulata* & Amla	Not required	No
2.	Kut Gamrar (DPF) (5 ha.)	N 32° 22' 24.0" E 076° 04' 24.1" 1585 m	Loose rocky sandy	*P. roxburghii, Salix spp. Pyrus pashia &* Mango	Gentle	Eastern	Landsliding during rainy season	-	*Pyrus pashia, Acacia catechu,* Amla, *Q. leucotrichophora,* & *Dalbergia sissoo*	Not required	Construction of water tank (3.5x3x2.5m) 1 No.
3.	Nihar (3 ha.)	N 32° 22' 22.0" E 076° 04' 14.7" 1463 m	Sandy	*P. roxburghii, Salix spp. Pyrus pashia &* Mango	Medium	Eastern	Soil erosion during monsoon	Construction of crate wire spur (3X3X2 m) (No. 3)	*Juglans regia, Grewia optiva* & Amla	Not required	No
9.	Chelli Village / Harnala C2 DPF	N 32°24'00.6" E 076°02'53.4" 1644 m	Loamy	*P. roxburghii, Rhododendron arboreum &Q. leucotrichophora*	Steep	Northern	Natural / Rains	Construction of check dams as engineering structure	*P. roxburghii* & *Juglans regia*	-	-
10.	Harnala DPF C2	N 32°24'02.6" E 076°03'02.1" 1640 m	Loamy	*P. roxburghii, Rhododendron arboreum &Q. leucotrichophora*	Steep	Southern-East	Natural / Rains	Construction of check dams as engineering structure	Fodder *spp. , P. roxburghii* & *Juglans regia*	-	-
11.	Harnala DPF C2	N 32°24'04.4" E 076°03'03.1" 1628 m	Loamy	*P. roxburghii, Rhododendron arboreum & Q. leucotrichophora*	Steep	Northern - East	Natural / Rains	Construction of check dams as engineering structure	Fodder *spp. , P. roxburghii* & *Juglans regia*	-	-
12.	Harnala DPF C2	N 32°24'04.8" E 076°03'02.9" 1630 m	Loamy	*P. roxburghii, Rhododendron arboreum & Q. leucotrichophora,*	Steep	Northern/ East	Natural / Rains	Construction of check dams as engineering structure	*P. roxburghii, Juglans regia, Rhododendron arboreum & Q. leucotrichophora,*	-	-

1	2	3	4	5	6	7	8	9	10	11	12
13.	Drumman Village/ Baloh Forest	N 32°24'18.7" E 076°02'48.6" 1418 m	Loamy	*P. roxburghii, Dalbergia sissoo, Ficus palmata*	Medium	Eastern/ South	Natural/ Rains	Construction of check dams as engineering structure	*P. roxburghii, Juglans regia & Dalbergia sissoo,*	-	-
14.	Baloh village/ Baloh Forest	N 32°24'22.7" E 076°02'45.7" 1428 m	Loamy	*P. roxburghii, Dalbergia sissoo, Ficus palmata*	Medium	Northern/ West	Natural/ Rains	Construction of check dams as engineering structure	*P. roxburghii, Juglans regia & Dalbergia sissoo*	-	-
15.	Drumman Village / Baloh Forest	N 32°24'17.9" E 076°02'42.0" 1371 m	Loamy	*P. roxburghii, Dalbergia sissoo*	Medium	Southern/ West	Natural/ Rains	Construction of check dams as engineering structure	*P. roxburghii, Juglans regia & Dalbergia sissoo,*	-	-
16.	Baloh Nala	N 32°24'31.0" E 076°02'32.7" 1406 m	Loamy	*P. roxburghii,*	Steep	Northern/ West	Natural/ Rains	Construction of check dams as engineering structure	*Dalbergia sissoo, Juglans regia & P. roxburghii*	-	-
17.	Drumman Village	N=32°24'10.8" E=(76°02'29.7" 1416 m	Loamy	*P. roxburghii, Dalbergia sissoo, Ficus palmata*	Steep	Southern/ West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia & P. roxburghii*	-	-
18.	Chelli Village Harnalla Lower Side	N 32°23'58.8" E 076°02'32.7" 1395 m	Loamy	*P. roxburghii, Dalbergia sissoo*	Steep	Southern/ West	Natural / Rains	Construction of check dams as engineering structure	*Juglans regia P. roxburghii & Dalbergia sissoo*	-	-
19.	Harnala C1	N 32°23'51.5" E 076°02'33.2" 1443 m	Loamy	*P. roxburghii*	Steep	Southern	Natural/ Rains	Construction of check dams as engineering structure	*P. roxburghii, Juglans regia & Dalbergia sissoo,*	-	-
20	Harnala C1	N 32°23'50.8" E 076°02'33.3" 1422 m	Loamy	*P. roxburghii*	Steep	Southern	Natural/ Rains	Construction of check dams as engineering structure	*P. roxburghii, Juglans regia & Dalbergia sissoo,*	-	-
21.	Harnala C1	N 32°23'47.9" E 076°02'32.0" 1439 m	Loamy	*P. roxburghii*	Steep	Northern	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-

1	2	3	4	5	6	7	8	9	10	11	12
22.	Harnala C1	N=32°23'44.3" E=076°02'26.1" 1446 m	Loamy	*P. roxburghii*	Steep	Southern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
23.	Chelli Village Harnala	N 32°24'60.8" E 076°02'29.3" 1393 m	Loamy	*P. roxburghii*	Steep	Western	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
24.	Gharani Village/ Gharani Forest	N 32°23'44.6" E 076°02'21.3" 1452 m	Loamy	*P. roxburghii*	Steep	Northern-East	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
25.	Gharani Village/ Phagot NDPF	N 32°23'35.0" E 076°02'16.9" 1402 m	Loamy	*P. roxburghii*	Steep	Northern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
26.	Gharani Village/ Phagot DPF C2	N 32°23'33.1" E 076°02'17.7" 1430 m	Loamy	*P. roxburghii*	Steep	Eastern	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
27.	Phagot DPF C2	N 32°23'25.9" E 076°02'12.4" 1399 m	Loamy	*P. roxburghii*	Steep	Northern	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
28.	Phagot DPF C2	N 32°23'23.4" E 076°02'12.9" 1374 m	Loamy	*P. roxburghii*	Steep	Northern	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
29.	Phagot DPF C2	N 32°23'22.4" E 076°02'13.6" 1361 m	Loamy	*P. roxburghii*	Steep	Southern - East	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
30.	Narhelu Village/ Loharka Forest	N 32°23'14.4" E 076°02'24.3" 1280 m	Loamy	*P. roxburghii*	Steep	Southern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
31.	Narhelu Village/ Loharka Forest	N 32°23'09.9" E 076°02'28.7" 1297 m	Loamy	*P. roxburghii*	Steep	Southern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-

1	2	3	4	5	6	7	8	9	10	11	12
32.	Narhelu Village/ Loharka Forest	N 32°23'08.8" E 076°02'32.1" 1269 m	Loamy	*P. roxburghii*	Steep	Southern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
33.	Narhelu Village/ Loharka Forest	N 32°23'03.7" E 076°02'35.0" 1253 m	Loamy	*P. roxburghii*	Steep	Southern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
34.	Kaloh Village/ Phagot NDPF C2	N32°23'13.4" E076°02'56.2" 1314 m	Loamy	*P. roxburghii*	Steep	Southern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-
35.	Kaloh Village/ Phagot NDPF C2	N32°23'10.3" E076°02'56.2" 1319 m	Loamy	*P. roxburghii*	Steep	Southern-West	Natural/ Rains	Construction of check dams as engineering structure	*Juglans regia, P. roxburghii & Dalbergia sissoo*	-	-

[C] AGRICULTURE, HORTICULTURE CROPS, ANIMAL HUSBANDRY & AMINITIES RELATED DATA

[Sub-Watershed Chhaki Khad – 1B1A7(3)]

1	2	3	4	5	6	7	8	9	10	11	12	13
A	Beat:	Chakki										
B	Block:	Raipar										
C	Range:	Chowari										
D	District:	Chamba										
1.	Chakdahan	Raipar	Maize, Rice, Wheat	Best quality seeds &measures for crop improvements required	-	Requirement of the seedlings of horticulture species	18	15	Milk yielding Hybrid varieties of cow & buffaloes	Dadriyada (4 Km.)	Dadriyada (4 Km.)	4 Km	-
2.	Jandrugh	Raipar	Maize, Rice, Wheat	Best quality seeds & measures for crop improvements required	-	Requirement of the seedlings of horticulture species like *Khumani, Amla*	12	25	Wool yielding varieties of Goats / Sheeps	Dadriyada (5 Km.)	Dadriyada (5 Km.)	5 Km.	-
3.	Dadriyada	Raipar	Maize, Rice, Wheat	Best quality seeds & measures for crop improvements required	-	Requirement of the seedlings of horticulture species	37	70	Hybrid varieties yielding more wool	Dadriyada (1 Km.)	Dadriyada (1 Km.)	100 Mtr.	-
4.	Kutt	Raipar	Maize, Rice, Wheat	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	14	126	Hybrid varieties yielding more wool	Dadriyada (6 Km.)	Dadriyada (6 Km.)	6 Km.	-
5.	Dramni	Raipar	Maize, Rice & Wheat	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	6	104	Well equipped veterinary dispensary required	Dadriyada (6 Km.)	Dadriyada (6 Km.)	6 Km.	
6.	Chihun	Raipar	Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	27	185	Fully equipped veterinary dispensary required having facilities like artificial insemination	Dadriyada (5 Km.)	Dadriyada (5 Km.)	5 Km.	-

1	2	3	4	5	6	7	8		9	10	11	12	13
7	Basred	Raipar	Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	28	40	Required good quality feed for milk yielding cattles	Dadriyada (5 Km.)	Dadriyada (5 Km.)	5 Km.	
8	Davdi	Raipar	Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	21	99	Required good quality feed for milk yielding cattles	Dadriyada (5 Km.)	Dadriyada (5 Km.)	5 Km.	
9	Rath-Bhora	Raipar	Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	29	145	Well equipped veterinary dispensary required	Dadriyada (4 Km.)	Dadriyada (4 Km.)	4 Km.	
10	Aahan	Raipar	Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	15	125	Fully equipped veterinary dispensary required having facilities like artificial insemination	Dadriyada (4 Km.)	Dadriyada (4 Km.)	4 Km.	
11	Kumar Ghodi		Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	21	152	Required good quality feed for milk yielding cattles	Dadriyada (4 Km.)	Dadriyada (4 Km)	4 Km.	-
12	Batli Behi		Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	19	105	Required good quality feed for milk yielding cattles	Duriyada (5 Km)	Dadriyada (5 Km.)	5 Km.	-
13	Aaru Ka Fer	Raipar	Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	37	149	Well equipped veterinary dispensary required	Dadriyada (6 Km.)	Dadriyada (6 Km.)	6 Km	-

1	2	3	4	5	6	7		8	9	10	11	12	13
14	Chaki	Raipar	Maize, Rice, Wheat & Barley	Plantation of the fodder species	-	Requirement of the seedlings of horticulture species	55	450	Fully equipped veterinary dispensary required having facilities like artificial insemination	Dadriyada (8 Km.)	Dadriyada (8 Km.)	8 Km	-

1	2	3	4	5	6	7	8		9	10	11	12	13
A	Beat:	Hathidhar											
B	Block:	Manhuta											
C	Range:	Chowari											
D	District:	Chamba											
1.	Khadret	Khadret	Wheat, Rice & Maize	Use of HYV of seeds, fertilizers	*Juglans regia*, Mango & *Pyrus spp.*	HYV of plants, modern scientific inputs	75	150	Fully equipped veterinary dispensary	At Sala-Luni (2 Km.)	At Mundi (2.5 Km.)	1 Km from road	No
2.	Bhatola Wasa	Khadret	Maize, Rice, Wheat & Barley	Latest scientific techniques HYV of seeds irrigation facilities	*Pyrus spp.* Mango & *Juglans regia*	HYV of plants, irrigation facilities	110	50	Fully equipped veterinary dispensary	At Sala-Luni (5 Km.)	At Mundi 4 Km.	2 Km. from road	No
3.	Mundi	Khadret	Maize, Rice, Wheat & Barley	HYV of seeds, irrigation, marker access	*Pyrus spp.* Mango & *Juglans regia*	Plants of HYV, fertilizers	70	50	Facilities in the veterinary dispensary	At Sala-Luni	At Mundi	Road head	No
4.	Saala at Luni	Khadret	Maize & Wheat	Fertilizers, HYV of seeds	*Apple*, Mango & *Pyrus spp.*	Protection from monkeys	45	30	Well equipped veterinary dispensary	At Sala-Luni	At Mundi	Road head	Yes
5.	Luni	Khadret	Wheat, Pulses & Maize	Improvement in soil fertility, HYV of seeds	Mango, Pear & Walnut	*Pyrus spp.* & *Juglans regia*	40	120	Fully equipped veterinary dispensary	At Sala-Luni (1 Km.)	At Mundi (2 Km.)	1 Km. from road head	No

1	2	3	4	5	6	7	8		9	10	11	12	13
A	Beat:	Manhuta											
B	Block:	Manhuta											
C	Range:	Chowari											
D	District:	Chamba											
1.	Bella	Manhuta	Maize & Wheat	Improvement of soil fertility & irrigation facilities	Khurmani, *Pyrus spp.* & *Juglans regia*	Protection of crops from monkeys	100	100	HYV of cattles are not available	At Dadriyara (4 Km.)	At Manhuta (7 Km.)	3 Km.	No
2.	Siun I	Manhuta	Maize & Wheat	Modern agricultural inputs &HYV of seeds	Mango & *Pyrus spp.*	Cultivation of HYV of crops	40	100	HYV of cattles are not available	At dadriyara (3.5 Km.)	At Manhuta (8 Km.)	4 Km.	No
3.	Samu	Manhuta	Maize & Wheat	Proper irrigation facilities &use of fertilizers	Mango, *Juglans regia* & *Pyrus spp*	Cultivation using HYV, fertilizers & latest techniques	50	100	Shortage of fodder during drought to be solved	At dadriyara (5 Km.)	At Manhuta (9 Km.)	5 Km.	No
4.	Gatura	Parsiyara	Wheat, Rice & Maize	Improvement in soil fertility & irrigation facilities can increase production	*Pyrus spp* & *Juglans regia*	Use of high yield varieties will increase production	60	48	Full facilities at veterinary are required	At Manhuta (2 Km.)	At Manhuta (2 Km.)	2 Km.	No
5.	Shatrel	Khadret	Wheat, Rice & Maize	Use of fertilizers HYV seeds & improvement in soil fertility	*Pyrus spp.* Mango & *Juglans regia*	Use of modern scientific inputs & fertilizers	100	40	Fully equipped Veterinary dispensary	At Sala Luni (4 Km.)	At Mundi 4 Km.)	Road Head	No
6.	Druma	Khadret	Wheat, Rice & Maize	Use of fertilizers HYV seeds & improvement in soil fertility	Mango & *Juglans regia*	Chemical spray, HYV of plants	60	35	Veterinary dispensary required	At Sala-Luni (4 Km.)	At Mundi (3 Km.)	1 Km. from road	No
7.	Jungle Druma	Khadret	Wheat, Rice & Maize	Use of HYV of seeds fertilizers	*Pyrus sp.* & Mango	Spray of chemicals will prevent the crop from disease	120	200	Cattles of superior analities	At Sala-Luni (2.5 Km.)	At Mundi (3 Km.)	1 Km. from road	No

1	2	3	4	5	6	7	8		9	10	11	12	13
8.	Godra	Khadret	Wheat, Rice & Maize	Irrigation facilities, seeds of HYV	*Pyrus sp.* & Mango	Plants of HYV, protection from monkeys	80	150	Well equipped Veterinary dispensary required	At Sala-Luni (3 Km.)	At Mundi (2 Km.)	Road head	No
9.	Phalas	Khadret	Wheat, Rice & Maize	Improvement in soil fertility & use of HYV of seeds	*Pyrus spp.* Mango & Khumani	Use of fertilizers, HYV of plants	45	80	Well equipped Veterinary dispensary required	At Sala-Luni (2 Km.)	At Mundi (2.5 Km.)	Road head	No

1	2	3	4	5	6	7	8		9	10	11	12	13
A	Beat:	Parsiyara											
B	Block:	Manhuta											
C	Range:	Chowari											
D	District:	Chamba											
1.	Gatuna	Parsiyara	Wheat & Maize	Improvement in soil fertility & irrigation facilities can increase production	Mango & *Pyrus spp.*	Use of high yield varities will increase production	60	48	Full facilities at veterinary are required	At manhuta (2 Km.)	At manhuta (2 Km.)	2 Km.	No
2.	Saasan	Parsiyara	Wheat, Rice & Maize	HYV seeds, fertilizers	*Pyrus spp.*, Khumani & *Juglans regia*	Protection from monkeys & transportation	40	25	Well equipped veterinary dispensary	At Manhuta (6 Km.)	At Samiru (3 Km.)	5 Km. from road	No
3.	Sihasan	Parsiyara	Wheat, & Maize	HYV of seeds, fertilizers	Mango, *Pyrus spp.* & Khumani	HYV of plants, market access	45	25	Well equipped veterinary dispensary	At Manhuta (5 Km.)	At Manhuta	2 Km. from road	No
4.	Kathura	Parsiyara	Wheat, Rice & Maize	HYV of seeds, fertilizers	*Pyrus spp.* & Mango	HYV of plants, market access	55	48	Fully equipped veterinary dispensary	At Manhuta (1 Km.)	At Manhuta (1 Km.)	1 Km. from road	No
5.	Rupehra	Parsiyara	Wheat, Rice & Maize	Irrigation facilities, HYV of seeds	*Juglans regia*, *Pyrus spp.* & Mango	HYV of plants, fertilizers	115	300	Well equipped veterinary dispensary	At Manhuta (5 Km.)	At Rupehra	Road head	-
6.	Sarho	Parsiyara	Wheat, Barley & Maize	Irrigation facilities available, soil fertility improvement, promoting organic farming	*Juglans regia*, *Pyrus spp.* & Mango	Protection of monkeys, HYV of plant stock	48	70	Well equipped veterinary dispensary	At Manhuta (6 Km.)	At Rupehra (2 Km.)	2 Km. from road	
7.	Sarho Phatti	Parsiyara	Wheat, & Maize	Soil improvement, irrigation facilities	*Juglans regia* & Khumani	Protection from monkeys, HYV of plants	32		100	HYV of cattles & veterinary dispensary	At Manhuta (8 Km.)	At Rupehra (3 Km.)	3.5 Km. from road

1	2	3	4	5	6	7	8	9	10	11	12	13
8.	Juhar	Parsiyara	Wheat, & Maize	HYV of seeds, soil fertility, improvements, organic farming	*Pyrus spp.* & Mango	HYV of plants, protection from monkeys	42	215	Fully equipped veterinary dispensary	At Manhuta (9 Km.)	At Rupehra (4 Km.)	4 Km. form road
9.	Juhar Dramsan	Parsiyara	Wheat, Rice & Maize	Promote organice farming, HYV of seeds	*Juglans regia, Prunus persica, Pyrus spp.* & Mango	JYV of plants, use of fertilizers	104	300	Fully equipped veterinary dispensary	At Manhuta (10 Km.)	At Rupehra (5 Km.)	5 Km. from road
10	Kut	Parsiyara	Wheat, Barley & Maize	HYV of seeds, organic farming &modern techniques	*Pyrus spp.*, Mango & *Juglans regia*	HYS of plants, fertilizers, soil fertility improvement	120	80	Fully equipped veterinary dispensary	At Manhuta (9 Km.)	At Rupehra (5 Km.)	5 Km. from road
11	Mohod	Parsiyara	Wheat, Rice & Maize	Soil fertility improvement, HYV of seeds	-	-	45	40	Fully equipped veterinary dispensary	At Manhuta (7 Km.)	At Rupehra (5 Km.)	5 Km. from road

ANNEXURE-II

Close View of Soil Erosion on right bank of Chaki Khad above road in Lohru Beat

Land Erosion on right bank of Kalam Khad in Lahru Beat

Land Slide on left bank of Kalam Khad in Kulera Forest in lower Chowari Beat

Land Slide on left bank of Kalam Khad due to construction of Banet Road

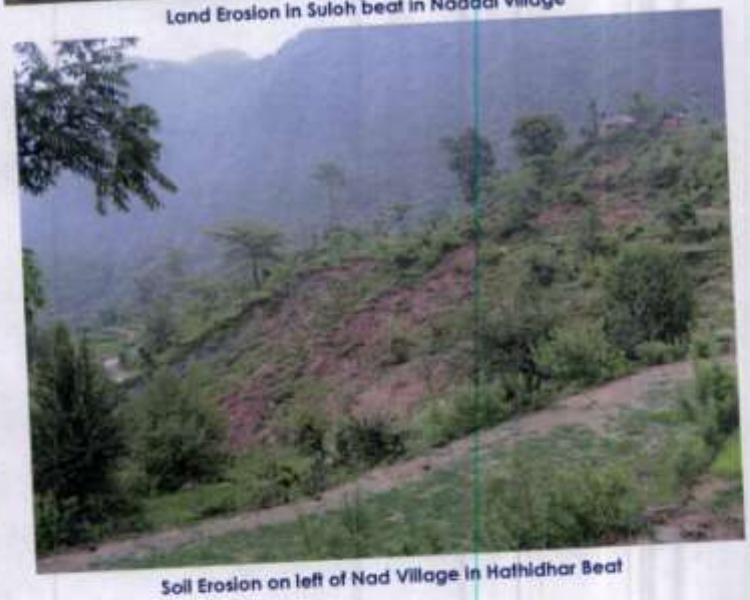
Land Slide due to Kalam Khad and Kenthli Rroad

Land Slide on left bank of Kalam Khad due to construction of Kalam HEP

Soil Erosion in Lahru Beat above SH-43

Land Slide in Lahru Beat above SH-43

Land Erosion in Suloh beat in Naddai village



Soil Erosion on left of Nad Village in Hathidhar Beat

Land Slide in Manuta Beat

Land Slide in Hathidhar beat near Banne Da Nala

Land Slide above village Raipur in Raipur Beat

General Topography of the Catchment Area

Steep and demanded slopes required afforestation and soil conservation activities

Alpine Pastures of the Catchment Area

Barren and busy area requiring afforestation

Check-dams proposed on small streams to enhance mountain livelihoods

Field Teams in Alpine Pastures, Surveying the Catchment Area

Identification of Afforestation Sites by Field Team along with HPFD Staff

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