



CHAPTER - 1

CATCHMENT AREA TREATMENT PLAN

1.1 INTRODUCTION

Land and water resources have optimum interactions and synergetic effects if developed in a scientific and rational manner. In a larger sense, land is represented by soil, which is usually susceptible to erosion due to various meteorological conditions such as total annual precipitation, snowfall, intensity of precipitation, wind velocity and directions, extent of vegetal cover and the topography of the catchment. The erosion of top soil from land reduces its fertility and the vegetation growth and increases its sedimentation. Sedimentation of reservoir is a function of soil erosion rate of the river catchment area. It impinges upon the useful capacity of reservoir, water quality and the availability of water for its designated use as also life of various components of the projects using water. 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. Therefore, it becomes imperative to evolve a plan based on scientific approach to prevent soil erosion to the extent possible.

The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity, thus, affecting the water availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment also adversely affects the agricultural production. Another important factor that adds to the sediment load and which contributes to soil degradation is grazing pressure. A large number of cattle, sheep and goats graze the pastures during summer season continuously for about six months. Because of which, the productivity of these pastures is also declining further. The lack of proper vegetal cover is a factor to cause degradation and thereby results in severe run off/soil erosion, and subsequently premature siltation of the reservoir. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to suitably address the above-mentioned adverse causes and the processes of soil erosion. The catchment area treatment involves understanding of the erosion characteristics of the terrain and suggesting remedial measures to reduce the erosion rate. For this reason, the catchment of the directly draining rivers, streams, tributaries, etc. are treated and the cost is included in the project cost.



Watershed is the basic unit of a catchment and is a natural hydrological and geographic unit of specific 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 multipronged data e.g., geology, geomorphology, topography, soil, landuse/ landcover, climate, hydrology, drainage pattern, etc. The catchment of the Integrated Kashang HEP comprises of two absolute and contiguous sub-watershed Kashang and Kerang Khads which have been further subdivided into two micro watersheds each. The multi-pronged data generated from various published sources and actual data collected from these watersheds on the above-mentioned parameters forming the basis of the Action Plan for catchment Treatment is presented here.

As a part of the EIA study for the proposed “Integrated Kashang HEP”, a Catchment Area Treatment (CAT) plan for the free draining and directly draining catchment area (**Figure 1.1**) has been prepared for areas with high soil erosion intensity. The CAT Plan targets towards 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 reducing total sediment flow in the reservoir and flowing waters.

1.2 OBJECTIVES

Integrated watershed management is aimed at minimizing the rate of sediment flow in the streams being harnessed for hydro power generation. The main aim of the Catchment Area Treatment (CAT) Plan is to rejuvenate various potential and degraded ecosystems in the catchment area for longevity of the underground balancing reservoir storage capacity. For this purpose, action plan has been prepared with the following objectives:

1. To facilitate the hydrological functioning of the catchment and to augment the quality of water of the river and its tributaries.
2. Conservation of soil cover and to reduce soil erosion, floods and siltation of the river and its tributaries and consequent reduction of siltation in the reservoir of the project.
3. Demarcation of the priorities of sub and micro watersheds for treatment on the basis of soil erosion intensity in the catchment area.



4. Rehabilitation of degraded forest areas through afforestation and 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 river and tributaries incidentally improving the quality of water
7. To meet the livelihood requirement of local people and broaden livelihood options through employment generation and community participation
8. Ecosystem conservation resulting from increased vegetal cover and water retaining properties of soil.
9. To run rural employment and economic upliftment programmes in the rural areas for poverty alleviation through medicinal plants.
10. Promotion of non-conventional energy device to reduce pressure on forest.
11. Promotion of community based eco-tourism with a little expenditure on maintaining designated paths eco-treks and by providing overnight camping facilities.

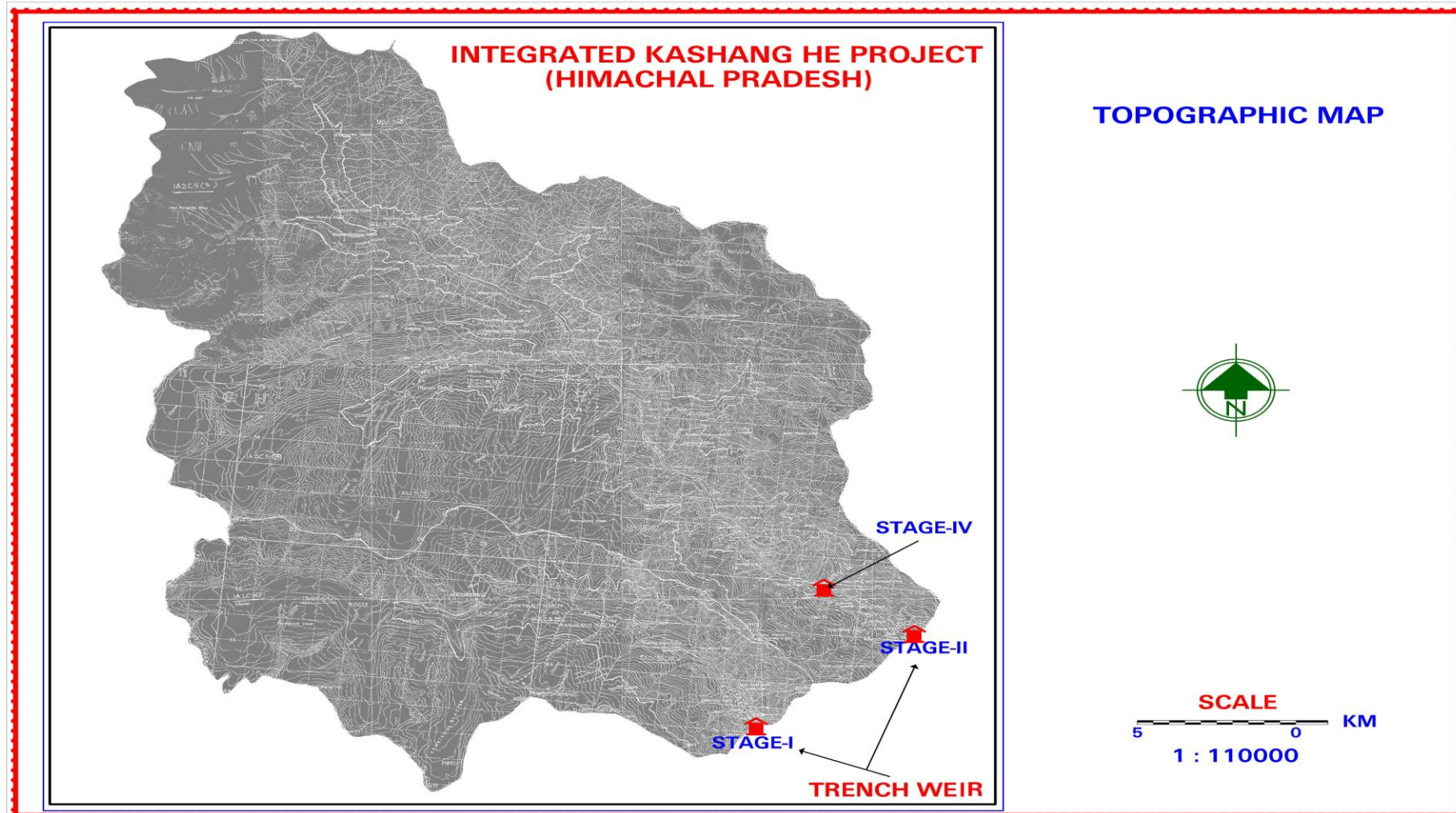


Figure 1.1: Free Draining Catchment Area of Integrated Kashang HEP



1.3 CATCHMENT AREA

The free draining catchment area of Kashang Khad up to proposed trench weir site of Stage-I at village Dolo Dogri is approximately 124.03 sq km and lies in between El 2820 m to 5938 m above msl. Out of 124.03 sq km catchment area, 30.96 sq km is snow bound. The free draining catchment of Kerang Khad up to the proposed trench weir site of Stage-II at village Lappo is about 400.04 sq km and lies between El. 2870 m to 5848 m above msl, out of which 96.95 sq km is snow bound. The sub watershed Kerang also houses Lippa - Asrang Wildlife Sanctuary extending over 30.89 sq km area.

As per nomenclature contained in Watershed Atlas of India, Edition 1990, the catchment area under study lies in Water Resources Region-1, Basin-A, Catchment IA2, Sub catchment 1A2C watersheds IA2C5 Kashang and Kerang streams, falling totally in district Kinnaur of Himachal Pradesh. Catchment Area Treatment Plan has been formulated for the free draining catchment. The satellite data subset of IRS LISS-III Gen: 22 November 2007, path-96, Row-48 of the free draining catchment is presented in **Figure 1.2**.

1.3.1 Basin Characteristics

The integrated Kashang HEP basically involves augmentation of comparatively higher discharges of Kerang Khad into Kashang Khad for utilizing comparatively steeper slope available in Kashang Khad up to its confluence with River Satluj, thereby utilizing 828.45 m gross head reckoned from intake point of Stage-I up to centerline of machine (El. 1999.20 m). In view of the proposed integration, basin characteristics of each of these Khads/Stream is discussed.

1.3.1.1 Basin Characteristic of Kashang Khad

Kashang Khad, a right bank tributary of River Satluj is a typical hill rivulet mostly fed by snow melt and have steep gradient with typical "step-pools bed configuration." The river emanates from Piddhang glaciers (El.5914 m) on north and Pingting glaciers (El. 5938 m) on south with Chikim Dhar and Mukim Dhar on the west forming boundary with Bhabha Catchment. The Khad runs for 18 km before its confluence with River Satluj as is depicted in the longitudinal section of the Khad shown in Fig 1.3, which clearly marks a steep bed slope of about 1:5 in the reach of the stream below the intake point. The basin is characterized by mountainous terrain with steep hill slopes in the lower reaches and has mountain chain with ice capped summits. Rogle, Pinagting and Skarishul glaciers as discussed earlier are some of the glaciers contributing snow melt in the basin.

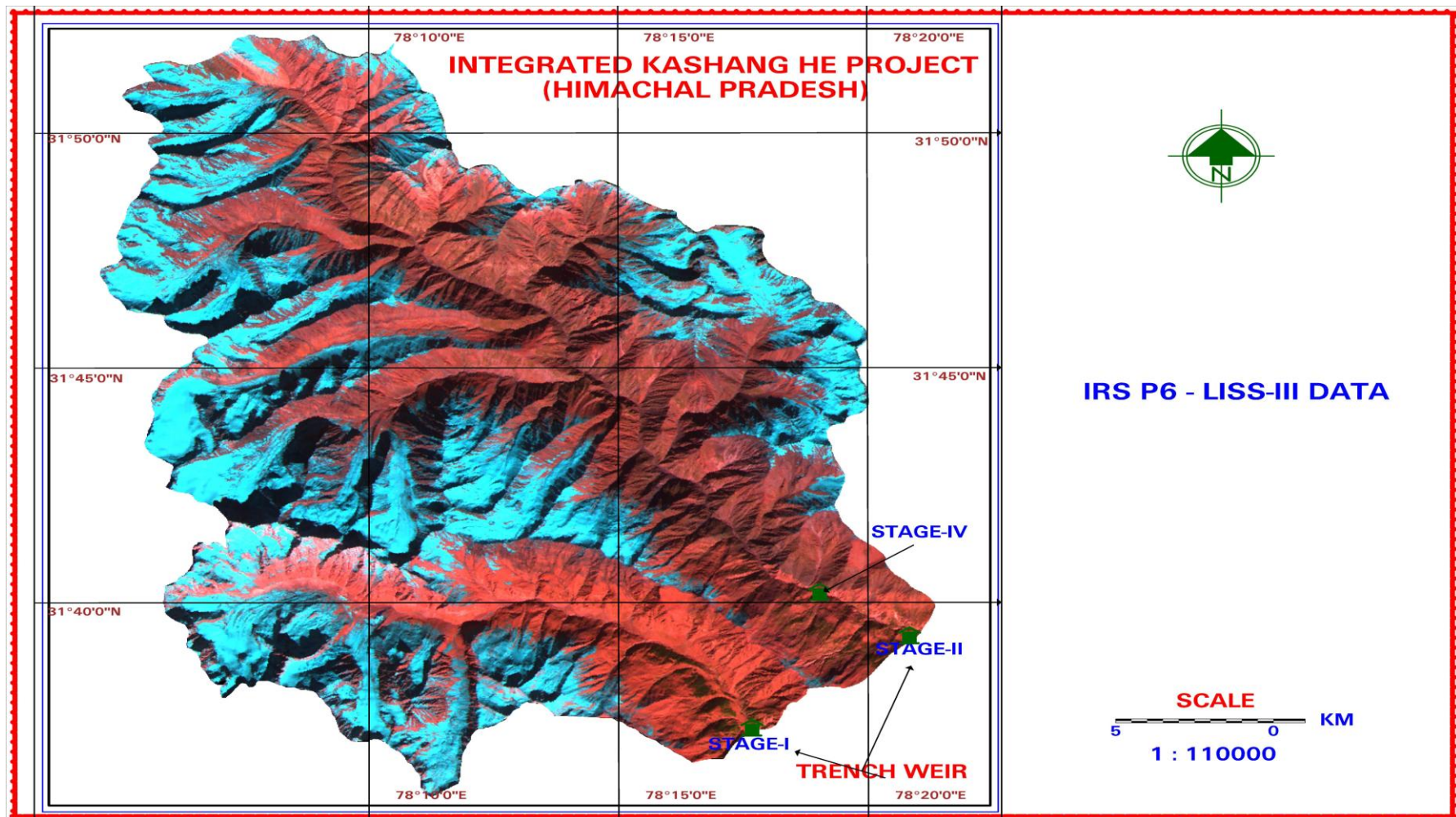


Figure 1.2: Satellite Imagery of Catchment Area



1.3.1.2 Basin Characteristic of Kerang Khad

Kerang Khad is also a right bank tributary of River Satluj and is a typical hill rivulet mostly fed by snow melt and have steep gradient with typical “step-pools bed configuration.” The river emanates near Larsa way Pass at El. 5692 m. above msl. on north. The glaciers on the north and north-west constitute the boundary with famous Pin Valley in District Lahul and Spiti. On the eastern side of the basin lies the Catchment of Ropa gad. The khad which is locally known as Taiti Garang is joined by small rivulets like Suti Garang, Gumjang Garang, Chippang Garang, Homgar Garang Wari Khad in upper reaches and has Porang and Pager Garang tributaries in the lower reaches. Pager Garang joins Kerang Khad near village Lippha about 3 km d/s of intake point of Stage-II. The Khad runs for 44 km before its confluence with River Satluj which is shown in **Figure 1.4**. The longitudinal section of the Khad, shown in **Figure 1.5**, manifests that from the intake point of Stage-II to the confluence with River Satluj the bed slope of Kerang Khad is 1:17.2 only. This, coupled with poor geology of proposed power house near its confluence with River Satluj, has necessitated addition of Kerang water into Kashang water conductor system through a low level Kerang-Kashang link tunnel. The terrain as a whole is characterized by long uninterrupted mountain chains with snow capped summits, longitudinal valleys and rolling foothills.

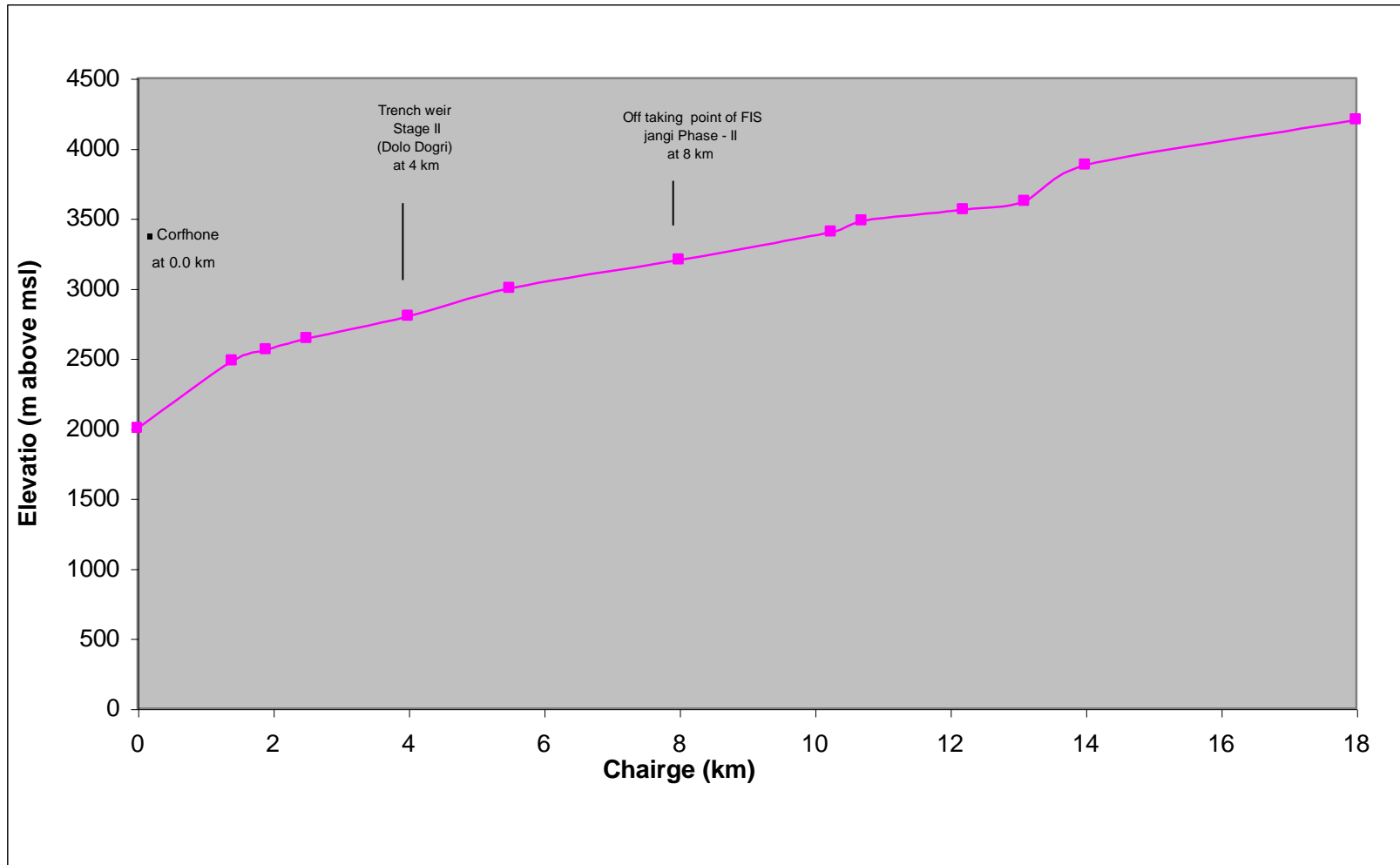


Figure 1.3: L-Section of Kashang Khad

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Figure 1.4: Confluence Point of Kerang Khad with River Satluj
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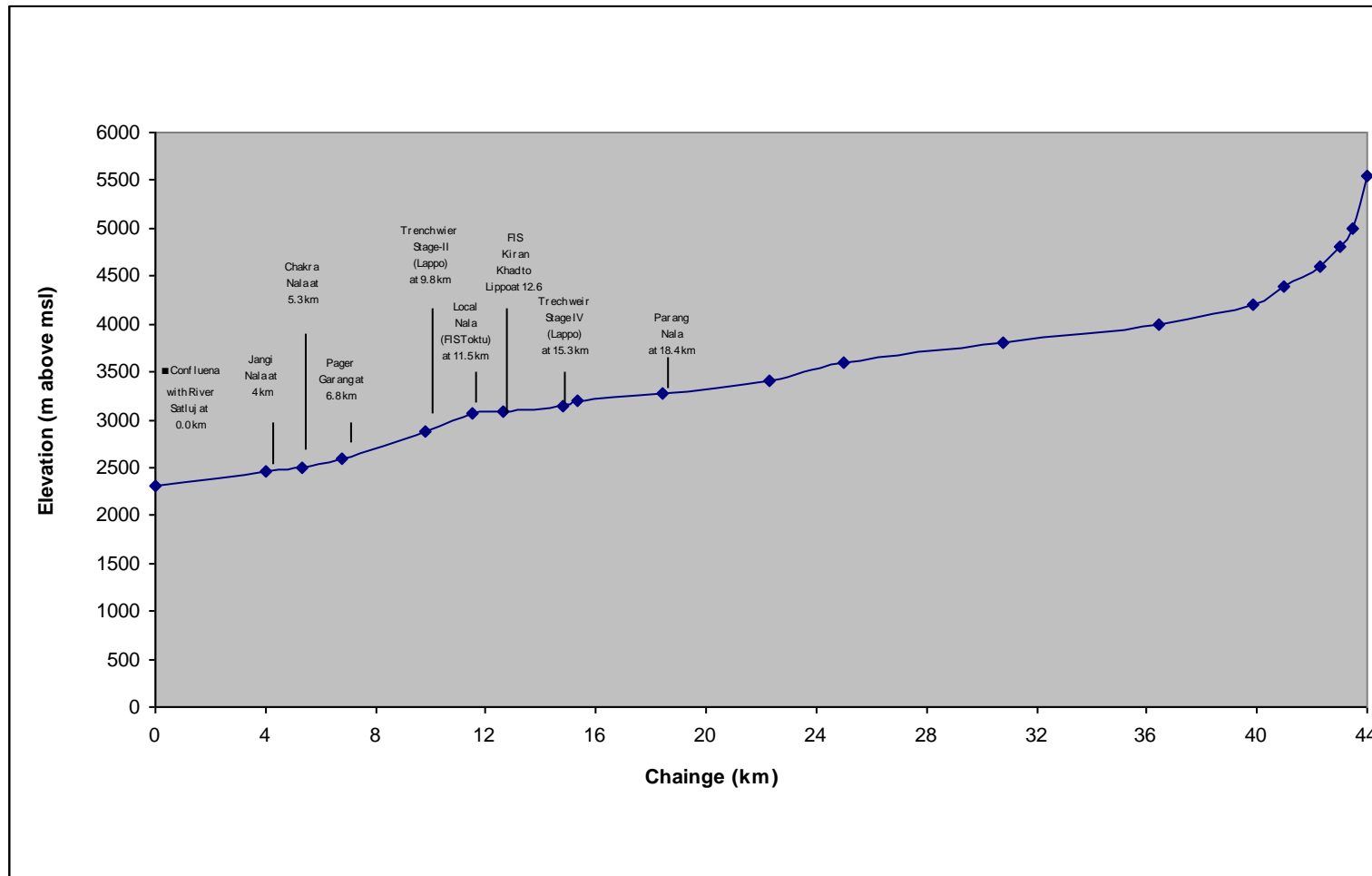


Figure 1.5: Longitudinal Section of Kerang Khad

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1.3.2 Free Draining Catchment

The basin of Kashang Khad upto the proposed intake point at Dolo Dogri at longitude 78°17'30" and latitude 31°37'30" constitutes the sub-watershed Kashang with a free draining catchment of 124.03 sq km. The basin of Kerang Khad upto the proposed intake point (Stage-II) at longitude 78°21'30.4" and latitude 31°39'21.3" constitutes the sub-watershed Kerang with a free draining catchment of 400.04 sq km. and a directly draining catchment of 53 sq km as the intake point of Stage-IV, at Toktu is upstream of it. In view of the overlapping catchment of Stage-II & Stage-IV and by considering the fact that the Stage-IV is also part and parcel of the integrated project, one complete sub-watershed upto intake point of Stage-II has been conceptualized for the purpose of making CAT plan for Kerang sub-watershed. The two sub-watersheds Kashang and Kerang have been further sub divided into two micro-watershed the aerial extents of which is apportioned in **Table 1.1**.

Table 1.1: Hydrological Units

S. No	Name of Sub Watershed	Name of Micro watershed	Micro-watershed code	Area (Sq.km)
1	Kashang	Rogle Dolo Dogri	1A2C5 (1) 1A2C5 (2)	86.85 37.18
Total Sub-Watershed Kashang				124.03
2	Kerang	Larsa Lappo	1A2C5 (3) 1A2C5 (4)	295.55 104.49
Total Sub Watershed Kerans				400.04
Grand Total				524.07

1.3.2.1 Micro Watershed Rogle [(1A2C5 (1))]

The micro-watershed which constitutes 70.02% of the total free draining catchment of Kashang Khad at intake site has a geographical area of 86.85 sq km out of which 30.92 sq km has been imaged as snow bound as per satellite image dated 22.11.2007. Open forest and scrub or scattered vegetation constitutes about 16.47% of the total geographical area of the micro-watershed. Piddhang glacier, El 5914 m a msl; Pingting glacier, El 5938 m a msl and Skarishul glaciers mark their presence in this micro-watershed.

1.3.2.2 Micro-watershed Dolo Dogri [1A2C5 (2)]

The micro-watershed, which constitutes 29.98% of the free draining catchment of Kashang Khad at intake point, has a geographical area of 37.18 sq km. out of which 0.04 sq km has been imaged as snow bound as per satellite image dated 22.11.2007. The predominant land use is open forest (19.84 sq km) followed by dense vegetation (14.81 sq km). Kashang Khad is joined by some of first and second order streams on both of its banks.



1.3.2.3 Micro-watershed Larsa [(1A2C5 (3))]

The micro-watershed, which constitutes 73.88% of the total free draining catchment of Kerang Khad at intake site of Stage-II at Lappo, has a geographical area of 295.55 sq km. Out of this 95.78 sq km has been imaged as snow bound as per satellite image dated 22.11.2007. Dense vegetation, open forest and scrubs jointly constitute about 35.86% of the total geographical area of the micro-watershed. The micro-watershed also houses part of Lippa-Asrang wildlife sanctuary. Kerang Khad, which is locally named as Taiti Garang meets some rivulets like Suti Garang, Gumjang Garang, chippand and Homgar Garang emanating from surrounding glaciers.

1.3.2.4 Micro-watershed Lappo [(1A2C(4))]

The micro-watershed, which constitutes 26.12% of the total free draining catchment of Kerang Khad at intake site of Stage-II, at Lappo, has a geographical area of 104.49 sq km out of which 1.17 sq km has been imaged as snow bound as per satellite image dated 22.11.2007. The predominant land use is dense forest (54.96 sq km) followed by open forest (28.45 sq km). Kerang Khad is met with Porang Khad upstream of intake point of stage-IV. Another local Nala, from which Toktu Flow Irrigation Scheme off-takes, also meets it d/s of Asrang village.

1.4 TOPOGRAPHY

The Integrated Kashang HEP lies in the border district of Kinnaur of Himachal Pradesh and physiographically the area is covered under sub-division of Western Himachal in series of long uninterrupted mountain chains with snow capped summits, longitudinal valley and rolling foothills. A number of brooks, streams originate from the glaciers. The topography of the catchment area is of steep to extremely steep hills, whereas the western side of Kashang and Kerang Khads are less steep hills. The eastern sides have steep hills, rocky area with sparsely dense vegetation. In the lower reaches of both the Khads, there are steep hills on both sides. At some locations open mixed type forest/grassland pastures are seen. The higher reaches of the sub watershed have alpine vegetation and barren areas. There is glacial flow in the upper reaches of both the streams. The elevation of free drainage catchment ranges from 2830 m to 5938 m above msl and from 2870 m to 5849m above msl in sub watershed Kashang and Kerang respectively. The slope maps of both sub watersheds are presented in **Figure 1.6** and **Figure 1.7** and the drainage map is shown in **Figure 1.8**.

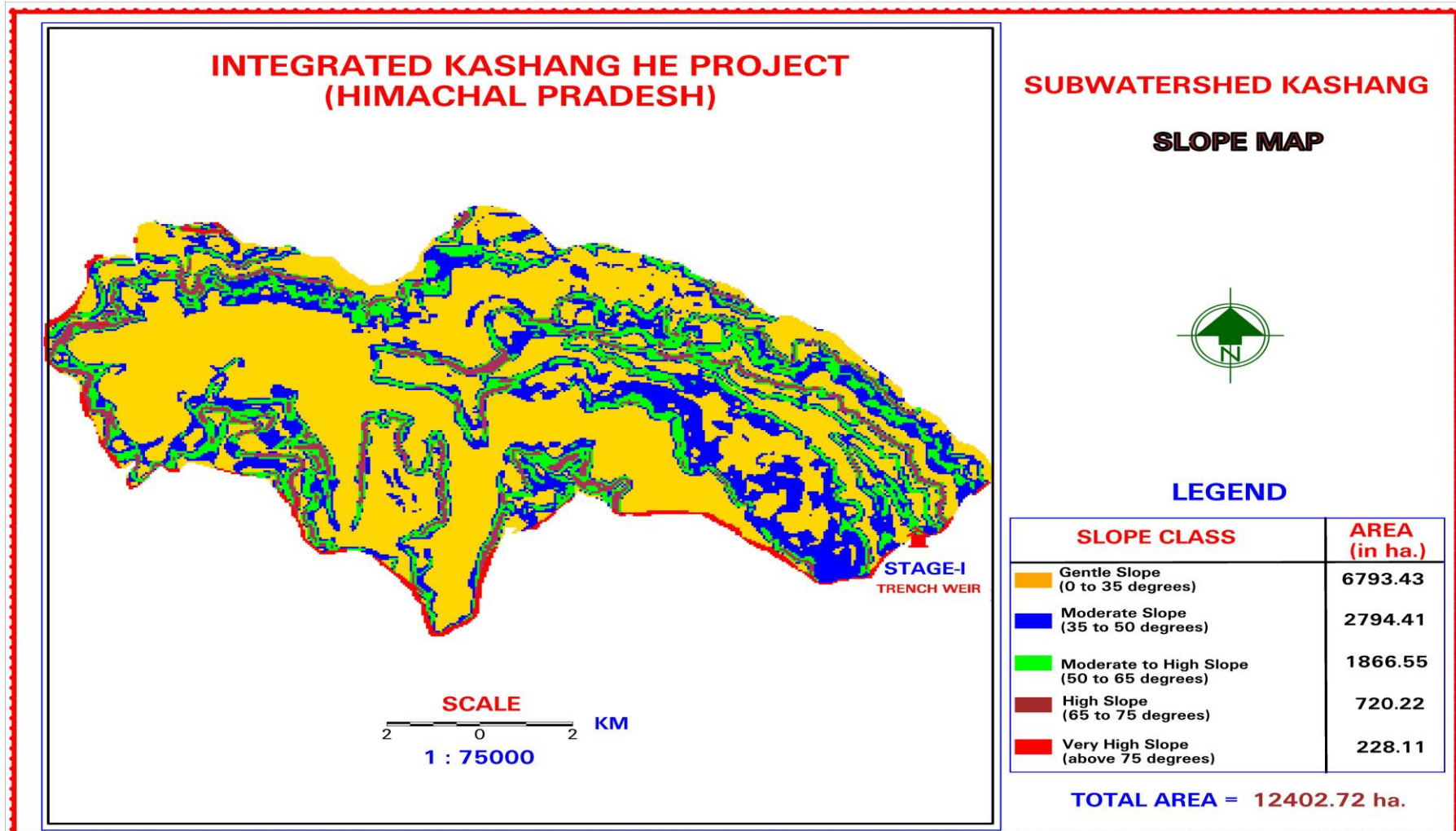


Figure 1.6: Slope Map of Sub-watershed Kashang

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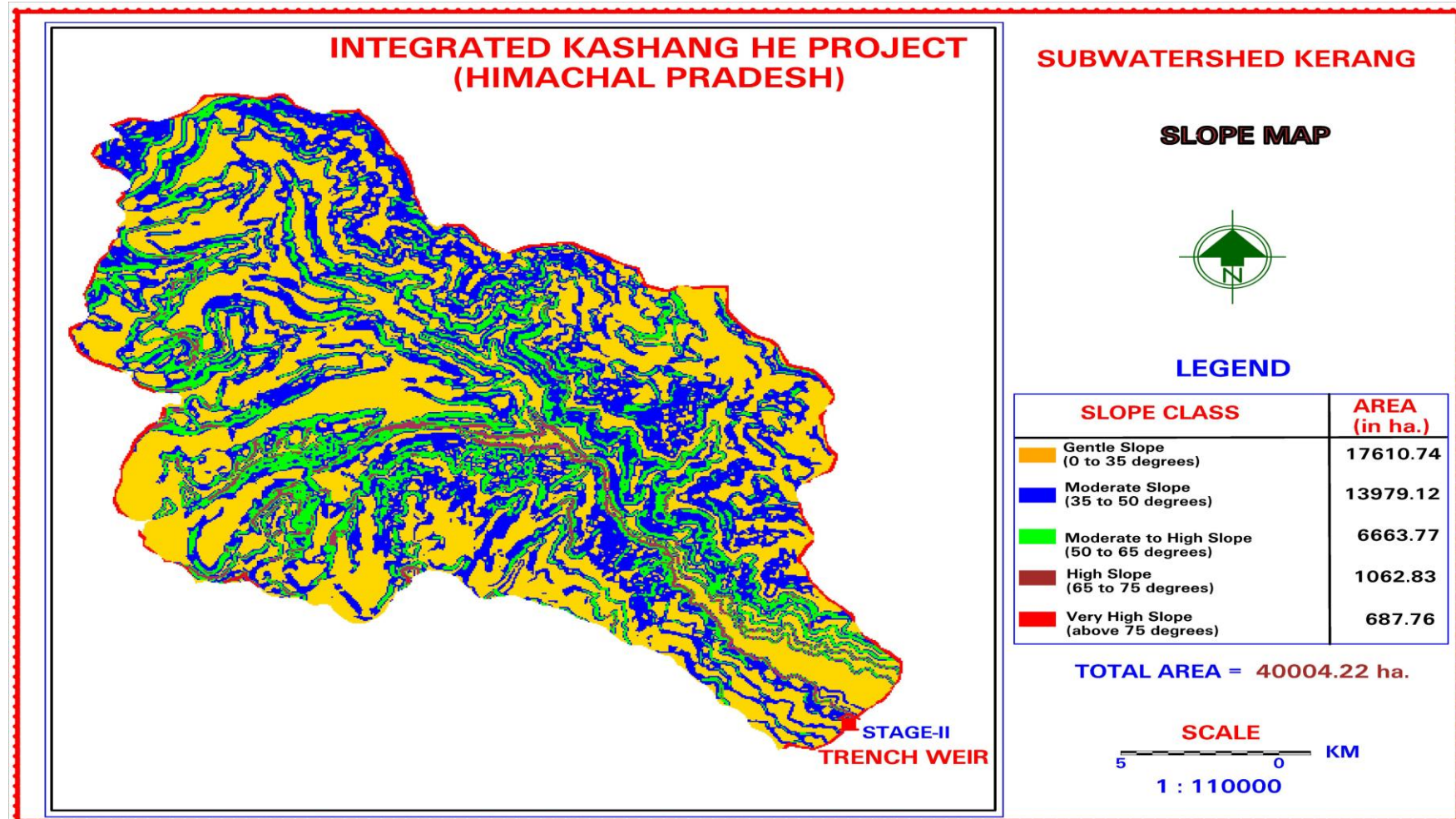


Figure 1.7: Slope Map of Sub-watershed Kerang

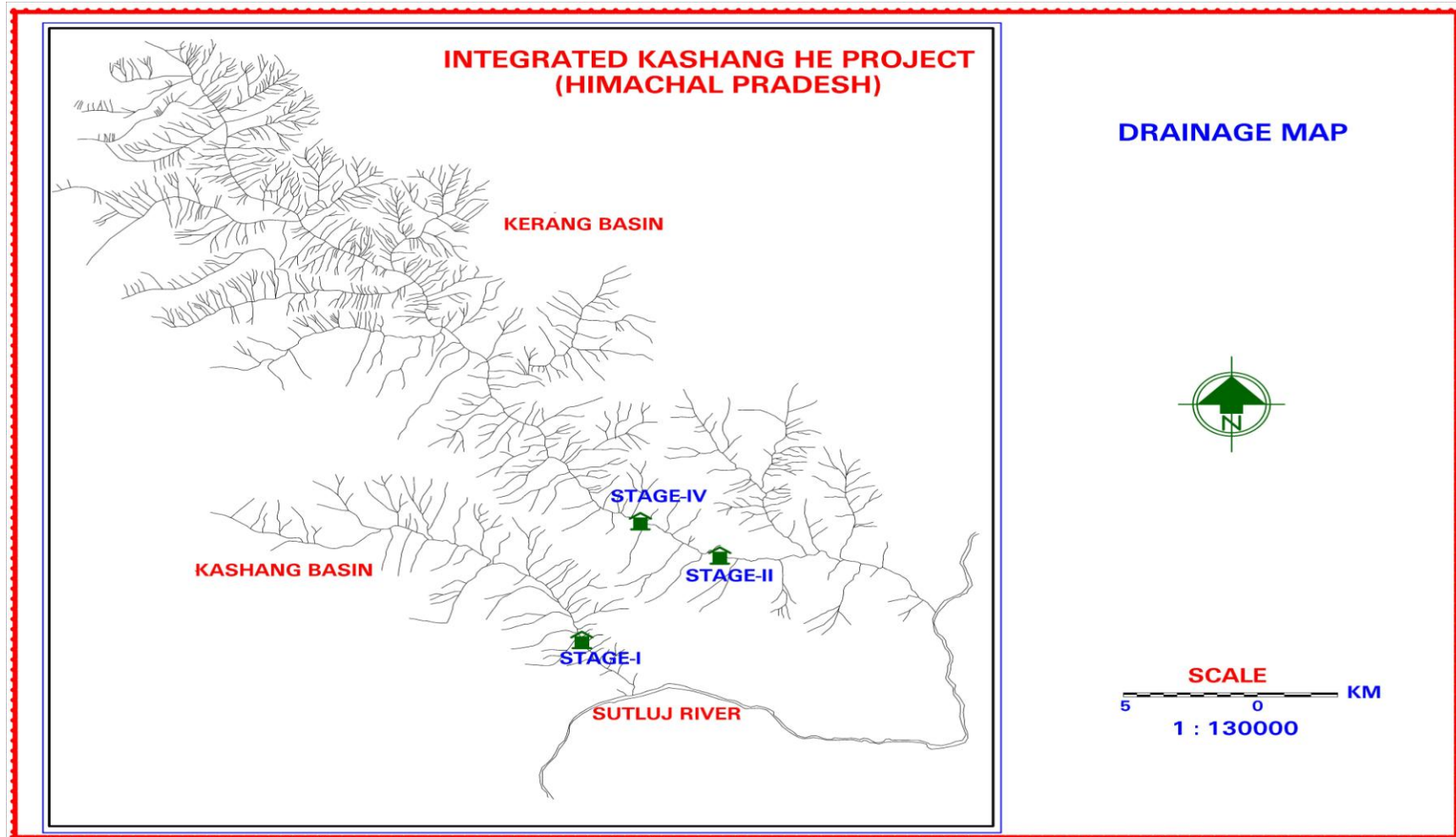


Figure 1.8: Drainage Map of Integrated Kashang HEP



1.5 SOIL

The soil in the area belongs to Soil of Greater Himalayas. The soil of summit and ridge tops and glacier valleys are shallow, excessively drained, sandy-skeletal soil with severe erosion. Taxonomically, such soils belong to sub order-Otrthents; Great group-cryorthents and sub group-Lithic cryorthents.

The soils of side/reposed slope belong to sub group Typic Cryorthents and are medium deep (50-100 cm) excessively drained, loamy skeletal, calcareous soil on very steep group with loamy surface, severe erosion. At some places the soil belongs to sub group Lithic cryorthents and are shallow, coarse loamy calcareous soil on steep slope with loamy surface associated with severe erosion and strong stoniness. The fluvial valley, which extends to some distance in Kerang Khad, shows loamy skeletal soil belonging to Typic Eutrochrepts sub group. The soils are medium deep (50-100 cm), mesic, loamy skeltical on very gentle slopes and have moderate erosion. The soil map of catchment is presented in **Figure 1.9**.

1.6 METHODOLOGY USED FOR THE STUDY

The Digital Satellite data of IRS P6 LISS-III (2006) acquired from NRSA was evaluated on ERDAS Imagine Software. The standard False Colour Composite (FCC) has been generated by assigning blue, green and red colors 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 of the directly draining catchment area were used for the purpose of geo-referencing. A large number of Geodetic Control Points (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 level range and to optimize the contrast, 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, color/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 color/tone and texture depends upon the brightness, contrast and resolution of the image. Various land units were identified, delineated and the map was validated.

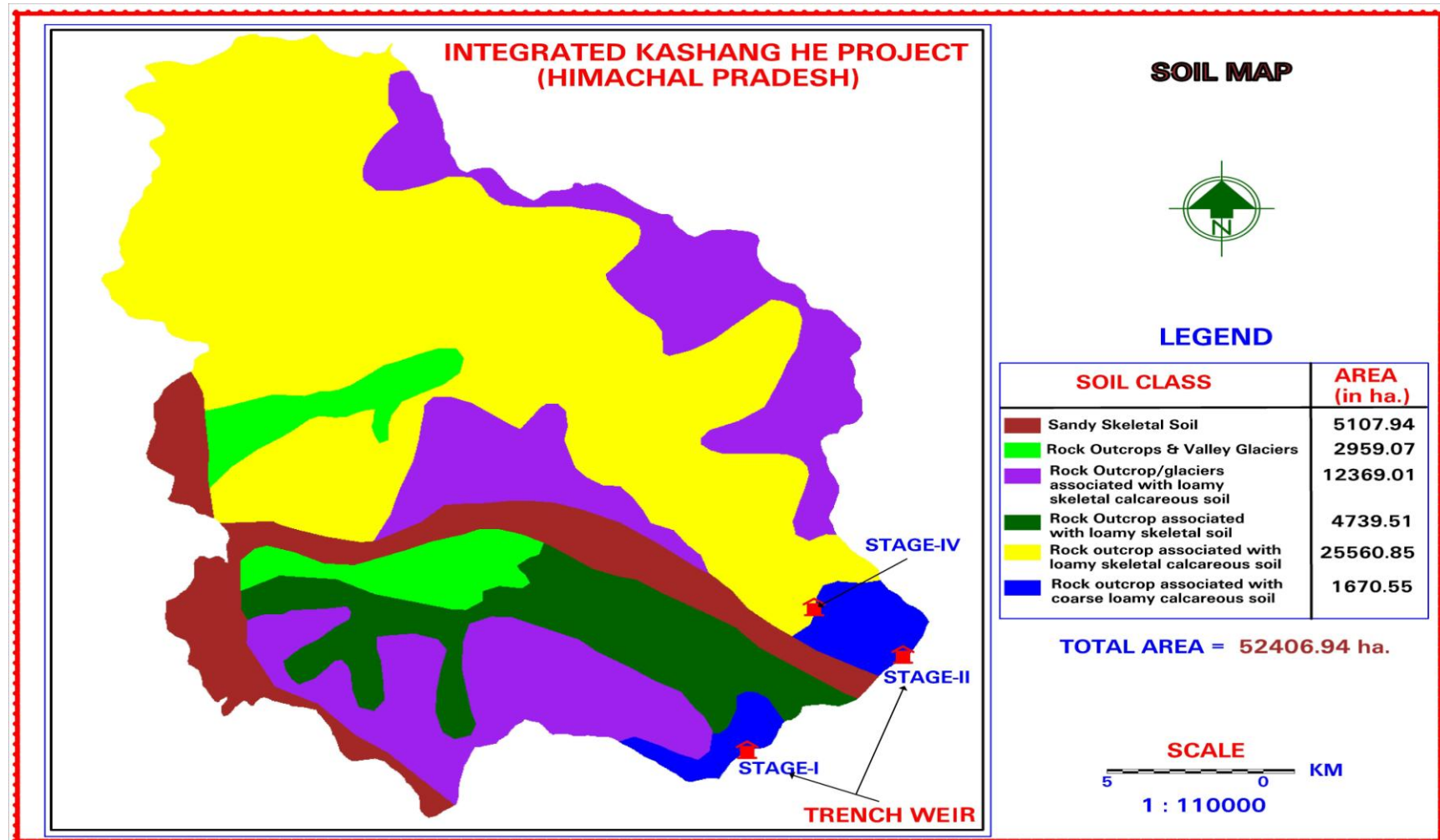


Figure 1.9: Soil Map of Free Draining Catchment Area of Integrated Kashang HEP



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 physiography, land-use/land-cover, lithology, geomorphological structure, drainage pattern, slope characteristics, landslides/slips, etc. These data sets were used for preparation of the thematic maps, calculation of sediment yield index and Erosion Intensity Units in the catchment area according to the following procedures:

1.6.1 Landuse - Landcover Classification

- Prior to ground truthing, the satellite data was classified using unsupervised classification technique. Further after collecting ground truth details maximum likelihood classification based 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.
- Reclassification of the land-use categories implementing the details and corrections was done. The reclassification output was used for the preparation of the final land-use classification map. This map after due verification was then composed and printed for different layers and purposes.
- The Landuse map of Study and Free draining Catchment area is presented in **Figure 1.10**. The Land-use Land-cover details for free-draining catchment and its sub watershed is presented in **Table 1.2**.

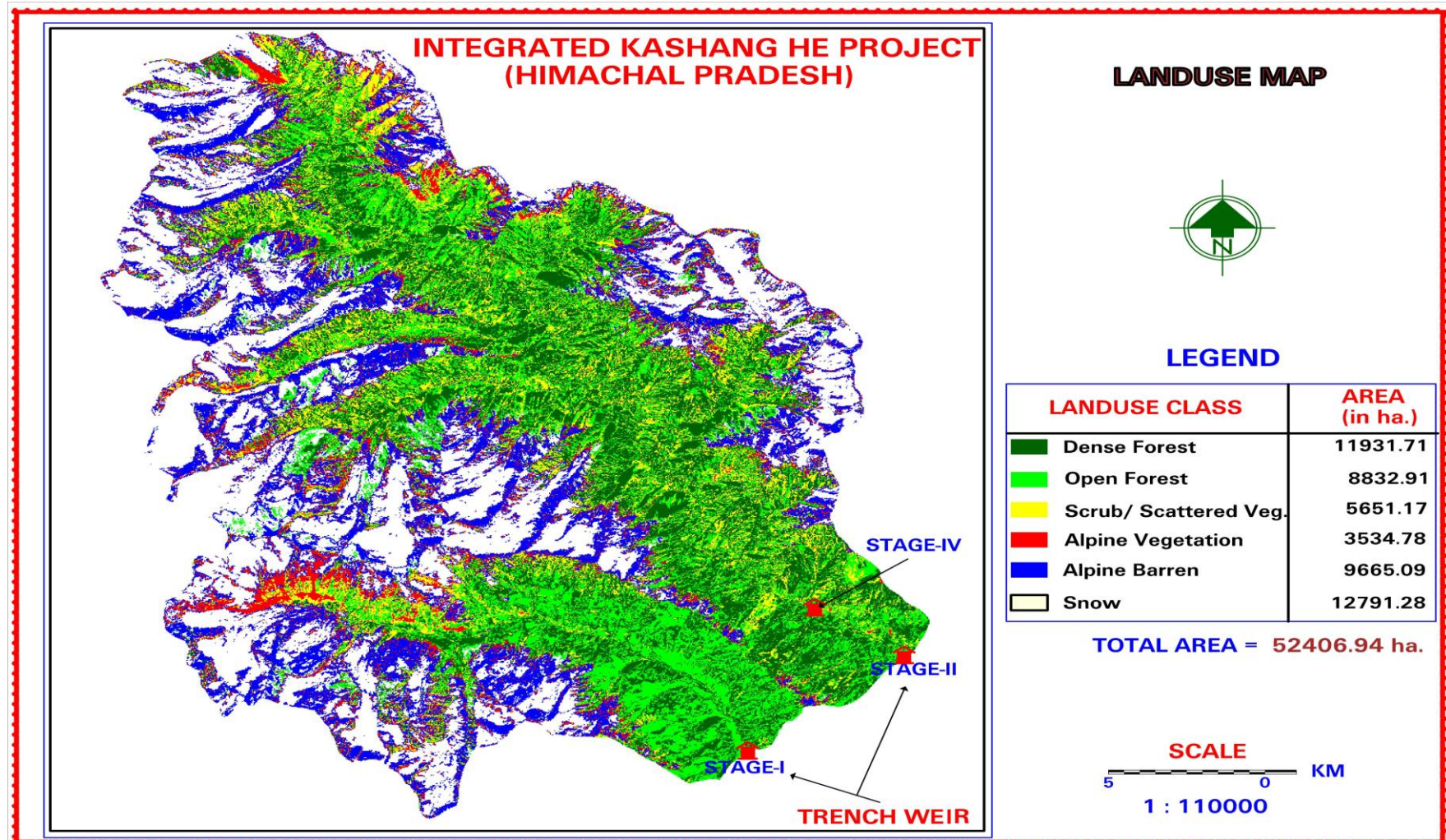


Figure 1.10: Land Use Map of Free Draining Catchment Area of Integrated Kashang HEP



Table 1.2: Land-use Land-cover Details

S. No.	Sub Watershed / Micro Watershed	Land Use/ Land Class, sq km						Total Area, sq. km.	% of sub-watershed
		Dense Forest	Open Forest	Scrubs / scattered vegetation/ agriculture	Alpine vegetation	Alpine Barren	Snow/ Glacier		
Kashang									
1.	1A2C5(1)	6.98	7.33	7.06	10.19	24.37	30.42	86.85	70.02
2.	1A2C5(2)	14.81	19.84	1.73	0.40	0.36	0.04	37.18	29.98
Total Sub-watershed (Kashang)		21.79	27.17	8.79	10.59	24.73	30.96	124.03	100.00
Kerang									
1.	1A2C5(3)	42.58	32.71	30.72	23.76	70.00	95.78	295.55	73.88
2	1A2C5(4)	54.96	28.45	17.00	0.99	1.92	1.17	104.49	26.12
Total Sub-watershed (Kerang)		97.54	61.16	47.72	24.75	71.92	96.95	400.04	100.00
Grand Total		119.33	88.86	56.51	35.25	96.65	127.91	524.07	

1.6.2 Slope Map Preparation

- Slope is a measure of change in the value of altitudes over distance, which can be expressed in degrees or as a percent. 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 “Integrated Kashang Hydroelectric 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 points contours in form of x, y and z points (x, y location and z their elevation). All this information was in real world coordinates (latitude, longitude and elevation in meters above sea level).
- A Digital Terrain Model (DTM) of the area was then prepared, which was used to derive a slope map. The slope was divided in classes of slope percentages.
- The slope of a watershed plays an important role in controlling the 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 segments of the watershed into suitable capability classes for formulating suitable soil erosion conservation measures. Broadly the following slope classes and ranges as per norms of All India Soil and Land Use Survey (AISLUS) were adopted for the present study. The slope types are presented in **Table 1.3**.

Table 1.3: Slope Types

Slope Rank	Slope Range (%)	Description
1.	0-35	Gentle slope
2.	35-50	Moderate slope
3.	50-65	Moderate to high slope
4.	65-75	High slope
5.	Above 75	Very high slope

The slope map of the free draining catchment is presented in **Figure 1.11**. The slope details are as presented in **Table 1.4**.

Table 1.4: Slope

S. No.	Sub Watershed / Micro Watershed Code	Slope										Total (Area in Sq km)
		0-35%		35-45%		45-55%		55-80%		>80%		
		Area	%	Area	%	Area	%	Area	%	Area	%	
Kashang												
1.	1A2C5(1)	53.26	61.32	14.57	16.78	11.48	13.22	5.39	6.21	2.15	2.47	86.85
2.	1A2C5(2)	14.67	39.46	13.37	35.96	7.18	19.31	1.82	4.90	0.14	0.37	37.18
Total Sub-watershed (Kashang)		67.93	54.77	27.94	22.53	18.66	15.05	7.21	2.81	2.29	1.84	124.03
Kerang												
1.	1A2C5(3)	139.97	47.36	102.31	34.62	42.39	14.34	5.02	1.70	5.86	1.98	295.55
2	1A2C5(4)	36.15	34.60	37.48	35.87	24.25	23.21	5.60	5.36	1.01	0.96	104.49
Total Sub-watershed (Kerang)		176.12	44.03	139.79	34.94	66.64	16.66	10.62	2.65	6.87	1.72	400.04
Grand Total		244.05	46.57	167.73	32.00	85.30	16.28	17.83	3.40	9.16	1.75	524.07

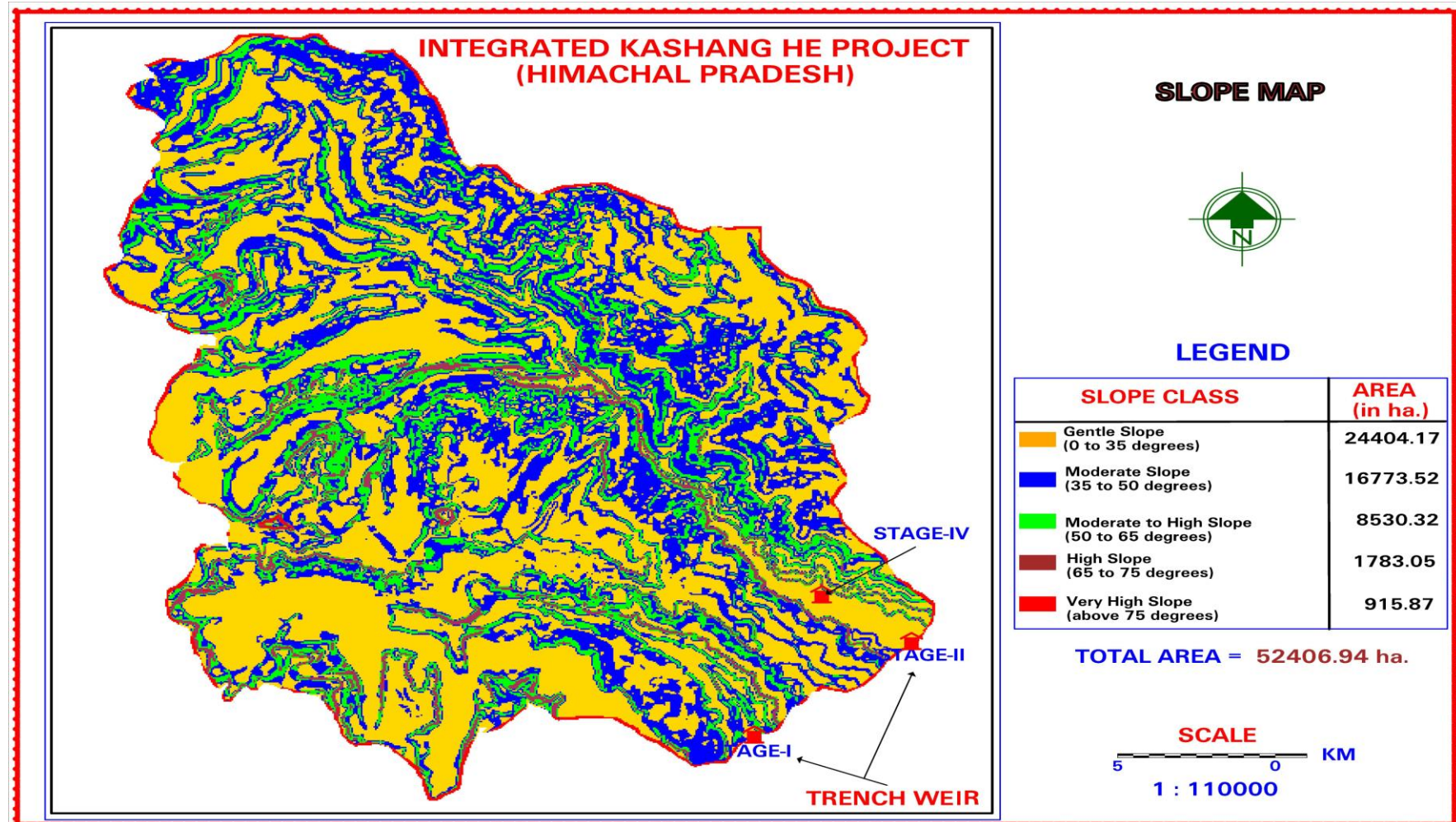


Figure 1.11: Slope Map of Free Draining Catchment Area of Integrated Kashang HEP



1.6.3 Soil Loss Using Silt Yield Index (SYI) Method

- The Silt Yield Index Model (SYI), considering sedimentation as product of erosivity, erodibility and aerial extent was conceptualized by 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 the calculation of sediment yield index developed by All India Soil and Land Use Survey (Department of Agriculture, Govt. of India) was followed in this study.

1.6.3.1 Erosion Intensity and Delivery Ratio

- Determination of erosion intensity unit is primarily based upon the integrated information on soil characters, physiography, slope, landuse/land-cover, lithology and structure. This is achieved through superimposition 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. The composite map for delineating different erosion intensity units was prepared through superimposition of the maps showing soil types, slope and land-use/landcover.
- This thematic mapping of erosion intensity for entire catchment was done using the overlay and union techniques. Based on ground truth conducted during field work and published data, weightage and delivery ratio was assigned to each erosion intensity unit. The composite erosion intensity map was then superimposed on the drainage map with sub-watershed boundaries to evolve Composite Erosion Intensity Unit (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 indicates 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 ratios to the erosion intensity units were assigned upon their distance from the nearest stream (being the most important factor responsible for delivery of the sediments) according to the following scheme. The delivery ratio criteria adopted for the study is presented in **Table 1.5**.

Table 1.5: Delivery Ratio (DR) Criteria Adopted for the Project
Nearest Stream Delivery Ratio (DR)

Sl. No.	Nearest Stream Distance (Km.)	Delivery Ratio
1.	0 - 0.9	1.00
2.	1.0 - 2.0	0.90
3.	2.1 - 5.0	0.80
4.	5.1 - 15.0	0.70
5.	15.1 - 30.0	0.50

1.6.3.2 Sediment Yield Index (SYI) and Prioritization of Sub-Watersheds

- The erosivity determinants are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the unit of the detached soil material. The relationship can be expressed as Sediment Yield Index (SYI).
- The SYI is defined as the Yield per unit area and SYI value for hydrologic unit is obtained by taking the weightage arithmetic mean over the entire area of the hydrologic unit by using suitable empirical equation.
- Prioritization of Watersheds/ Sub-watersheds within the vast catchments is based on the (SYI of the smaller units. The boundary values or range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating the suitable breaking points. The watersheds/sub watersheds are subsequently rated into various categories corresponding to their respective SYI values.
- Keeping in view the above explanations, 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.



- The data on climatic factors were obtained for different locations in the catchment area from the meteorological station whereas the field investigations were carried for estimating the other attributes.
- The various steps involved in the application of model are
 - Preparation of a framework of sub-watersheds through systematic delineation
 - Rapid reconnaissance surveys on 1:50,000 scale leading to the generation of a map indicating erosion-intensity mapping units.
 - 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.
 - Assignment of weightage values to various mapping units based on relative silt-yield potential.
- 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 = $\sum (A_i \times W_i \times D_i) \times 100 / A_w$, where $i = 1$ to n

Where,

A_i = Area of i th unit (EIMU)

W_i = Weightage value of i th mapping unit

D_i = Delivery ratio

n = No. of mapping units

A_w = Total area of sub-watershed

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

Sl. No.	Priority Category	SYI Range
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-9)

Accordingly after excluding the area of snow/glaciers from the total geographical area of micro watersheds to the Sediment Yield Index (SYI) was calculated for 4 micro-watersheds and they were categorized into five erosion ranking classes i.e., very High, High, moderate, and low according to priorities. These prioritized watersheds would require treatment according to their priority ranking for soil conservation measures. The details are given in **Table 1.6**.



Table 1.6: Sediment Yield Index and Priority Rating as per Erosion Intensity

MWS Code	Erosion Intensity Class	Area, ha.	Weightage	Weightage x Area	DR	Grass Silt (EXF)	SYI	Priority
A	B	C	D	E	F	G	H	I
1A2C5(1)	Negligible	611.13	10.0	6111.30	1.0	6111.30	1050.0	Low
	Slight	1742.27	11.0	19164.97	0.9	17248.47		
	Moderate	721.09	13.0	9374.17	0.9	8436.75		
	Severe	65.62	18.0	1181.16	0.9	1063.04		
	Very Severe	14.67	20.0	293.40	0.9	264.06		
	Total	3154.78						
1A2C5(2)	Negligible	1386.08	10.0	13860.80	1.0	13860.80	1069.0	Low
	Slight	2008.31	11.0	22091.41	1.0	22091.41		
	Moderate	276.43	13.0	3593.59	0.9	3234.23		
	Severe	15.74	18.0	283.32	0.8	226.66		
	Very Severe	0.00	20.0		0.8	0.00		
	Total	3686.56		20914.90				
1A2C5(3)	Negligible	2091.49	10.0	66093.61	1.0	20914.90	1135.0	Medium
	Slight	6008.51	11.0	42001.70	0.9	59484.25		
	Moderate	3230.90	13.0	21863.88	0.9	37801.53		
	Severe	1214.66	18.0	10529.60	0.9	19677.49		
	Very Severe	526.48	20.0		1.0	10529.60		
	Total	13072.04						
1A2C5(4)	Negligible	2430.84	10.0	24308.40	0.9	21877.56	1121.0	Medium
	Slight	4339.86	11.0	47738.46	0.9	42964.61		
	Moderate	2084.02	13.0	27092.26	0.9	24383.03		
	Severe	744.72	18.0	13404.96	1.0	13404.96		
	Very Severe	564.07	20.0	11281.43	1.0	11281.40		
	Total	10163.51						
Note:- Total area under micro watershed does not include the area under permanent snow/glaciers.								



1.7 CATCHMENT AREA TREATMENT PLAN

It is well known fact that there are mainly five categories of land uses around which a proper treatment plan need to be developed and factors pertaining to agricultural land always have an edge over all of them and can never be eliminated. Agricultural practices/ activities, if faulty, result in heavy losses of fertile soil. Second in the category being open forest land in particular follows for obvious conservation reasons. Scrub or degraded lands, which contributes heavily to the silt load and possibilities exists to bring this area under pastures and other plantation to meet the local demand of fuel, fodder and NTFP and thus decreasing the 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 in at few places soil conservation measures are required. For treatment of catchment, the areas that require treatment have been delineated from the Composite Erosion Intensity Unit Map. The sum of weightages was reclassified as per the **Table 1.7** below to further subdivide the area as per the erosion intensity classes. The Weightages for Landuse, Slope and Soil were summed to get the Erosion Intensity Classes.

Table 1.7 Erosion Intensity and Weightages

Erosion Intensity Class	Sum of Weightages
Very severe (E5)	12 to 14
Severe (E4)	9 to 11
Moderate (E3)	6 to 8
Low (E2)	4 to 5
Negligible (E1)	0 to 3

The vulnerability of catchment in terms of soil erosion intensity is presented in **Figure 1.12** and the statistics is presented in **Table 1.8**.

Table 1.8: Erosion Intensity Categories in Micro Watershed

Sl. No.	Sub-watershed	Erosion Intensity Class / Area in ha					Total Area Ha
	MWS Code	Negligible	Slight	Moderate	Severe	Very Severe	
Sub Watershed Kashang							
1.	1A2C5(1)	611.12	1742.27	721.09	65.62	14.67	3154.77
2.	1A2C5(2)	1386.08	2008.31	276.43	15.74	0.00	3686.56
Total S.W. Kashang		1997.20	3750.58	997.52	81.36	14.67	6841.33



Sub Watershed Kerang							
1.	1A2C5(3)	2091.49	6008.51	3230.90	2084.02	526.48	13941.40
2.	1A2C5(4)	2430.84	4339.86	1214.66	744.72	564.07	9294.15
Total S.W. Kerang		4522.33	10348.37	4445.56	2828.74	1090.55	23235.55
Grand Total		6519.53	14098.95	5443.08	2910.10	1105.22	30076.88

The two micro watershed viz. 1A2C5(1) and 1A2C5(2) falling under the sub watershed Kashang have been categorized as low priority on the basis of SYI and have 81.36 ha and 14.67 ha area under severe and very severe erosion intensity class. The other two micro-watershed viz. 1A2C5(3) and 1A2C5(4) falling under the sub-watershed Kerang have been categorized as medium priority on the basis of SYI and have 2828.74 ha and 1090.55 ha area under severe and very severe erosion intensity class. The erosion intensity map of Kashang and Kerang sub watershed is shown in **Figure 1.13** and **Figure 1.14**.

In the light of the fact that MoEF, New Delhi, vide its letter dated 15-11-2002, has already accorded environment clearance for erstwhile Kashang hydroelectric project to be built in sub watershed Kashang and as per their instruction dated 12-12-2007 regarding incorporating of CAT plan of the erstwhile Kashang HEP (now Stage-I) in the new EMP for the integrated project, the provision of earlier approved CAT plan for Stage-I shall be made mutatis mutandis integral part of the present CAT plan involving sub watershed Kerang, too. Areas which are inaccessible i.e. areas with more than 55 degree slope, and area under permanent snow / glaciers and areas above tree line having natural eco-system with little human interference shall be excluded to arrive at those areas where appropriate treatment measures can be undertaken.

1.7.1 Erosion and Landuse

The 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. The soil and land use maps of sub watershed Kashang are presented in **Figure 1.15** and **Figure 1.16**. The soil and land use map of sub watershed Kerang are presented in **Figure 1.17** and **Figure 1.18**.

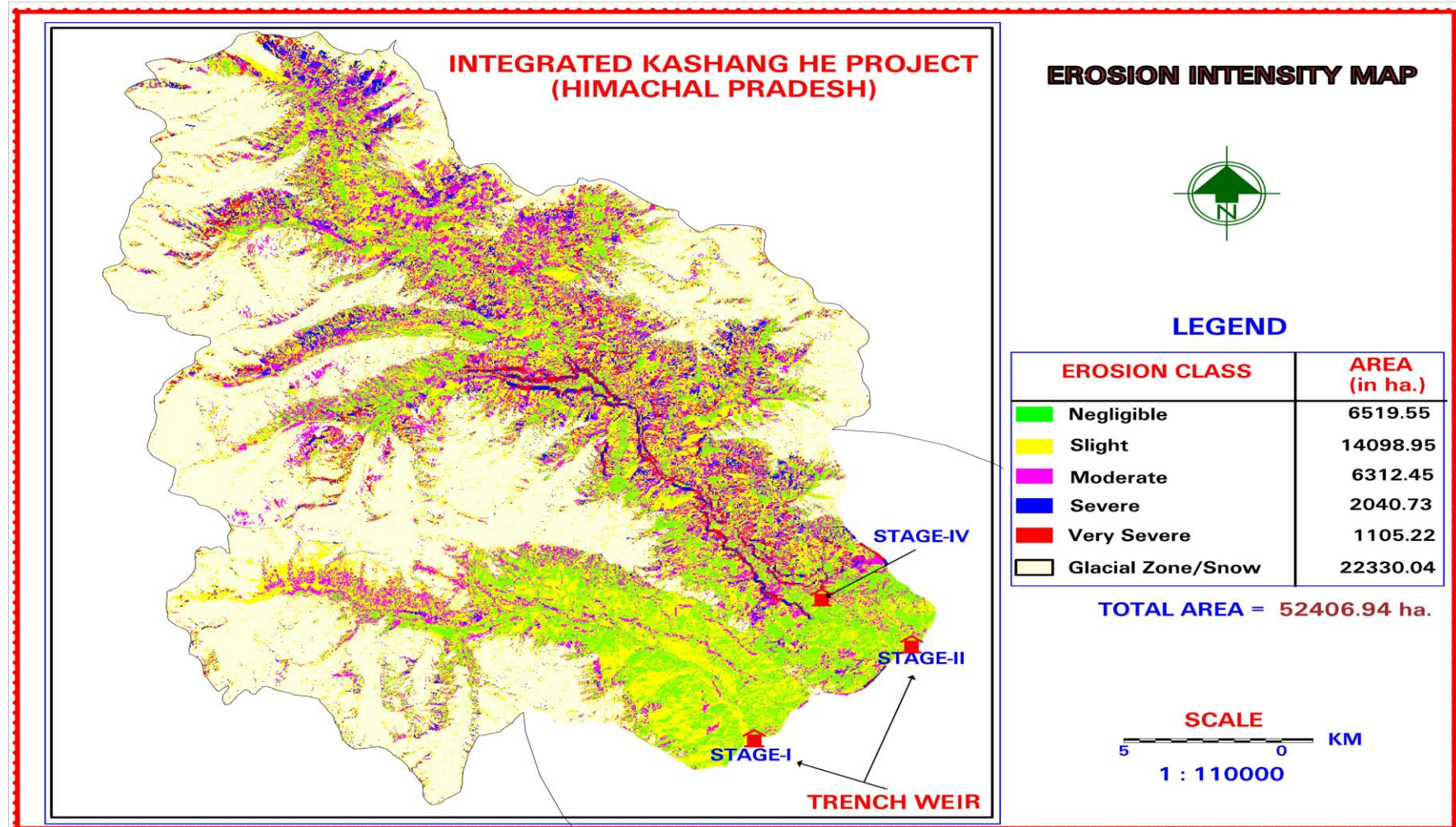


Figure 1.12: Erosion Intensity Map of Free Draining Catchment Area of Integrated Kashang HEP

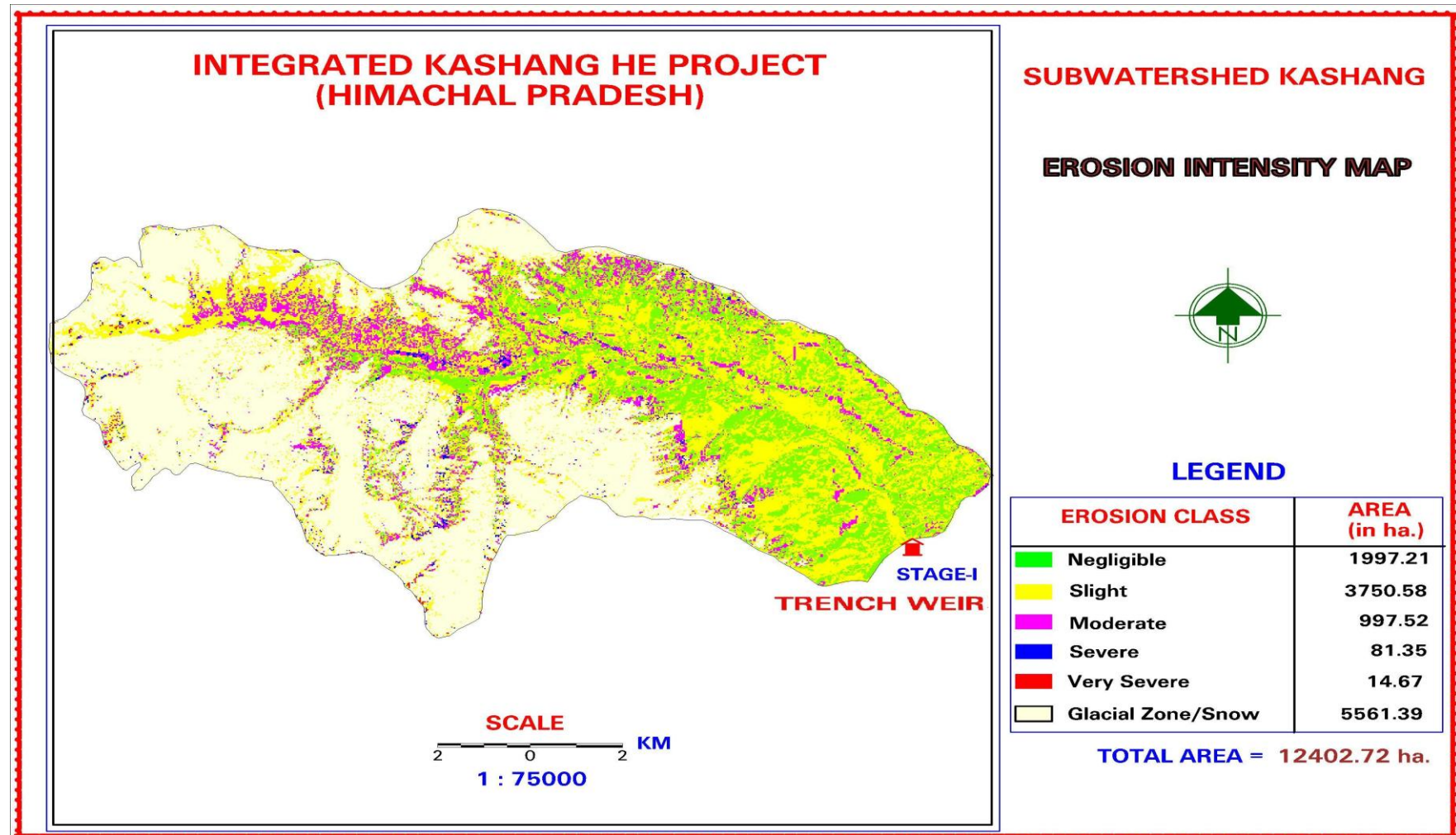


Figure 1.13: Erosion Intensity Map of Sub-Watershed Kashang

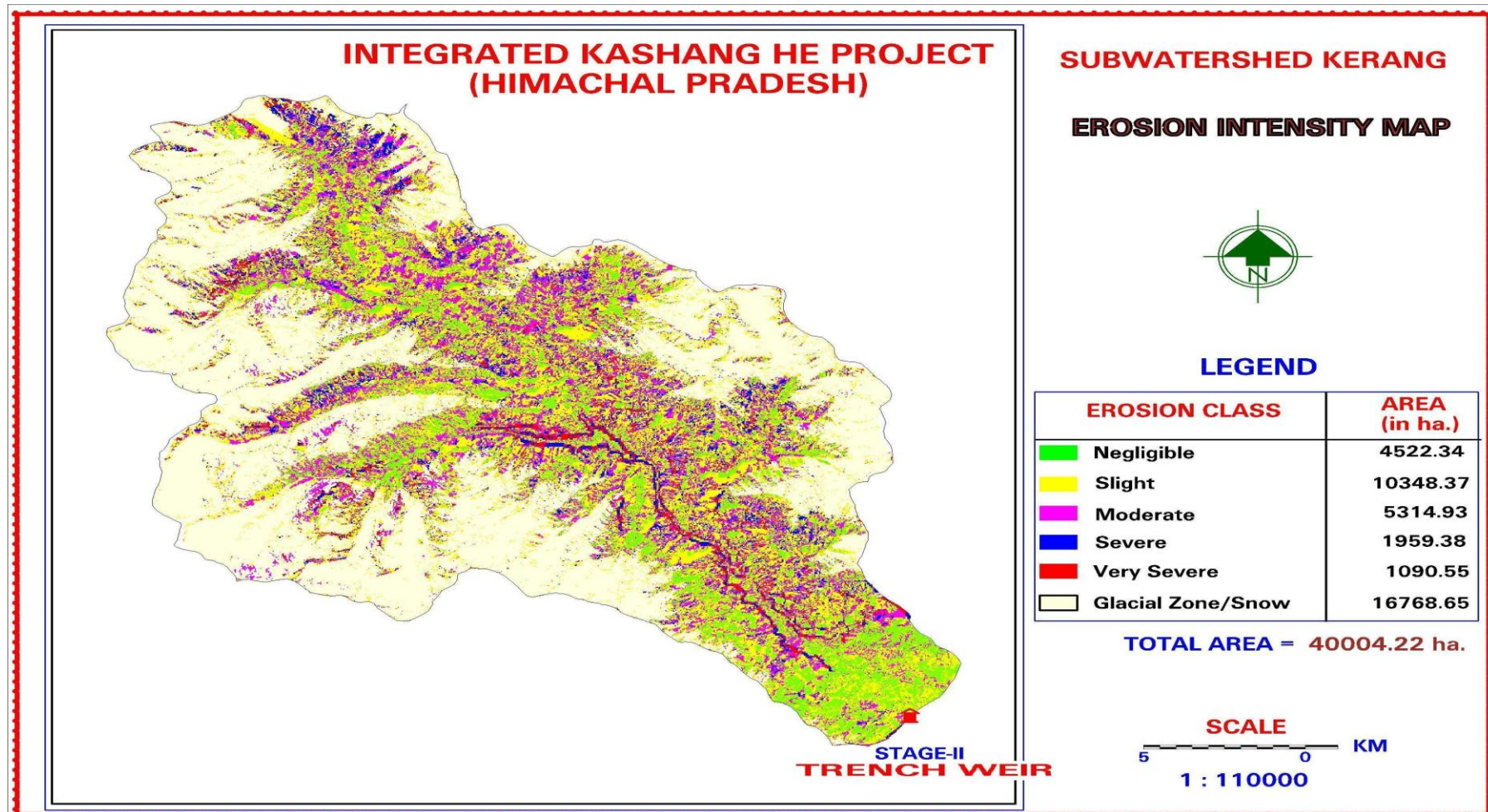


Figure 1.14: Erosion Intensity Map of Sub-Watershed Kerang

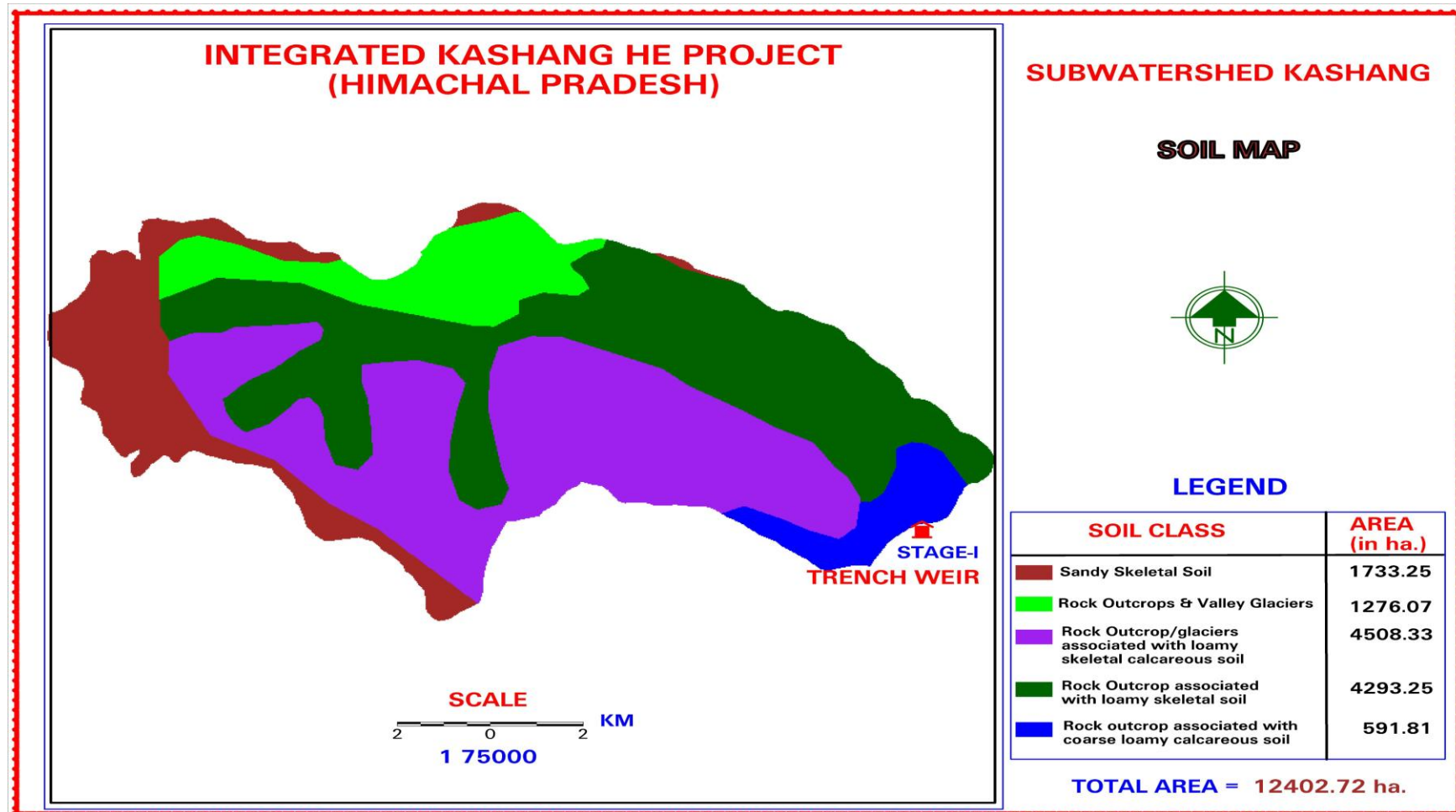


Figure 1.15: Soil Map of Sub-Watershed Kashang

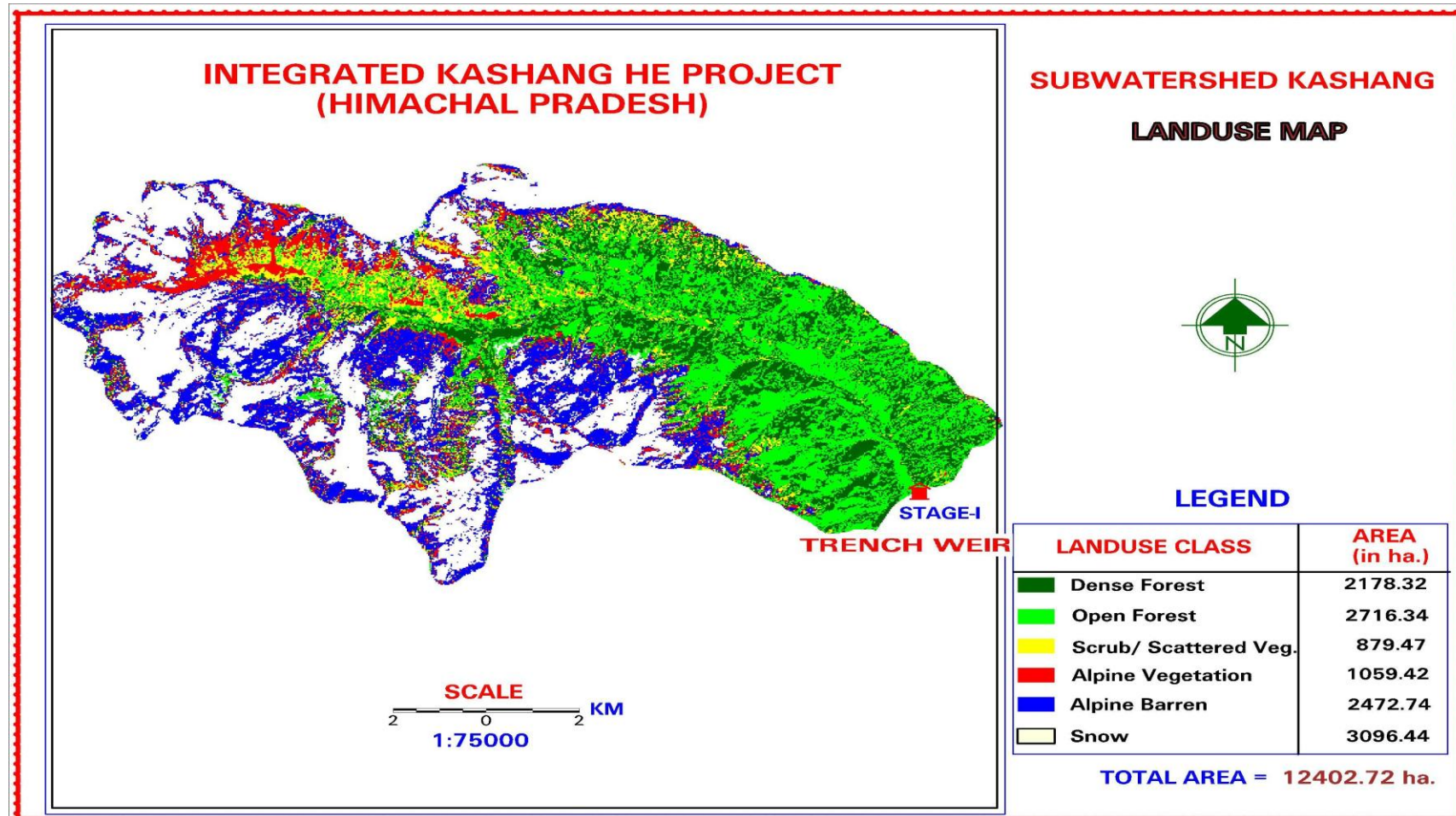
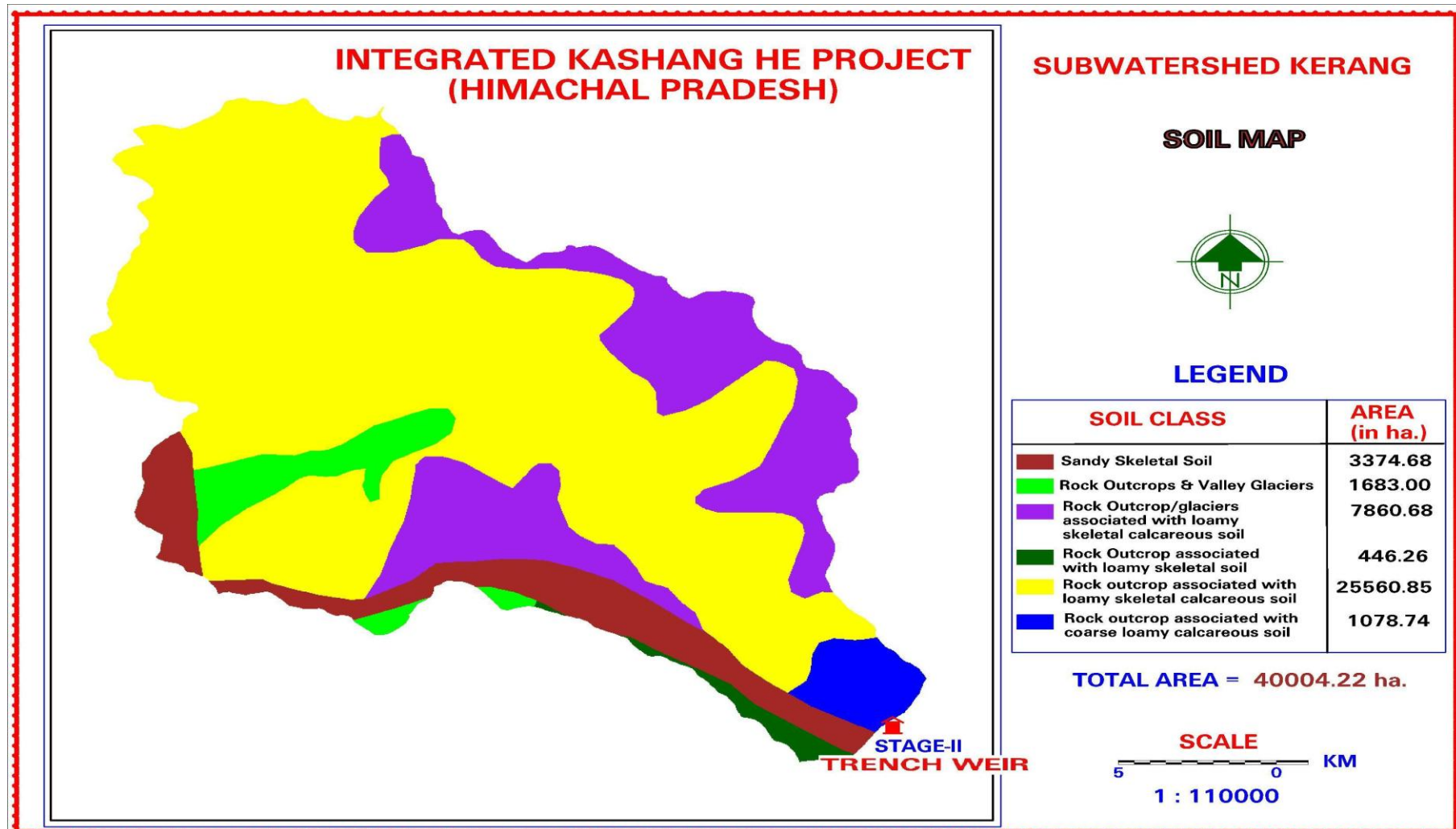


Figure 1.16: Landuse Map of Sub-Watershed Kashang



1.17: Soil Map of Sub-Watershed Kerang
Chapter-1: Catchment Area Treatment Plan

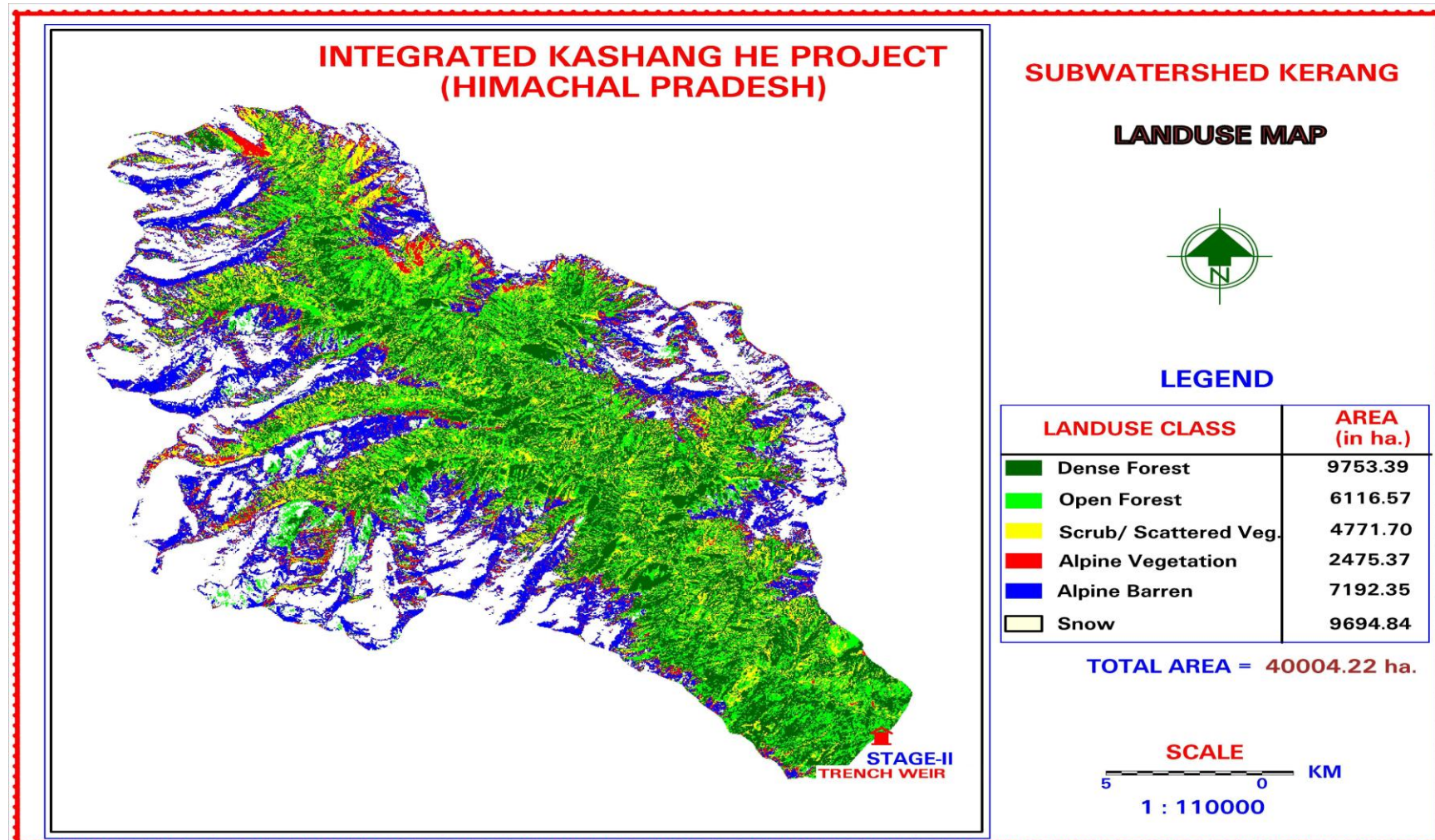


Figure 1.18: Land Use Map of Sub-Watershed Kerang



1.7.1.1 Scrub / Scattered Vegetation / Agricultural Land

About 879.47 ha and 4771.7 ha areas pertaining to sub- watersheds of Kashang and Kerang, respectively constituting about 7.1% and 11.9% area forming their free-draining catchment comes under this category. In the free draining catchment well-planned and developed terraces were seen only in the areas under the apple orchards. Almost 30% of the terraces are properly stabilized by using the stones which itself will manage to reduce the erosion. In general at places the sheet and rill type of soil erosion predominates with few gullies in early stage of its development. Very few measures have been undertaken by the Forest Deptt. in respect of conserving soil of scrub / scattered vegetating area under their control. In agriculture areas 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 improve and alter the design of agricultural terraces, which mostly follow the faulty agricultural practices. It is more required in view of allotment of govt. land to villagers for raising orchards.

Agroforestry practices proposed to be introduced and contour hedgerow technology of agricultural practice need to be followed. Temporary and semi permanent soil conservation structures like brushing dams, wiring woven dams, gabion check dams etc. are also suggested.

1.7.1.2 Barren Areas

Under the waste land category sub watersheds Kashang and Kerang have 2482.74 ha and 7192.35 ha areas i.e. about 20% and 18% respectively of their free draining catchment. 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. Most of these areas are in upper reaches of sub watershed therefore, only engineering measures are proposed.

1.7.1.3 Alpine Vegetation

Around 1059.42 ha and 2475.37 ha area respectively in sub watershed Kashang and Kerang constitute under this land-use category in their free draining catchment. These areas (LPG 60-120 days) exist in the upper reaches are characterized by highly degraded land surface. Very little and only seasonal vegetation cover exists. Huge gullies, frequent land slips and high to extreme high erosion rates are other prominent features. Stream bank protection work is suggested for such land-use category undergoing erosion. Pasture plantation and natural rejuvenation can also be done/ convened.



1.7.1.4 Light Vegetation / Open Forest

Open forest area has a spread of 2716.34 ha and 6116.57 ha area of sub watershed Kashang and Kerang in their free draining catchment. Forest crown density ranges from 0-40% or on average 20% 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 high erosion rates on steeper slopes. Therefore, rill erosion predominates, which in due course leads to scrub lands formation with gullies. Plantation of the suitable species is suggested so as to increase the crown density by 20% in whole of the area.

1.7.1.5 Dense Vegetation

Dense vegetation covers about 2178.32 ha and 9753.39 ha areas i.e. 17.6% and 24.4% respectively of sub-watershed Kashang and Kerang in their free draining catchment. Forest crown density ranges above 40%. Soils are very good in water holding capacity, humus and nutrients with no erosion but due to steeper slopes small area requires soil conservation measures. Under this model only soil conservation measures have been proposed.

1.7.1.6 Snow Cover Areas

Snow cover / glaciers areas approximately cover 3096.44 ha and 9694.84 ha areas i.e. 25% and 24.2% respectively of sub watershed Kashang and Kerang. Neither any engineering nor any biological measures are possible and therefore, no conservation measures on these lines have been suggested.

1.7.2 Activities To Be Undertaken

1.7.2.1 Engineering Measure

- **Check Dams and Retaining Walls**

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 moderate to steep slopes would be subjected to bench terracing. The local people would be convinced to follow this type of terracing for comparatively better yield and with minimum threat to erosion. Moreover, in number of habitations in the catchment such practices are already visible. While making bench terraces, care will 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 1.5 m and cutting depth may be kept at 50 cm. The minimum average width of the terrace would be kept from 4 to 5 m in order to enable usage of prolong hinge. The shoulder bunds of 30 x 15 cm would also be provided. Staggered channels will drain off the excess water from the terraces.

- **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 condition comprised of different materials depending upon the site conditions and the easy availability of material (stones) at local level and transport accessibility. Consultant for such recommendation can be had for effective measures.

- **Stream Bank Protection**

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

- **Contour Staggered Trenches**

Contour staggered trenches are mainly provided to trap the silt, reduce runoff and improve percolation. This is also done to prepare a fertile base for plantation.

- **Landslides Control**

Rainfall pattern of the area, 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. Critical land slide zones would be identified and treated with a mix of biological and engineering measures.



- **Catch-water Drains**

Among the most effective, practical and least expensive measures of landslide hazard management is the construction of catch-water drains for run-off and surface waters in the identified hazard-prone zone so that no or little water is able to infiltrate into the ground. All the streams and minor water courses would be diverted around the crown of the slide or the potentially hazardous area through catch water drains with a adequate gradient. The catch water drain when provided avoids the 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 leveled out to eliminate all depressions where water can accumulate.

1.7.2.2 Biological Measures

- **Restoration of Degraded Areas**

In critically degraded areas, plantation of locally useful diverse and indigenous plant species such as timber plantation species, fodder species, conifers, fuel wood species, grasses, shrubs, legumes, medicinal and aromatic plants would be undertaken. For raising plantation, nurseries would be developed over a total area of 6 ha.

- **Afforestation**

This will include raising of multi-tier mixed vegetation 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 some vegetation cover by way of timber plantation.

- **Fodder Plantation**

To overcome the problem of scarcity of the fodder, it is proposed to bring a substantial area under fodder plantation with suitable fast growing species.

- **Plantation of Horticulture Crops**

Under this treatment plan suitable horticultural crop species like, apple, peach, rose apple and dry fruits like chilgoza, almond and walnuts shall be planted in select areas adjacent to the villages. These plants would be distributed to families residing in villages within the catchment with the objective of supplementing their income.



- **Pasture Development**

As there are degraded patches of pastures in the area, this measure will be adopted to encourage development of new and healthy pasture areas for the use of cattle rearers. Under this treatment suitable species of grasses and tree fodder, and leguminous plant species shall be planted in the land area earmarked for this purpose.

Effective fencing would also be provided for protection of saplings. Before any new area is taken up for plantation, etc., eradication of weeds and unpalatable grass species is equally important. It is recommended that some parts of the pastures should be closed for seeding purpose only.

- **Non-Timber Forest Produce (NTFP) Cultivation**

Taking the cognizance of Himachal Pradesh forestry sector Medicinal Plants Policy, 2006 and with a view to conserve and augment the state's rich medicinal plant resources in its natural habitat through adaptive and participatory management of the local people, cultivation of high priority medicinal plant species shall also be undertaken. Thrust shall be made to organic cultivation of medicinal plants, while recommending commercial cultivation of these species.

1.8 TREATMENT OF INDIVIDUAL SUB-WATERSHEDS IN FREE DRAINING CATCHMENT (EFFECTIVE) UNDER THE PROJECT

The area and type of treatment to be undertaken is based upon the stream drainage pattern, extent of forest cover, accessibility of the area, land-use, soil profile and slope. The areas with very severe erosion intensity having very steep slopes and which are inaccessible would be left alone for natural rejuvenation. Areas under high erosion intensity category also have been earmarked for treatment owing to local condition and degradation factors. The details of micro watershed-wise treatment measures are described below:

1.8.1 Micro Watersheds Rogle [1A2C5 (1)] and Dolo Dagri [1A2C5(2)]

These two micro watersheds comprise the Sub watershed Kashang. The free draining catchment area up to trench weir site at Dolo Dogri is 124.03 sq. km. The micro watershed Rogle, the upper catchment of the sub watershed Kashang has an area of 86.85 sq km and is shown in **Figure 1.19**. The predominant land use in this micro watersheds is snow/ glacier (30.92 sq km) followed by Alpine barren (24.375 sq km), Alpine vegetation (10.18 sq km) and open forest (7.33 sq km) etc. the area requiring treatment under very severe and sever erosion intensity is only 14.67 ha and 65.62 ha only.

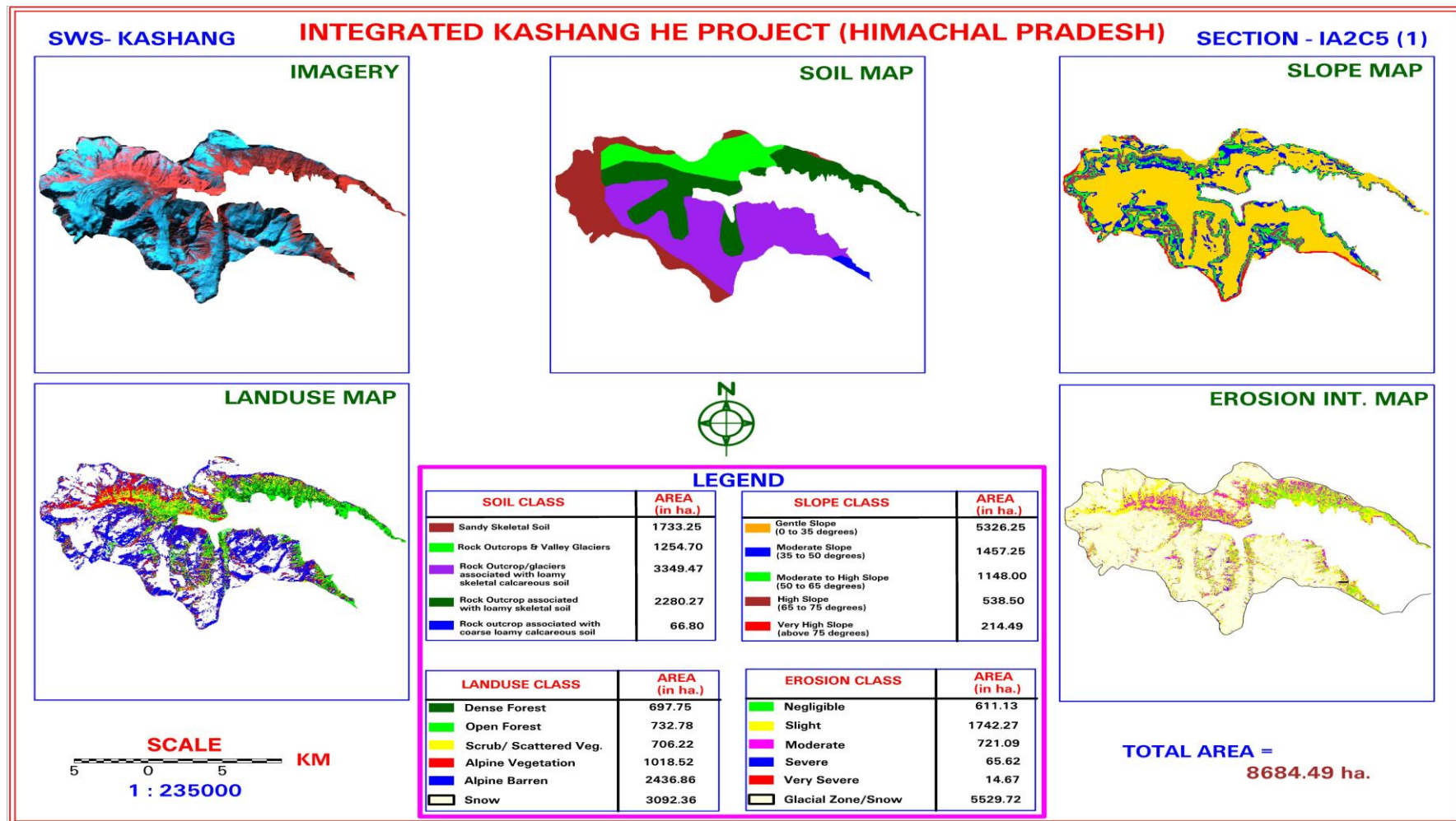


Figure 1.19: Thematic Maps of MWS 1A2C5(1) Under SWS Kashang



The micro watershed Dolo Dogri, the lower catchment of the sub watershed Kashang, has an area of 37.18 sq km and is shown in **Figure 1.20**. The predominant land use in this micro watershed is open forest (19.84 sq km) followed by dense forest (14.81 sq km), scrubs/scattered vegetation /agricultural land (1.73 sq km) and Alpine vegetation (0.41 sq km). The area requiring treatment under very severe and severe erosion category aggregate to 15.74 ha only.

1.8.1.1 CAT Plan of Erstwhile Kashang HEP (Now Stage-I)

It has already been pointed out that the MoEF vide its letter dated 15.11.2002, had already accorded environment clearance to the erstwhile Kashang HEP (now stage-I) and that vide its letter dated 12.12.07, while approving the ToR for the Integrated Kashang HEP (243 MW), it has directed that the CAT Plan of erstwhile Kashang HEP would be incorporated as such in the new EMP.

1.8.1.2 Provision under Erstwhile Kashang HEP CAT Plan

The CAT Plan under erstwhile Kashang HEP (now stage-I) has been prepared by the Forest Department for treatment of the degraded areas in catchment of Kashang khad under the plan 115 ha area has been proposed to be brought under afforestation @ Rs. 39,500 / ha besides pasture improvement of 75 ha @ Rs. 7,900/ ha. In addition to these establishment of a new nursery at Rakethi Khana for raising Deodar, Fir, Betula species and extension/ maintenance of existing nurseries at Akpa, Kalpa, Pangi, Boldoo and Peo. Besides biological measures, soil conservation works involving treatment of slips/ nallahs as have also been proposed with overall cost of Rs. 160 lacs. A provision of Rs. 10.00 lacs has also been made for wild Life Management.

The break up of the estimated cost under different work/ activities is summarized in the following **Table 1.9**.

Table 1.9: Summary of Finance for the CAT Plan

S. No	Year	Nursery (Rs lac)	Soil Conservation (Rs lac)	Afforestation (Rs lac)	Pasture Improvement (Rs lac)	Contingency / Office expenditure (Rs lac)	Wild Life Management (Rs lac)	Total (Rs lacs)
1.	2001-02	15.00	35.00	0.00	0.00	6.00	-	56.00
2.	2002-03	6.00	40.00	5.925	2.765	2.50	-	57.19
3.	2003-04	5.00	30.00	13.530	3.545	2.50	5.00	59.575
4.	2004-05	4.00	15.00	26.165	0.685	2.50	5.00	53.35
5.	2005-06	2.00	40.00	14.830	0.420	2.50	-	59.75
6.	2006-07	1.00	0.00	7.200	0.160	-	-	8.360
7.	2007-08	0.00	0.00	4.395	0.00	0.00	0.00	4.395
8.	2008-09	0.00	0.00	2.795	0.00	0.00	0.00	2.795
9.	2009-10	0.00	0.00	1.820	0.00	0.00	0.00	1.820
10.	2010-11	0.00	0.00	0.390	0.00	0.00	0.00	0.390
	Total	33.00	160.00	77.050	7.575	16.00	10.00	303.625

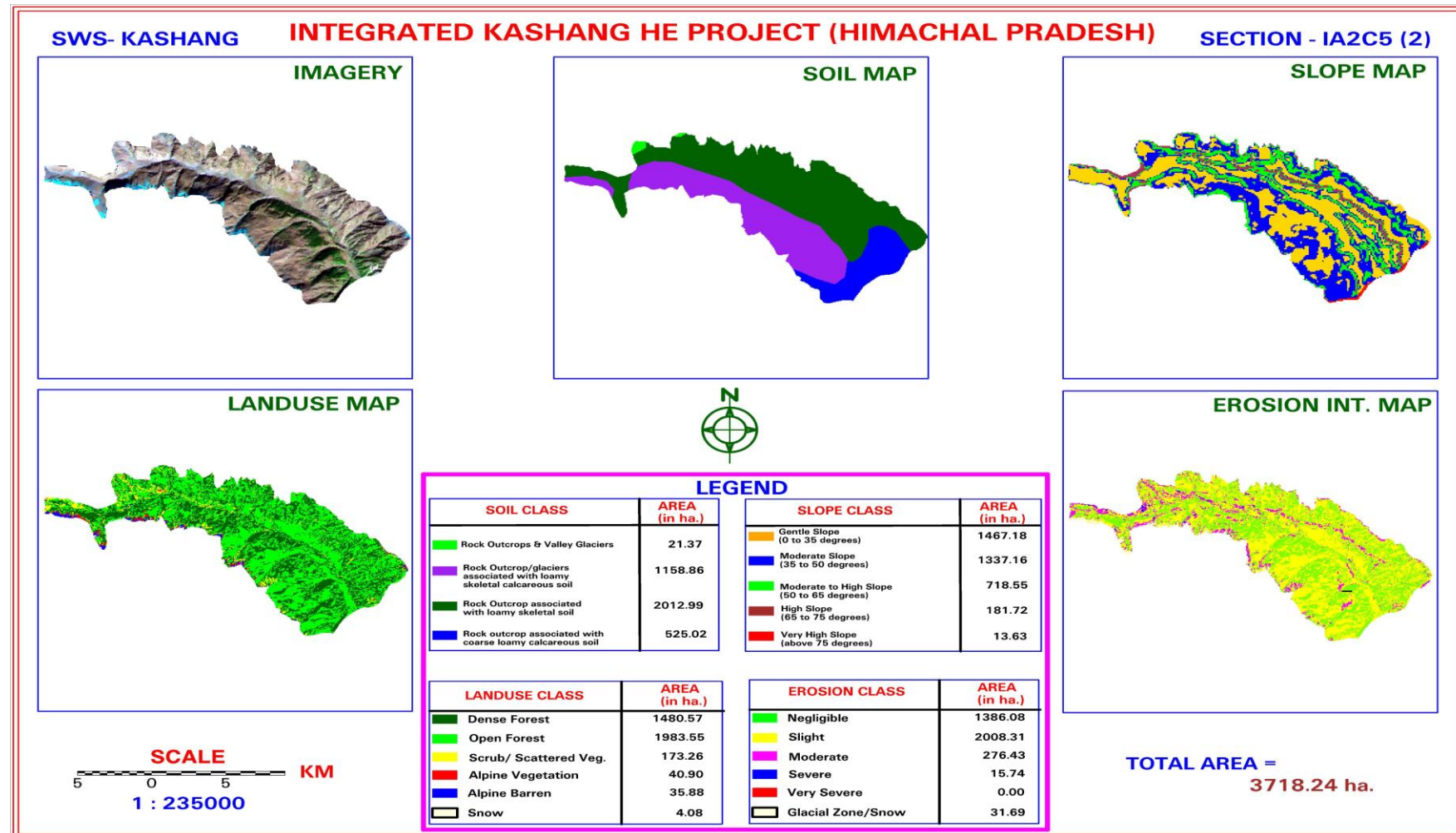


Figure 1.20: Thematic Maps of MWS 1A2C5(2) Under SWS Kashang



1.8.1.3 Progress Achieved under CAT Plan of Erstwhile Kashang HEP

The project proponent have stated to have deposited, by end of March 2008, a sum of Rs 175 lacs in CAMPA against the estimated CAT Plan cost of Rs 303.625 lacs. The work under the CAT plan is being carried out under the administrative control of Rampur Forest Circle.

The progress of work carried out under the CAT Plan during the Financial Year 2005-06 and 2006-07 has been gathered from the office of Project Officer-cum-D.F.O, Kinnaur Forest Division and is being summarized under various head of activities in **Table. 1.10**.

Table 1.10: Progress of Work under CAT Plan of Erstwhile Kashang HEP

S. No.	Components	Year 2005-06		Year 2006-07		Total	
		Physical	Financial (Rs. lac)	Physical	Financial (Rs. lac)	Physical	Financial (Rs. lac)
A.	Nurseries						
(i)	Establishment of new nursery	1 ha	7.0	-	-	1 ha	7.00
(ii)	Improvement/ Extension of old Nurseries	0.7 ha	1.50	-	-	0.7 ha	1.50
(iii)	Maintenance of old Nurseries	4 No	4.50	6	6.50	10 No	11.00
B.	Soil Conservation works	12 No	11.61	-	14.647	-	26.257
C.	Afforestation						
(i)	New Plantation	5 ha	1.975	5 ha	1.975	10 ha	3.95
(ii)	Maintenance	-	-	5 ha	0.560	5 ha	0.56
D.	Pasture Improvement	-	-	-	-	-	-
E.	Improvement operational		4.025	-	1.709	-	5.734
	Total		30.61		25.391		56.001

1.8.1.4 Balance Works under CAT Plan of Erstwhile Kashang HEP

The balance work left to be executed under the approved CAT Plan after deducting the progress achieved under different component of activities and their updated cost as per present norms is given in **Table 1.11**. No updation in respect of components like, wildlife management and operation support has been carried out as a separate chapter of wildlife management has been provided in the EMP and separate provision for infrastructure support component has been provided separately.



Table 1.11: Update Cost of Balance Work to be Incorporated in New CAT Plan

S. No	Component	Provision under approved CAT Plan (Rs. lacs)	Progress achieved (Rs. lac)	Cost of balance work (Rs. lacs)	Update cost of balance work
1.	Nurseries	33.00	19.50	13.50	60.00
2.	Soil Conservation Works	160.00	26.257	133.743	186.688
3.	Afforestation				
(a)	New Plantation (115 ha)	115 / 45.425	10 ha / 3.95	41.475	50.40
(b)	Maintenance	115 ha / 31.625	5 ha / 0.56	31.065	29.70
4. (a)	Pasture Improvement (75 ha)	75 ha / 6.31	-	6.31	34.135
(b)	Maintenance	75 ha / 1.265	-	1.265	6.825
5.	Wildlife Management	10.00	-	10.00	-
6.	Operational Support	16.00	5.734	10.266	-
	Total	303.625	56.001	247.624	367.748

1.8.2 Micro-watershed Larsa [1A2C5(3)]

The micro watershed Larsa is the upper catchment of sub watershed Kerang Khad which is locally known as Taiti Garang. It has a geographical area of 295.55 sq km and is shown in **Figure 1.21**. A few small glacial streams viz. Suti Garang, Gumjang Garang, Chippang Garang, Homgar Garang and Wari Khad drain through this micro watershed. The predominant land use in this micro watershed is snow / glacier (95.78 sq km) followed by Alpine barren (70 sq km), dense vegetation (42.58 sq km) open vegetation (32.71 sq km) and Scrub / Scattered vegetation (30.72 sq km). Neither there is any village / settlement nor any agricultural land in this micro watershed. In fact the area under alpine barren and alpine vegetation also remains under snow from month of December to May. The area under very severe and severe erosion intensity is 526.48 ha and 1214.66 ha respectively and is mostly in glacier valleys and along the glacial- fluvial valleys where mild slope of scree and morain material with shallow depth is predominant. The treatment measures suggested for the micro watershed are hard engineering measures to check erosion from banks of the river and check dams on small rivulets. The catchment area lies above 4200 m, therefore no biological measures are proposed; however some of the engineering measures shall be resorted to as elucidated below.

B.	Engineering Measures	
1.	Wire crate check Dams	25 Nos.
2.	Wire crate boulder spurs	20 Nos.



1.8.3 Micro-watershed Lappo [1A2C5(4)]

The micro watershed is the lower catchment of sub watershed Kerang and has a geographical area of 104.44 sq km and is shown in **Figure 1.22**. The general altitude in the micro watershed varies from El. 2870 m to 4200 m. Lappo, Asrang and Toktu are the main villages/settlement/ hamlets in the micro watershed which has predominant land use of dense forest (54.96 sq km) followed by open forest (28.45 sq km), scrubs/ scattered vegetation including area under agricultural and settlement (17 sq km), Alpine barren (1.93 sq km). The slope map shows that approx 35 % and 37 % of the area has slope ranging from 0° -35° and 35° & 45° respectively. The area under very severe erosion intensity is 286.20 ha and 564.07 ha., respectively and mostly lies along the banks of river and side/ reposed slopes. The treatment measures for accessible areas suggested for the micro watershed are:

A.	BIOLOGICAL MEASURES	Area in Hectare
1.	Afforestation	150.00
2.	Timber Plantation	75.0
3.	Fodder Plantation	75.00
4.	NTFP Cultivation	20.00
5.	Pasture Development	110.00
		430.00
B.	ENGINEERING MEASURES	
1.	DRSM check dams	300 Nos.
2.	Wire crate check dams	175 Nos.
3.	Wire crate boulder spurs	80 Nos.
4.	Bench terracing	20 ha
5.	Contour staggered trenches.	20 ha
6.	Catch water drain	1.0 km

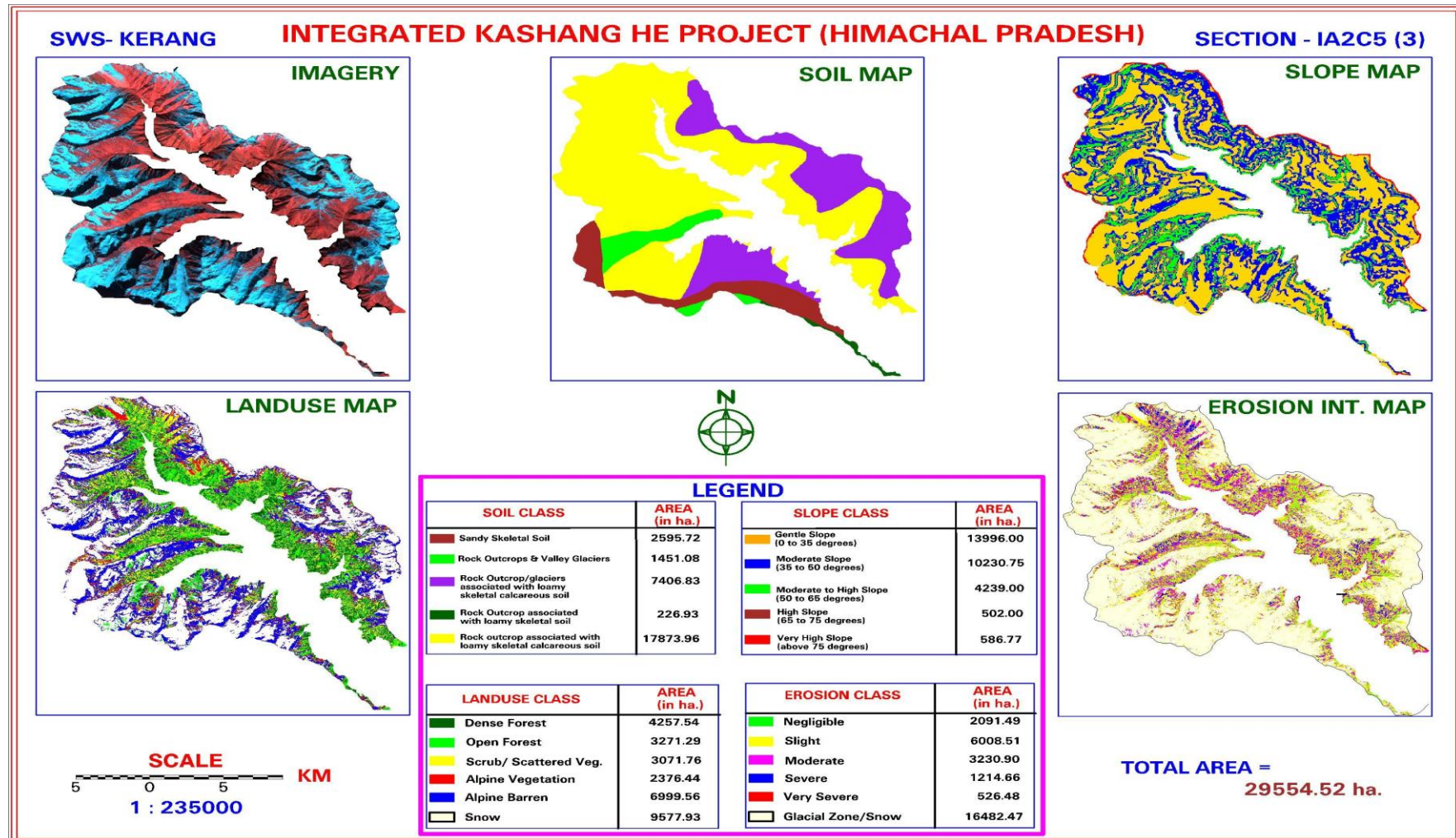


Figure 1.21: Thematic Maps of MWS 1A2C5(3) Under SWS Kerang

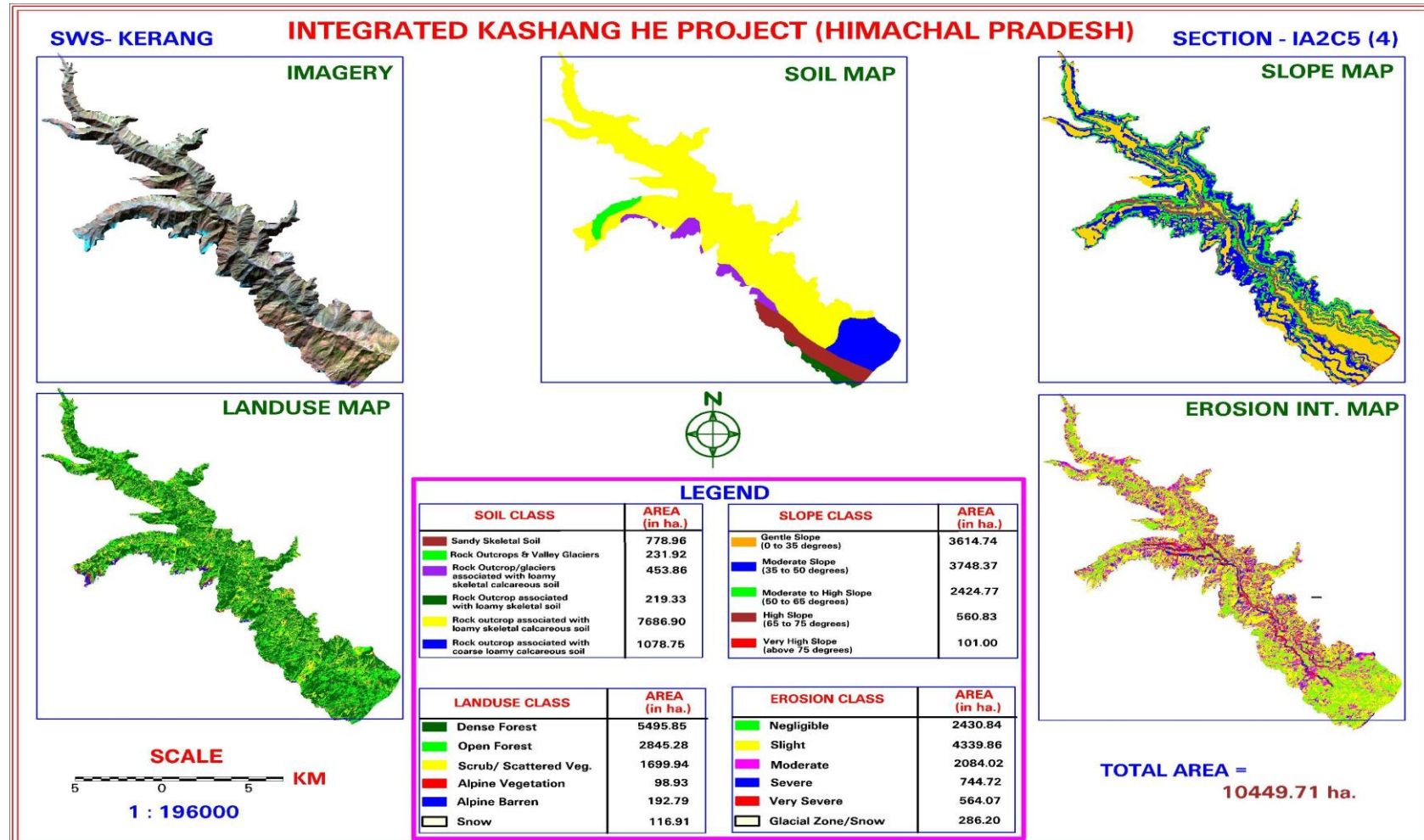


Figure 1.22: Thematic Maps of MWS 1A2C5(4) Under SWS Kerang



1.9 COST ANALYSIS OF DIFFERENT WORKS UNDER PLAN

1.9.1 Biological Measures

The cost analysis for per ha plantation @ 1500 plants/ha under afforestation, timber fodder NTFP plantation has been worked out on the basis of norms fixed for arriving per ha. afforestation cost as suggested by Himachal Pradesh Forest Department Circular No. Ft. 15-1790-2 (D)-Vol V (Norm) dated 19-6-2008 after incorporating labour and material rates as per schedule of rate applicable in Rampur Forest Circle with latest enhancement and allowance for Tribal areas. The cost per hectare of afforestation inclusive of maintenance at Rs. 75000/ha as shown in **Table 1.12**. The cost analysis for pasture development at 500 plant/ha is worked out in **Table 1.13**. The cost analysis of horticulture development has been worked out on the basis of 500 plants/ha @ Rs. 70/- plant. The cost of biological measures for Kerang sub watershed is shown in **Table 1.14**. The combined cost of all biological measures includes updated cost of balance work under sub watershed Kashang along with expenditure already incurred works out to Rs. 495.56 lacs and is shown in **Table 1.15**. The cost is inclusive of maintenance charges also.

Table 1.12: Cost Estimate for Pasture Development per Ha.

S. No.	Particulars of works	Quantity	Rate (Rs.)	Amount (Rs.)
1	Survey and demarcation of the selected area.	1 ha	L. S.	300.00
2	Digging of pits in hard stratum	500	3.91/pit	1955.00
3	Preparation of patches for the sowing of legume appr. Size of 45 x 45 x 25 cm	500	4.02/Na	2010.00
4	Lay out of pits	1 ha	140	140.00
5	Preparation of legume plants in 45 cm ³	200 Rmt.	9.65	1930.00
6	Planting of legume plants	500	6.70/No	3350.00
7	Sowing of legume plants	500	1.20/No	600.00
8	Sowing of grass seeds in trenches	200 Rmt.	1.05	210.00
9	Construction of brush wood fence	300 Rmt.	12.90	3870.00
10	Live Hedge fencing along with bush wood fence	300 Rmt.	10.90	3270.00
11	Cost of plants (Nursery - cost)	500	10.00	5000.00
12	Cost of legume seed	10 Kg	200.00	2000.00
13	Cost of grass seed	10 Kg	380.00	3800.00
14	Wooden post fencing cost	1 ha	10109.61	10109.61
			Total	3854461
	Maintenance cost for 5 years @ Rs. 3300 for first year, Rs. 2100 for second year, Rs. 1300 for third year and Rs. 1200 for every year thereafter up to 5 years			9100.00
			Total	47644.61
			Contingencies (5% of total cost)	2382.23
			Grand Total	50026.84

Say Rs. 50000.00



Table 1.13: Per Ha. Cost Norm for Model Plantation Works (Under CAT / Compensatory Afforestation Works) 1500 Plants per Ha. with Wooden Fence Posts

Sl. No.	Particulars of Work	Quantity	Rate	Amount for Non Tribal Area
A. Fencing Work				
1	Survey and demarcation of plantation area including marking of sections, path and preparation of map	1 ha	83.84/ha	83.84
2	Cutting and preparation of wooden posts 1.80 m long and 8 to 10 cm dia including debarking and fastening the top 15 cm in conical shape	60 Nos.	1056.16/hundred	633.70
3	Carriage of fence post up to 2 m long and 8 to 10 cm dia over distance 2 kms.	60 Nos.	556.17/hundred	667.40
4	Charring and coal tarring of the ends of fence posts	60 Nos.	228.97/hundred	137.38
5	Preparation / digging of holes 20-30 cm dia and 45 cm deep	60 Nos.	743.17/hundred	445.90
6	Fixing of wooden posts including strutting	60 Nos.	570.4/hundred	342.24
7	Carriage of B/wire over average distance of 2 km uphill	0.90 qtls	111.85/km	201.33
8	Stretching and fixing of barbed wire with U-staples in each strand (4 stands)	720 Rmt	3.86/Rmt	2779.20
9	Preparation of inspection path 60 cm wide	250 Rmt	8.87/Rmt	2217.50
10	Preparation of water retention mounds/ trenches	LS		2000.00
11	Interlacing of thorny bushes in B/wire obtained from planting site	180 Rmt	3.34/RM	601.20
	Total Fencing Works Cost			10109.69
B-Planting				
1	Digging of pits 45 cm x 45 cm x 45 cm (40% of total)	600 Nos	782.07/hundred	4692.42
2	Digging of pits 30 cm x 30 cm x 30 cm (60% of total)	900 Nos	391.12/hundred	3520.08
3	Filling of pits 45 cm x 45 cm x 45 cm	600 Nos	224.05/hundred	1344.30
4	Filling of pits 30 cm x 30 cm x 30 cm	900 Nos	156.37/hundred	1407.38
5	Carriage of naked root plants over distance of 2k m uphills (BL as well as conifers)	600 Nos	28.88/hundred/km	346.56
6	Carriage of plants in P/bags over distance of 2 km up hills	900 Nos	178.75/hundred/km	3217.50
7	Planting of entire plants raised in P/bags	900 Nos.	178.84/hundred	1609.56
8	Planting of naked root plants	600 Nos.	150.74/hundred	904.44
9	Planting of grass tufts / preparation of strips including sowing in strips 100 m x 30 m x 5 cm for grass sowing along contour	500 strips	753.97/hundred	3769.85
	Total Planting Cost			20812.09



Sl. No.	Particulars of Work	Quantity	Rate	Amount for Non Tribal Area
	C-Material			
1	Cost of barbed wire	0.9 Qtl	7000 per Qtl	6300.00
	Nursery Cost of Plants			
1	Naked root plants	600 Nos	6/plant	3600.00
2	Polythene bags plants	900 Nos	8/per plant	7200.00
	Total Material Cost			17100.00
	Grand Total (A + B + C)			48021.78
	Or Say			48000.00
	D. Maintenance Cost			
	1st year maintenance 30% mortality			
1	Re-digging of pits 45 cm x 45 cm x 45 cm	180 Nos.	391.12/hundred	704.01
2	Re-digging of pits 30 cm x 30 cm x 30 cm	270 Nos.	195.52/hundred	527.90
3	Filling of pits 45 cm x 45 cm x 45 cm	180 Nos.	224.05/hundred	403.29
4	Filling of pits 30 cm x 30 cm x 30 cm	270 Nos.	156.37/hundred	422.20
5	Planting of polythene bags plants	270 Nos.	178.84/hundred	482.86
6	Planting of naked root plants	180 Nos.	150.74/hundred	271.33
7	Planting of grass tufts / preparation of strips including sowing in strips 100 m x 30 m x 5 cm for grass sowing	200 Nos.	753.97/hundred	1507.94
8	Carriage of polythene bags plants over a distance of 2 km uphill	270 Nos.	178.75/hundred/km	965.25
9	Carriage of naked root plants over a distance of 2 km uphill	180 Nos.	28.88/hundred/km	103.97
10	Nursery cost of plants	270 Nos.	8/plant	1440.00
11	Nursery cost of polythene bags naked root plant	180 Nos.	6/plant	1080.00
12	Repair of fence	180 Rmt	1.32/Rmt	237.60
13	Repair of inspection path		L. S.	700.00
14	Repair of soil and moisture conservation works		L.S.	1000.00
	Total Maintenance Cost			9846.35
	Or Say			9800.00
	2nd year maintenance 20% mortality			
1	Redigging of pits 45 cm x 45 cm x 45 cm	120 Nos.	391.12/hundred	469.34
2	Redigging of pits 30 cm x 30 cm x 30 cm	180 Nos.	195.52/hundred	351.94
3	Filling of pits 45 cm x 45 cm x 45 cm	120 Nos.	224.05/hundred	268.86
4	Filling of pits 30 cm x 30 cm x 30 cm	180 Nos.	156.37/hundred	281.47
5	Planting of polythene bags plants	192 Nos.	178.84/hundred	343.37
6	Planting of naked root plants	108 Nos.	150.74/hundred	162.80
7	Carriage of polythene bags plants over a distance of 2 km up hills	192 Nos.	178.75/hundred/km	686.40
8	Carriage of naked root plants over a distance of 2 km up hills	108 Nos.	28.88/hundred/km	62.38



Sl. No.	Particulars of Work	Quantity	Rate	Amount for Non Tribal Area
9	Nursery cost of plants in polythene bags	192 Nos	8/plant	1536.00
10	Nursery cost of naked root plant	108 Nos.	16/plant	648.00
11	Repair of fence	180 Rmt	1.32 Rmt	237.60
12	Repair of inspection path		L. S.	500.00
13	Repair of soil and moisture conservation works		L. S.	800.00
	Total 2nd Year Maintenance Cost			6348.16
	Or Say			6300.00
	3rd Year maintenance 10% mortality			
1	Redigging of pits 45 cm x 45 cm x 45 cm	60 Nos.	391.12/hundred	234.67
2	Redigging of pits 30 cm x 30 cm x 30 cm	90 Nos.	195.52/hundred	175.97
3	Filling of pits 45 cm x 45 cm x 45 cm	60 Nos.	224.05/hundred	134.43
4	Filling of pits 30 cm x 30 cm x 30 cm	90 Nos.	156.37/hundred	140.73
5	Planting of polythene bags plants	90 Nos.	178.84/hundred	160.96
6	Planting of naked root plants	60 Nos.	150.74/hundred	90.44
7	Carriage of polythene bags plants over a distance of 2 km up hills	90 Nos.	178.75/hundred/km	321.75
8	Carriage of naked root plants over a distance of 2 km up hills	60 Nos.	28.88/hundred/km	34.66
9	Nursery cost of plants in polythene bag	90 Nos.	8/plant	720.00
10	Nursery cost of naked root plant	60 Nos.	6/plant	360.00
11	Repair of fence	200 Rmt	1.32 per Rmt	264.00
12	Repair of inspection path		L. S.	400.00
13	Repair of soil and moisture conservation works		L. S.	800.00
	Total 3rd Year Maintenance Cost			3837.61
	Or Say			
	4th Year maintenance 10% mortality			
1	Redigging of pits 45 cm x 45 cm x 45 cm	60 Nos.	391.12/hundred	234.67
2	Redigging of pits 30 cm x 30 cm x 30 cm	90 Nos.	195.52/hundred	175.97
3	Filling of pits 45 cm x 45 cm x 45 cm	60 Nos.	224.05/hundred	134.43
4	Filling of pits 30 cm x 30 cm x 30 cm	90 Nos.	156.37/hundred	140.73
5	Planting of polythene bags plants	90 Nos.	178.84/hundred	160.96
6	Planting of naked root plants	60 Nos.	150.74/hundred	90.44
7	Carriage of polythene bags plants over a distance of 2 km up hills	90 Nos.	178.75/hundred/km	321.75
8	Carriage of naked root plants over a distance of 2 km up hills	60 Nos.	28.88/hundred/km	34.66
9	Nursery cost of plant in polythene bag	90 Nos.	5/plant	720.00
10	Nursery cost of naked root plant	60 Nos.	6/plant	360.00
11	Repair of fence	200 Rmt	1.32/Rmt	264.00
12	Repair of inspection path		L. S.	300.00



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Sl. No.	Particulars of Work	Quantity	Rate	Amount for Non Tribal Area
13	Repair of soil and moisture conservation works		L. S.	700.00
	Total 4th Year Maintenance Cost			3637.61
	Or Say			3600.00
	5th Year maintenance 10% mortality			
1	Redigging of pits 45 cm x 45 cm x 45 cm	60 Nos.	391.12/hundred	234.67
2	Redigging of pits 30 cm x 30 cm x 30 cm	90 Nos.	195.52/hundred	175.97
3	Filling of pits 45 cm x 45 cm x 45 cm	60 Nos.	224.05/hundred	134.43
4	Filling of pits 30 cm x 30 cm x 30 cm	90 Nos.	156.37/hundred	140.73
5	Planting of polythene bags plants	90 Nos.	178.84/hundred	160.96
6	Planting of naked root plants	60 Nos.	150.74/hundred	90.44
7	Carriage of polythene bags plants over a distance of 2 km up hills	90 Nos.	178.75/hundred/km	321.75
8	Carriage of naked root plants over a distance of 2 km up hills	60 Nos.	28.88/hundred/km	34.66
9	Nursery cost of plants in polythene bag	90 Nos.	8/plant	720.00
10	Nursery cost of naked root plant	60 Nos.	6/plant	360.00
11	Repair of fence	200 Rmt	1.32/Rmt	264.00
12	Repair of inspection path		L. S.	300.00
13	Repair of soil and moisture conservation works		L. S.	600.00
	Total 5th Year Maintenance Cost			3537.61
	Or Say			3500.00
	Abstract	Amount (in Rs.)		
	New plantation cost	48000.00		
	I year maintenance cost	9800.00		
	II year maintenance cost	6300.00		
	III year maintenance cost	3800.00		
	IV year maintenance cost	3600.00		
	V year maintenance cost	3500.00		
	Grand Total	75000.00		



Table 1.14: Cost Estimate for Biological Measures of Sub Watershed Kerang

MWS Code	Afforestation / Timber / Fodder / NTFP		Horticulture		Pasture Development		Amount (Rs lacs)
	Area (ha)	Cost @ Rs 75,000 / ha (Rs. lacs)	Area (ha)	Cost @ Rs 35,000 / ha (Rs. lac)	Area (ha)	Cost @ Rs 50,000 / ha (Rs. lacs)	
1A2C5 (3)	-	-	-	-	-	-	-
1A2C5(4)	320	240.00	-	-	110	55.00	295.00
	320	240.00	-	-	110	55.00	295.00

Table 1.15: Total Cost Estimate for Biological Measures for Sub-watershed Kashang and Kerang

S. No.	Sub water	Particular	Amount (Rs. lacs)
1.	Kashang	Total cost of balance work under biological measures at present cost along with expenditure incurred. (Table 1.11)	121.06
2.	Kerang	As per Table 1.14	295.00
3.		Nursery Development (including expenditure done) for Kashang & Kerang Sub-watersheds	79.50
Grand Total			495.56

The location of plantation sites under Catchment Area Treatment Plan, have been delineated and are presented in **Table 1.16**.

Table 1.16: Plantation Activities under Catchment Area Treatment Plan (CAT)

Sl. No.	Name of Location	Longitude/ Latitudes	Type of Proposed Activity
1.	L/B of Kashang Khad near Botharaj Dogri	78° 18' 08" / 31° 37' 42"	25 ha Afforestation
2.	L/B of Kashang Khad near Shiianda Dogri	78° 17' 01" / 31° 39' 10"	25 ha Afforestation
3.	L/B of Kashang Khad near Shangidor Dogri	78° 16' 30" / 31° 39' 25"	20 ha Afforestation
4.	R/B of Kashang Khad near Dundng Dogri	78° 16' 10" / 31° 38' 34"	25 ha Afforestation
5.	Near Roktibale Thach	78° 12' 19" / 31° 40' 15"	25 ha Pasture Development
6.	Near Masaldong	78° 13' 34" / 31° 39' 40"	25 ha Pasture Development
7.	Near Pibrushyang	78° 14' 30" / 31° 37' 58"	25 ha Pasture Development
8.	L/B of Kerang Khad Opposite Lapo Dogri	78° 20' 30" / 31° 40' 10"	130 ha Afforestation
9.	L/B of Kerang Khad Opposite Toktu Village	78° 19' 05" / 31° 40' 40"	100 ha Afforestation



10.	L/B of Kerang Khad near Limti Thach	78° 17' 05" / 31° 43' 12"	120 ha Afforestation
11.	Near Sukhi Thabi Thach	78° 16' 23" / 31° 43' 49"	110 ha Pasture Development
12.	In Shalamati PF	78° 19' 36" / 31° 38' 54"	150 ha Afforestation
13.	Near Chamang Thatang Thach	78° 12' 55" / 31° 45' 24"	50 ha Pasture Development
14.	Near Philang wach	78° 15' 30" / 31° 42' 21"	100 ha Afforestation

1.9.2 Engineering Measures

The engineering measures are to be implemented over “Severe” and “Very Sever” erosion intensity areas to control the sediment yield and further degradation of the free draining catchment areas. Since the measures are to be carried out by construction of individual structures such as create wires, 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 provided. The analysis of rates is presented in **Table 1.17**.

Under engineering measures 200 no. wire crate checkdams spurs, 100 no. wire crate boulder spurs, 300 No. DRSM check dams, 20 ha bench terracing, 20 ha contour staggered terracing and 1.0 km catch water drains are proposed to be constructed in sub watershed Kerang the details of which are shown in **Table 1.18**. The overall cost under engineering measures including the updated cost of balance work and expenditure incurred with respect to sub watershed Kashang is shown in **Table 1.19** and works out to Rs. 418.895 lacs.

Table 1.17: Cost Analyses for Engineering Structures

S. No		Quantity	Unit	Rate	Amount
1.	Dry Rubble Stone masonry (DRSM) Cheek Dam.				
(a)	Excavation in foundation with 50% soft rock & 50% E & B. 5m x 1.5 x 0.50	3.75	Cum	145.60	546.00
(b)	Labour charges for dry stone masonry with outer face stone dressed & 100 m lead.	17.03	Cum	205.79	3504.60
	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 = <u>2.40</u> 17.03				
(c)	Carriage of boulder by head load beyond initial 100 m lead up to 1 km manually	17.03	Cum	689.71	11745.76
(d)	Collection of boulder	17.03	Cum	142.23	2422.18
				Total	18218.54
				Add 3% Contingencies	546.56
				Grand Total Rs.	18765.10
				Say Rs.	18,800.00



2.	Wire Crate Check Dam				
(a)	Excavation in foundation with 50% Shale & 50% E & B -6 x 2 x 1	12	Cum	145.60	1747.20
(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 cm ²				
	I- Step - 2(6 x 1.9 + 6 x 1 + 2 x 1) = 38.8 m ²				
	II- Step - 2(6 x 1.8 + 6 x 0.8 + 2 x 0.8) = 34.4 m ²				
	<u>113.2 m²</u>	113.2		22.04	244.93
(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	M ³	118.08	3783.28
(d)	Collection of boulder	32.04		142.23	4557.08
(e)	Carriage of boulder average lead 1 km manually	32.04	m ³	689.71	22098.31
(f)	Cost of GI wire	2.25	Qtl	689.71	15750.00
(g)	Carriage of GI wire to an average lead of 1 km ponies	2.25	Qtl	111.85	251.66
Total Rs.					50682.39
Add 3% Contingencies					1520.47
Grand Total Rs.					52202.86
Say Rs.					52200.00
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	145.60	637.00
(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	118.08	2905.95
(c)	Collection of boulder	24.61	Cum	142.23	3500.28
(d)	Carriage of boulder average lead 1 km manually	24.61	Cum	689.71	16973.76
(e)	Cost of G.1 wire crates				
	7 x 15.10 sqm	105.70	Sqm	117.00	12366.90
(f)	Carriage of G.1. wire crate to an average lead of 1 km by ponies	3	Qtl	111.85	335.55
Total					36719.44
Add 3% Contingencies					1101.05
Say Rs					37,800.00
4	Bench terracing / ha excavation	100	Cum	145.60	14560.00
5	Contour staggered trenches / ha excavation	75	Cum	145.60	10920.00
6.	Catch water drain / RM Average dimension = 1 m x 0.5 m x 0.5 m Excavation (1.5 + 0.75) x 0.75 Labour charges for dry stone masonry	0.84 0.50	Cum Cum	146.50 205.78	123.06 102.90
Total Rs.					225.96
Grand Total Rs.					226.00



Table 1.18: Cost Estimate for Engineering Measures for Sub watershed Kerang

MWS Code	Wire Crate Check Dam		Wire Crate Spurs.		DRSM Check Dam		Bench Terracing		Contour Terracing		Catch Drain		Total Cost (Rs lac)
	No.	Cost @ Rs. 52200/ No (Rs lac)	No.	Cost @ Rs. 37800/ No (Rs lac)	No.	Cost @ Rs. 18800/ No. (Rs lac)	Ha.	Cost @ Rs. 14560/ha (Rs lac)	Ha.	Cost @ Rs. 10920/ ha (Rs lac)	Rm.	Cost @ Rs 226/ m (Rs lac)	Total Cost (Rs lac)
1A2C5(3)	25	13.05	20	7.56	-	-	-	-	-	-	-	-	20.61
1A2C5(4)	175	91.35	80	30.24	300	56.40	20	2.91	20	2.18	1000	2.26	185.34
Total	200	104.40	100	37.80	300	56.40	20	2.91	20	2.18	1000	2.26	205.95

Table 1.19: Cost Estimate for Engineering Measure for Sub watershed Kashang and Kerang

S. No	Name of Sub watershed	Particular	Amount (Rs lacs)
1.	Kashang	Total cost of balance engineering measure at present cost along with expenditure incurred (Table 1.11)	212.945
2.	Kerang	Estimated cost as per (Table 1.17)	205.95
Total			418.895

The location of soil and water conservation sites under Catchment Area Treatment Plan, have been delineated and are presented in **Table 1.20**.

Table 1.20: Soil Conservation Activities under Catchment Area Treatment Plan

Sl. No.	Name of Location	Longitude/ Latitudes	Type of Proposed Activity
1.	L/B of Kashang Khad near Masdalong	78° 13' 34" 39' 40"	Wire crate check dams
2.	Near Roktibale Thach	78° 13' 10" / 31° 39' 38"	Wire crate check dams
3.	Near Karang Thach	78° 14' 02" / 31° 39' 27"	Land slide control/catch water drains/ retaining walls.
4.	L/B of Kerang Khad opposite Toktu on slide zone	78°, 19' 05" / 31° 40' 40"	DRSM/ Wire crate check dams
5.	L/B of Keerang Khad opposite Lapo Dogri village on local Khad	78° 20' 30" / 31° 40' 10"	Stream bank protection with wire crate spurs.
6.	L/B of Kerang Khad between stage IV and II	78° 20' 40" / 31° 39' 40"	Stream bank protection with wire crate spurs.
7.	R/B of Kerang Khad between Toktu and Lapo	78° 20' 00" / 31° 39' 33"	Check dam and stream bank protection with wire boulder crates
8.	L/B of Kerang Khad near Surdan Thatch	78° 13' 45" / 31° 46' 30"	Check dam and stream bank protection with wire boulder crates.
9.	L/B of Kerang Khad opposite Perang Dogri	78° 17' 40" / 31° 41' 02"	Check dam and stream bank protection with wire boulder crates



1.10 TREATMENT OF IMPACT AREA

The river stretch of 9.8 km of Kerang and 4 km of Kashang Khad downstream of the intake point till its confluence with River Satluj will get affected due to change in hydraulic regime mainly due to abstraction of water and also due to the effect of project related activities like construction of new or widening of the existing roads etc. The local folk of the nearby areas are definitely affected as them being the users of forestland being diverted for the project for non-forestry use. For their utter dismay they find it difficult to comprehend that the CAT plan would not cover their areas. In the present context the impact area comprises of the catchment of Pager Khad, which confluences with Kerang Khad at RD 6.8 km. Project proponents will ensure that accumulation of shaol will be cleared at all cost even if it require shutting down of the Powerhouse for diverting the flow to clear the depository material on the left bank of Pager Khad, near village Lippa. The Operation Manual will incorporate suitable provisions for this commitment made to public. Besides, a few local streams Chakra Khad and Jangi Khad meet Kerang Khad at-RD 6.3 and 4.0 km respectively. A lot of erosion is taking place in the upper reaches of Pager Khad near Thothang Thach and upstream of it confluences with Kerang Khad, which is predominant in area between L/B of Kerang Khad and R/B of Pager Khad. The landslide and erosion can also be seen on R/B of Kerang Khad near village Kotang Dogri. These areas, which do not form part of free draining catchment under the project, are part of Kerang sub catchment. In view of the fact that no HEP has been proposed in Kerang khad of which the area in question could be under free draining catchment, it is logical and imperative to treat the area to facilitate the hydrological functioning of the catchment served by the area and to augment the quality of water flowing through the area. The rehabilitation of the existing degraded forest area, mitigation measures in active landslide areas through Soil Conservation and biological measures shall certainly ameliorate the environment of the Sub-Catchment Kerang as a whole. It is proposed to treat the area with Biological and Engineering measures in the same manner as the other micro-watershed of free draining catchment and is given in Table 1.21.

Table 1.21: Cost of Treatment of Impact Area

Sl. No.	Particular	Quantity	Unit	Rate	Amount (Rs Lacs)
(A)	Biological Measures.				
1	Afforestation/Timber/Fodder/NTFP with	120	ha	75,000.00	90.00
2	Pasture Development	60	ha	50,000.00	30.00
	Sub Total (A)				120.00



(B)	Engineering Measures				
1	Wire crate check dam	40	No.	52200	20.88
2	Wire crate spur	40	No.	37800	15.12
3	DRSM check dam	200	No.	18800	37.60
4	Bench Terracing	20	ha	14560.00	2.91
5	Contour Terracing	32	ha	10920.00	3.49
	Sub Total (B)				80.00
	Grand Total (A) + (B)				200.00

1.11 TREATMENT OF PRIVATE LAND

The silt contribution to private land holding is very significant. The agriculture land, if not developed properly and coupled with faulty agricultural practices like interrupting the natural drainage, contributes heavy soil erosion as compared to the other landuse 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. Therefore, it is proposed to provide treatment to private holdings for development of horticulture, agriculture and private pasture development. Some parts of the free draining Catchment area falling under MWS Dolo-Dogri and MWS Lappo have such development potential. An area of 50 ha and 30 ha have been earmarked to be undertaken for horticulture and agricultural land development and private pasture development respectively under this plan as a joint venture with the owners of the land with their share of the cost being the cost of fencing and maintenance. The cost of works proposed under this head work out to Rs. 40.26 lakh and is shown in Table 1.22.

Table 1.22: Cost of Private Land Treatment

Sl. No	Particular	Quantity	Unit	Rate	Amount (Rs. Lacs)
(A)	Biological Measures				
(1)	Horticulture Development	50	ha	35000	17.50
(2)	Private Pasture Development.	30	ha	40,900	12.27
	Sub Total (A)				29.77
(B)	Engineering Measures				
	Wire crate check dam	08	No	52200	4.18
	DRSM check dams.	20	ha	18800	3.76
	Bench Terracing	10	ha	14560.00	1.46
	Contour staggered Terracing	10	Ha	10920.00	1.09
	Sub Total (B)				10.49
	Grand Total (A) + (B)				40.26



1.12 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, 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 3-8-2009.

1.12.1 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 vehicles with O & M charges for 4 years as shown in Table 1.23.

Table 1.23: Cost Estimate for Support Infrastructure

Sl. No.	Particular	Quantity	Unit	Rate	Amount
(A)	Office Equipments				
1	Purchase of Pentium 4 PC Complete with accessories and Laser printer	4	No	0.50	2.00
2	Purchase of Xerox Machine	2	No	1.00	2.00
3	Purchase of Fax Machine	3	No	0.10	0.30
4	Purchase of GPS and Survey instruments	LS	-	-	1.20
5	Purchase of inspection vehicles	2	no	8.00	16.00
6	O & M Charges for vehicles @ Rs 1.0 lacs/year for 4 years	2 x 4	no	1.0/yr	8.00
7	Expenditure already incurred				5.73
	Total				35.23

1.12.2 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 solar cookers and LPG gas connection with cylinder at 100% subsidized cost. At the outset this provision is being made for 500 number of such families, who are residing in the area falling under micro watershed Lappo [1A2C5(4)]. Beneficiary preference shall be given to weaker section of society, families headed by women and also to



the old couples and widows/ widower living below poverty lines with no one to look after. The cost debitable on this account for LPG connection @ Rs. 2880/- each shall be Rs. 14.40 lacs.

1.12.3 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 block headquarters for which a provision of Rs. 15.25 lacs is being made @ 0.5% of CAT plan outlay.

1.12.4 Provision for Formulation of Micro Plans

Based on the ground truth reality in each of the Village Forest Development Committee or Society falling under the different sub-watersheds, comprehensive micro plan for execution of the work has to be prepared as per norms. For this purpose a provision of Rs. 30.50 lacs is being made @ 1% of the CAT plan outlay.

1.12.5 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. 15.25 lacs is being made @ 0.5% of the CAT plan outlay. 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.

1.12.6 Gender Support

By far the women folk are more industrious than man in the hills. There is a need to keep them in center stage in programme implementation so that they can play an active role in the preservation of ecology as well as the socio-economic development of the area. Proper training with respect to work related to NTFP cultivation, animal husbandry, gardening and farm works etc. shall be imparted for which a provision of Rs. 15.25 lacs is being made @ 0.25% of the CAT plan outlay.



1.12.7 Funds for Educational Activities Related to Medicinal Plant Sector

In keeping with the provision under para 4.6.2 of Himachal Pradesh Forestry Sector medicinal Plants Policy, 2006, a provision of Rs. 30.50 lacs is being earmarked for various conservation and educational activities related to medicinal plant sector.

1.12.8 Monitoring of Silt

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. Therefore, for recording soil and silt data at regular interval one small laboratory/ observatory each shall be established at Dolo Dogri, Lappo and Lippa where the regular discharges of Kashang, Kerang and Pager Khads respectively shall be monitored. For establishing these a provision of Rs. 36.00 lacs is being made.

1.12.9 Development of Eco-Tourism

The trekking routes such as Larsa way pass along Taiti Garang with camping facilities can help to boost eco-tourism in the area. Concept of "Homesteads" can be promoted. Such host families who are enterprising and having reasonable traditional accommodation in the village en-route to good eco-treks can accommodate tourists on payment basis. Some financial support to rural people can boost the activity. Involvement of local youths can fetch them self employment avenues by providing services like guides, porters and making arrangement for boarding and lodging of eco-tourists. Thus poor families can get wage earning by porter or other small works. Eco-tourism societies can be formulated under the overall control of the special purpose vehicle (SPV) for anchoring the eco-tourism activities. There is a lot of scope for eco-tourists for beholding the nature in its wild virgin and pristine glory and catching the everlasting enthralling moments in their mind while enjoying and learning the nature. In keeping with the Revised Policy on Development of Eco-tourism in Himachal Pradesh, 2005, and guideline issued by the Himachal Pradesh Forest Department, vide letter No. Ft-48-124/94 (FCA), one percent of the CAT plan should be earmarked for eco-tourism purposes. However, a provision of Rs 50.00 lacs is being made on this count as it seems to be meaningful and purposeful for establishing a certain asset.

1.12.10 Provision for Floristic Survey and Research

Though adequate provision of Rs 20 lacs & 15 lacs have already been provided in Environment Monitoring Plan for ecosystem monitoring including environmental studies respectively during construction and post



constructional stage, yet a provision of Rs 20.0 lacs is being made for carrying out floristic survey of the area after completion of implementation of the CAT plan i.e. immediately after the fifth year of maintenance. The researchers will work on surveys and natural history of endangered animals such as Ibex, Bharal, Snow Leopard, Brown Bear and Musk Deer. The wildlife research organizations located at Dehra Dun and Mysore or other subject matter specialist be invited to undertaken such work.

1.12.11 Eco-Force

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

The state of Himachal Pradesh has also raised 133 Infantry Battalion TA (Ecological) in March 2006 with sole purpose of generation of employment opportunities for ex-servicemen of the state though afforestation and soil conservation work. The Eco- Battalion is engaged in Satluj basin in the task of rim plantation in Tatapani area of Karsog Forest Division. There are a number of on-going and proposed HEP in Satluj basin whose CAT plan are either being implemented or being formulated. In the light of the fact that the state has already mooted a proposal for raising two more Eco-Battalions one each for Ravi and Beas catchment, financial resources are to be pooled to support the existing Batallion and the two more Batallions to be raised. The integrated Kashang HEP (243 MW) also lies in Satluj basin. Therefore, with a view to pool in resources to support ETF, a provision of Rs. 61.000 lacs has been made @ 2% of the CAT plan outlay.

1.12.12 Provision for Monitoring and Evaluation

In keeping with broad 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. Therefore, a provision of Rs 152.00 lac is being made on this count.

1.12.13 Provision for Providing Environmental Services

In Keeping with the guidelines issued in this direction, a provision @ 10% of the CAT plan outlay shall have to be earmarked on this count. Therefore a provision of Rs 305.00 lacs is being made under this sub-head. A Cold Arid



Zone Research Station to carry out the research with a special focus on Chilgoza and other native species, including that of faunal species, will be established locally along side Hydro Meteorological Station. Besides focusing *forestry research and solutions* for cold desert areas the proposed Arid Zone Research Centre will also be a nodal point for wildlife research in the region.

1.12.14 Provision for Forest Protection

The need for rigorous watch and ward of the forest covered under the catchment area becomes more imperative in view of proposed new plantations under the CAT plan and due to increased human activity in the form of labour, who shall be engaged for forestry works. Thus fire protection measures including construction and maintenance of fire lines, construction of check-posts, watch towers have to be undertaken. The area seems to give a lot of unique wildlife habitats such as gorges and hidden valleys, which are home to many such species, may be new to the science (such as amphibians like salamanders, etc.). There is a need to identify such unique habitats and protect them from blasting, degradation, etc. Same is true for nesting sites of vultures (cliffs, ledges, etc.), galliforms, etc. The surveying and mapping of such critical and unique areas need to be done. Protection of unique habitats shall be strictly monitored by the concerned authorities with resources from Monitoring and Evaluation (Para-1.12.12). Besides these construction/ repair of forest boundary pillars shall also be carried out. The forest staff shall have to be properly equipped with modern utility gadgets like walky-talky, GPS and fire-fighting equipments. For these a provision of Rs. 50.00 lacs is being earmarked.

1.12.15 Provision for Forest Infrastructure Development

The proposed works under CAT plan shall be implemented in the interior areas. For this, protection of forests, monitoring, etc., forest staff shall have to camp nearby the sites of works, therefore, the field staff has to be provided with accommodation. Thus, the cost of creating residential and non-residential buildings like office, staff accommodation, inspection huts has to be included in the plan. Likewise, for the movement of the field staff and the labour, the forest path and bridges need construction and repair. Therefore for providing such forest infrastructure development works a sum of Rs. 100.00 lacs is being earmarked in the CAT plan.

1.12.16 Provision for Rural Infrastructure Development

A sum of Rs. 214.40 lacs is being made in the plan for creating rural infrastructure works like village paths, small bridges, small irrigation channels, repair of school buildings, enhancing rural livelihoods, panchayat bhawan, construction of crematorium / cremation ghats etc. The scheme shall be finalized in consultation and through JFM meetings. The community living in the villages in the project area need to be made part of the forest and



wildlife management effort. The micro-credit schemes in the area may be an effective tool to do so. Emphasis will be given on proper micro-planning and suitable measures of organic farming, education of girl child, training of teachers in the schools, use of alternate sources of energy, vermi-compost, etc.

1.12.17 Publicity and Environmental Awareness

For protection of environment, awareness regarding environmental values is of utmost importance especially, among the children. Mountains are most vulnerable to the climate change and therefore, it becomes important to make aware people about the environmental value and the consequence thereof. For this, periodic workshops, short duration environmental awareness camps will be organized, where the importance of environment conservation will be emphasized. Also wide publicity will be conducted to send the message of protecting and conserving environment. For publicity, the Publicity Wing of Forest Department along with District Administration will be involved. A provision for formation of Street Theatre of the local community may be very effective for the protection of wildlife and forests. Several bands of ten to twelve village youth each may go performing about wildlife and forest conservation (with local nature based songs and natti) from village to village. The wages for one of such performance (including traveling and boarding, lodging) will be about Rs. 3,000/- per performance. In a day, two performances may be given by one party/ band. Sixteen such parties/ bands will be supported. A dress, musical instruments and workshops for their training, etc. will also be part of this arrangement. For publicity and awareness, a provision of sum of Rs. 20 lacs is being made in the Plan.

1.12.18 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 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. 25.00 lacs has been made in the plan.

1.12.19 Wildlife Management and Biodiversity Conservation Plan

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 has been made in a separate Chapter-5 under the EMP. The cost of the plan has been assessed as Rs. 100.00 lacs. The priority under the plan is to conserve and protect the biodiversity of the Lippa-Asrang Wildlife Sanctuary and also support the pheasant conservation and breeding programme at Sarahan.



1.12.20 Provision for Subsidized Fuel

The fuel need of the labourers / workers has to be attended in an organized manner, otherwise, the labour may resort to indiscriminate felling of trees owing to their cost free and easy availability at leisure. Therefore, action plan has been devised to meet the fuel needs of the workers. The estimated cost of the plan is Rs. 113.00 lacs and is covered in a separate Chapter-10, captioned as “**Provision for Subsidized Fuel**” under the EMP.

1.13 INSTITUTIONAL MECHANISM

1.13.1 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 State Forest Department and Officials from the Environment Group at HPPCL. 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 enough in operationalizing the plan need to be consulted from time to time.

1.13.2 CAT Implementation

Environmental officer or Manager (Environment) of project proponent would coordinate with forest department for the implementation of the proposed Plan. The 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 certificate in the light of guidelines fixed by CAMPA. 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 Kashang - Kerang CAT plan Society with its Headquarter at Reckong Peo should be instituted for the project for administrative guidance and smooth realization of targets.

1.13.3 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 Environmental Cell of Himachal Pradesh Power Corporation Ltd (HPPCL) 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 HPPCL, 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.

1.14 SUMMARY OF COST OF WORKS

The cost of all the works proposed in the CAT Plan after incorporating the cost of CAT Plan of erstwhile Kashang HEP is enumerated in **Table 1.25**. Year-wise break-up of CAT plan outlay is shown in **Table 1.26**.



Table 1.25: Cost Estimate of CAT Plan

Sl. No.	Particulars	Amount (Rs. Lacs)
1	Treatment Works under free draining catchment.	
a)	Biological Measures	495.56
b)	Engineering Measures.	418.90
2	Treatment Works Under Impact Area.	
a)	Biological Measures	120.00
b)	Engineering Measures.	80.00
3	Treatment Works under private land	
a)	Biological Measures	29.77
b)	Engineering Measures.	10.49
	Sub Total (1) + (2) + (3)	1154.72
4	Implementation of Support Infrastructure Cost	35.23
5	Fuel wood saving devices.	14.40
6	Training and Extension Programme	15.25
7	Preparation of Micro Plans	30.50
8	Documentation	15.25
9	Gender Support	15.25
10	Funds for Educational Activities related to Medicinal Plant Sector	30.50
11	Monitoring of silt	36.00
12	Development of Eco-tourism	50.00
13	Provision for floristic survey	20.00
14	Support for Eco-task force	61.00
15	Provision for Monitoring and Evaluation Activities	152.00
16	Provision for providing Environmental Services.	305.00
17	Provision for forest protection	50.00
18	Provision for forest infrastructure development	100.00
19	Provision for rural infrastructure development	214.40
20	Publicity and environmental awareness	20.00
21	Capacity building	25.00
22	Wildlife Management and Biodiversity Conservation Plan (Chapter-5)	100.00
23	Provision for Subsidized Fuel (Chapter-10)	113.00
24	Cost escalation at 10% per year	493.10
	Grand Total	3050.60



Table-1.26: Year-wise Break-up of CAT Plan Outlay

Rs. in Lacs													
S. No.	Component		0 Year	1 Year	2 Year	3 Year	4 Year	5 Year	6 Year	7 Year	8 Year	9 Year	Total
1	Treatment Works under free draining catchment.												
a)	Biological Measures	24.01	60.0	65.00	75.00	75.00	75.00	36.00	29.00	24.00	18.00	14.55	495.56
b)	Engineering Measures.	26.26	-	100.00	100.00	100.00	92.64	-	-	-	-	-	418.90
2	Treatment Works Under Impact Area	-	-	40.00	40.00	40.00	40.00	12.00	10.00	8.00	6.00	4.00	200.00
3	Treatment Works under private land	-	-	15.00	15.00	5.26	5.00	-	-	-	-	-	40.26
4	Infrastructure Support	5.73	-	18.00	4.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	35.23
5	Fuel wood saving devices.	-	-	14.40	-	-	-	-	-	-	-	-	14.40
6	Training and Extension Programme	-	-	7.75	7.50	-	-	-	-	-	-	-	15.25
7	Preparation of Micro Plans	-	10.5	10.00	10.00	-	-	-	-	-	-	-	30.50
8	Documentation	-	-	-	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.95	15.25
9	Gender Support	-	-	7.75	7.50	-	-	-	-	-	-	-	15.25
10	Funds for Educational Activities related to Medicinal Plant Sector	-	-	-	10.50	10.00	10.00	-	-	-	-	-	30.50
11	Monitoring of silt	-	-	12.00	10.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	36.00
12	Development of Eco-tourism	-	-	20.00	15.00	15.00	-	-	-	-	-	-	50.00
13	Provision for floristic survey	-	-	-	-	-	-	5.00	5.00	5.00	5.00	-	20.00
14	Support for Eco-task force	-	-	-	21.00	20.00	20.00	-	-	-	-	-	61.00
15	Provision for Monitoring and Evaluation Activities	-	-	-	27.00	25.00	25.00	25.00	25.00	25.00	-	-	152.00
16	Provision for providing Environmental Services.	-	-	80.00	75.00	75.00	75.00	-	-	-	-	-	305.00
17	Provision for forest protection	-	-	10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	50.00
18	Provision for forest infrastructure development	-	-	50.00	25.00	25.00	-	-	-	-	-	-	100.00
19	Provision for rural infrastructure development	-	-	50.00	50.00	50.00	50.00	14.40	-	-	-	-	214.40
20	Publicity and Environmental Awareness	-	-	5.00	5.00	5.00	5.00	-	-	-	-	-	20.00
21	Capacity building	-	-	6.25	6.25	6.25	6.25	-	-	-	-	-	25.00
22	Wildlife Management and Biodiversity Conservation Plan	-	5.5	12.00	19.50	21.50	16.50	10.00	6.00	3.50	3.50	2.00	100.00
23	Provision for subsidized fuel	-	-	28.25	28.25	28.25	28.25	-	-	-	-	-	113.00
24	Escalation	-	-	-	-	-	-	-	-	-	-	-	493.10
	Total	56.00	76.00	537.00	573.30	511.16	458.54	112.30	84.90	75.40	42.40	30.50	3050.60