

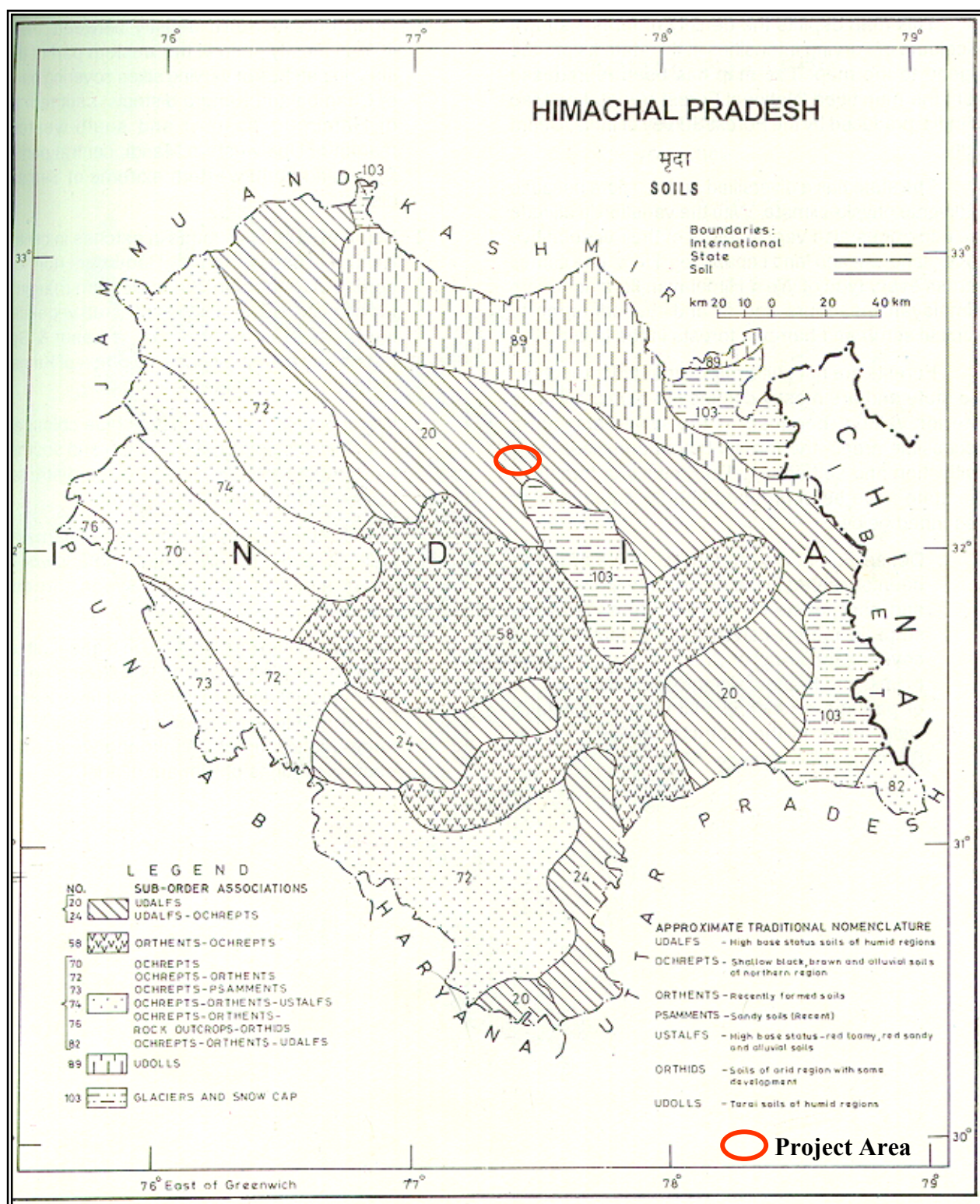


Figure 4.4: Geological map of Himachal Pradesh showing soil type in the Project Area

The proposed underground power house and pressure shaft sites are located in a hill on the left bank of Allain stream where streaky gneisses with quartz-mica schist bands are well exposed. These rocks are fresh and fairly hard but jointed in nature. The strike of foliation varies from N - S to N 35° E - S 35° E with a dip towards East direction. The rock is at places intruded by quartz and pegmatite veins along foliation.

Tailrace Tunnel

The tailrace tunnel from the powerhouse crosses Allain stream below the stream bed and after short-cutting the bend in the course of stream it comes out from the right bank of Allain stream. Bedrock comprising streaky hard and massive gneisses is well exposed on both the banks. The strike of foliation varies from N - S to N 20° W - S 20° E and the dip is of the order of 10° to 15° towards East direction.

4.4.3

Landuse

The landuse pattern of catchment area has been worked out based on earlier study done by RSWM through RITES and additional information generated by ERM India. In order to assess landuse under both studies, base maps were prepared from Survey of India topographical sheets of 1:50000 scale, no. 521-Y3, 521Y4, 52FY7, 521-US. Satellite data was interpreted and landuse information was transferred on this base map using PROCOM instrument. Aerial photographs (Panchromatic Aerial Photographs on 1:50,000 scale) were interpreted with the help of mirror stereoscope and additional information was added on to the base map. The Satellite data used for the interpretation is as follows:

- IRS-IA - LISS-2 - P-30, R-45 23 October 1998
- IRS-IB - LISS-2 - P-30, R-46 03 November 1993
- IRS-1C- LISS-3 - P-95, R-98 16th January 2001

For satellite data interpretation, false colour coding (FCC) of the above mentioned images were used. On the basis of colour composition, shape and texture of spectral signatures different forest groups were categorised. These vegetation classes were confirmed on the aerial photographs. With the help of aerial photographs and satellite images for the total geographical area of catchment (19,400-ha) the classification key was prepared for various categories of land use as shown in the following subsections:

- 1) *Forest*: These have been classified into three categories, viz. dense forest, open forest, and degraded forests.
 - a) *Dense forest* represents well-stocked forest having good crown cover which ranges from 40% and above with no visible canopy cover gaps in between the trees as observed under the mirror stereoscope. In satellite images it is seen as deep red colour with uniform textures and smooth regular pattern.
 - b) *Open forest* represents not so well stocked forest with sparse vegetation cover with average crown cover. The crown cover ranges between 10% and 40% as observed under the mirror stereoscope. Satellite data shows red colour patches with non-uniform pattern.
 - c) *Degraded forests* are identified as those, which are very poorly stocked and degraded due to natural or anthropogenic interference. The canopy cover

ranges below 10% and some of the patches are devoid of any forest cover or undergrowth and may be considered as forest blanks.

- 2) *Agricultural Area*: Agricultural areas were shown as the total area representing cropped, uncropped and habitation around the villages as per the following details:
 - a) *Cropped Area* is recorded in satellite data as pinkish red colour irregular in pattern with very smooth texture and the crop is in full vigor, it represents blue grey tone after the harvest season. In aerial photographs it is recorded as grey toned areas.
 - b) *Uncropped Area* is represented by yellowish red tinge with uniform texture in satellite data.
- 3) *Grass Land*: These are represented alone gentle to steep sloping surfaces with regular and uniform pale yellow colour in the month of November in satellite imageries.
- 4) *Pasture*: These are recorded at higher altitudes and were represented by reddish brown colour with regular smooth texture in satellite data in the month of November.
- 5) *Stoney Rocky Waste Area*
 - a) *Stoney rocky waste*: This area is located at higher altitude along the snowline and represents a dark grey colour with irregular pattern and are recorded sub parallel to the water divide. In aerial photographs these are clearly distinct with other mountainous features like scree, waste debris, alluvial fans etc.
 - b) *Glaciers*: These are seen as linear elongated valleys at higher elevation. These valleys are filled with ice cover alongwith moraineous debris in linear pattern as observed in satellite and aerial photographs.

The details of Landuse /Landcover of the Catchment Area in terms of above key classification are given in Table 4.2. The landuse of the entire Himachal Pradesh is shown in Figure 4.5 whereas the catchment area landuse interpretation of different satellite imageries are shown in Figures 4.6.

Table 4.2: Distribution of Landuse/Landcover in the Catchment Area

Sl. #	Landuse system	Area (km ²)	% of Total Area
1.	Forest		
	- Dense forest	20.92	10.78
	- Open forest	8.46	4.36
	- Degraded forest	6.97	3.59
	- Forest blank	0.95	0.49
2.	Agricultural area	5.96	3.07
3.	Scrub land	12.32	6.36
4.	Alpine pasture		
	- Dense pasture	43.19	22.27
	- Degraded pastures	5.00	2.58
5.	Stoney/Rocky Waste		
	- Stoney waste	28.98	14.94
	- Barren land	11.58	5.97
	- Glacial area	2.21	1.14
	- Gullied	0.47	0.24
6.	Snow cover	46.99	24.20
Total		194.00	100.00

Landuse Distribution of Catchment Area

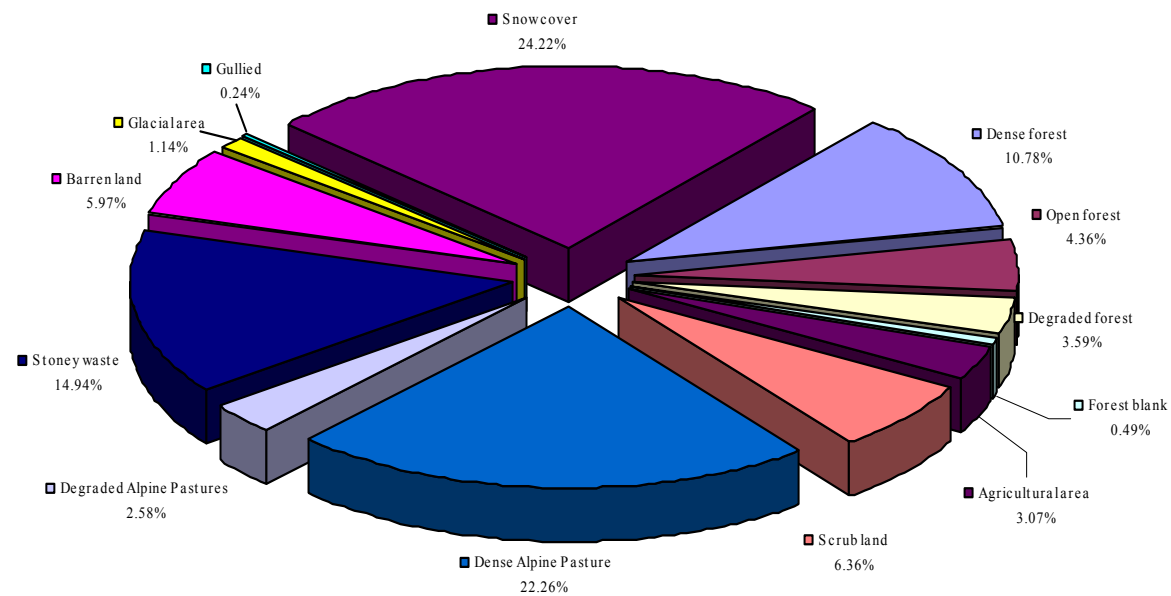


Figure – 4.5: Landuse of Catchment Area for Allain Duhanagan Hydropower Project

The existing ownership of the land that will have to be acquired for various components of the project scheme is also evaluated. The land use evaluated includes the land required for the following project features:

- Barrage/weir.
- Silt removal chambers.
- Storage reservoir/ Surge shaft
- Roads.
- Plant areas.
- Switchyard & Tailrace.
- Colonies, Offices & transit camps.
- Powerhouse.
- Dumping areas.
- Magazine sites.

There are three classes of ownership considered for classification and the following table provides the quantitative figures for the same.

Table 4.3: *Break-up of land required for the project on the basis of land ownership*

S.No.	Land ownership / type	Area (ha)	% of total area
1.	Forest	32.167	41.62%
2.	Private	36.565	47.31%
3.	Government	8.54	11.05%
Total		77.272	-

The lives of the people in Himachal Pradesh are closely intertwined with the natural resource base, as 90% of the population is dependent on agriculture and animal husbandry. Valuable timber species such as deodar cedar (*Cedrus deodara*) and blue pine (*Pinus wallichiana*) have long been a source of income. The common oaks (*Quercus incana*, *Q. dilatata* and *Q. semecarpifolia*) are the backbone of the fuel and fodder economy. In some locations entire groups of people, such as the Gujjars, depend on alpine grazing lands for a living. Any change in the natural resources of the region will have far-reaching repercussions.

4.4.4 *Visual Landscape/ Aesthetics*

Manali is located in the heart of the Pir Panjal Range of the Himalaya, close to the source of the Beas River. Together with the Chandra-Chenab, Ravi and Sutlej Rivers, which also drain in this region of the Himalaya, the Beas serves as an important water source for agricultural and industrial development in the Punjab and Haryana. In its upper reaches, the Beas River flows north to south or transversely through the mountain ranges to form what is known as the Kullu Valley. In its lower reaches, that is downstream from Bhuntar, the river is antecedent, cutting a deep and confined gorge, flowing alternately north to south and east to west through the southern Himalayan Ranges and foothills.