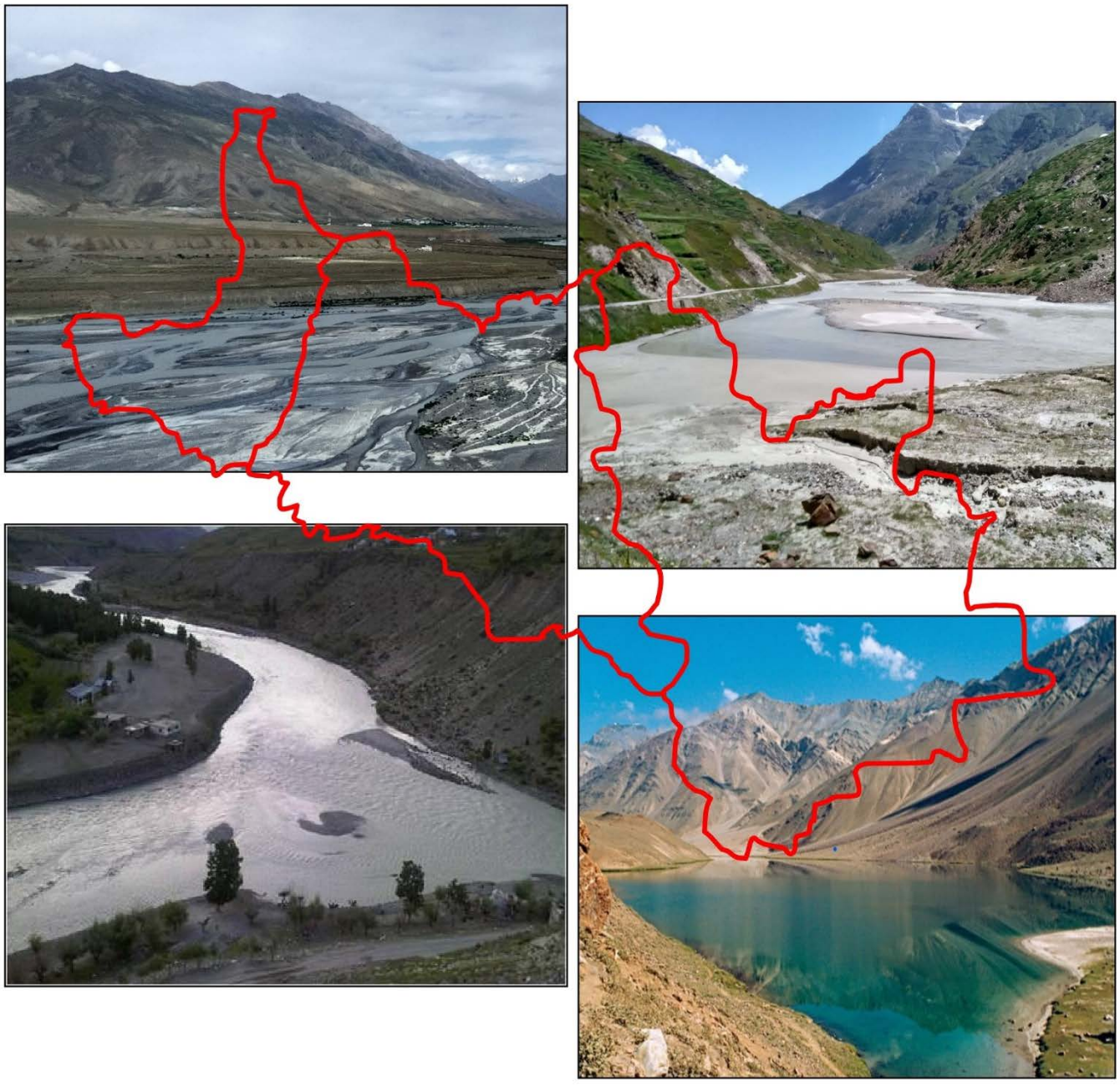
DISTRICT SURVEY REPORT-2024
District- Lahaul Spiti Himachal Pradesh



DISTRICT SURVEY REPORT FOR SAND
MINING OR RIVER BED MINING *AND OF MINOR MINERALS*

OTHER THAN SAND MINING OR RIVER BED MINING

Prepared and submitted by Department of Industries, Himachal Pradesh

Finalized & approved by SEIAA, Himachal Pradesh in its 70th meeting (PARIVESH-1) held on dated 30th Sept., 2024 vide Agenda Item No. 1.

Contents

Executive Summary DSR

District Survey Report (DSR) is a comprehensive document prepared to regulate riverbed and hill slope mining activities within the district. This report is essential for sustainable management of riverbed mining, ensuring that the extraction of minerals is conducted in an environmentally sound and socially responsible manner. The preparation of DSRs is mandated under the Sustainable Sand Mining Management Guidelines, 2016.

District Survey Report of riverbed mining are indispensable tools for the sustainable management of riverine mineral resources. They offer a structured approach to resource assessment, environmental protection, regulatory compliance, and stakeholder engagement. By fostering sustainable mining practices, DSRs contribute significantly to environmental conservation, socio-economic development, and the overall well-being of communities dependent on river ecosystems.

As per the EIA Notification, 2006 and its subsequent amendment vide S.O. 3611(E) dated 25th July, 2018 issued by MoEF&CC, GoI, the main objective of the preparation of District Survey Report (as per the Sustainable Sand Mining Guideline) is to ensure the identification of areas of aggradations or deposition where mining can be allowed; and identification of areas of erosion and proximity to infrastructural structures and installations where mining should be prohibited and calculation of annual rate of replenishment and allowing time for replenishment after mining in that area.

- **Key Aspects of District Survey Report**

1. **Assessment of Resources**: DSR provide a detailed assessment of available mineral resources in the riverbeds within the district. This includes data on the quantity, quality, and distribution of sand and other minor minerals. By accurately estimating these resources, the report aids in preventing over-extraction and depletion of minerals.
2. **Environmental Impact Analysis**: The report include an analysis of the environmental impact of riverbed mining. This encompasses the effects on river morphology, hydrology, aquatic ecosystems, and biodiversity. Understanding these impacts is crucial for mitigating adverse environmental effects and preserving riverine ecosystems.
3. **Regulation and Compliance**: DSR serve as a regulatory framework for riverbed mining operations. They outline guidelines and standards for mining practices, ensuring compliance with national and state environmental laws. This helps in curbing illegal mining activities and promoting legal and regulated mining.
4. **Sustainable Mining Practices**: By recommending sustainable mining practices, DSR help in minimizing environmental degradation. These practices may include controlled mining depths, restricted extraction zones, and periodic replenishment studies to maintain the ecological balance of river systems.
5. **Socio-Economic Considerations**: The report also takes into account the socio-economic aspects of riverbed mining, including the impact on local communities. This includes evaluating benefits such as employment generation and revenue for local governments, as well as addressing negative consequences like displacement and loss of livelihoods.
6. **Data-Driven Decision Making**: DSR provide a scientific basis for decision-making regarding riverbed mining. The inclusion of geospatial data, remote sensing images, and field surveys enhances the accuracy and reliability of information. This data-driven approach supports informed policy-making and resource management.

7. **Stakeholder Involvement**: The preparation of DSR involves consultation with various stakeholders, including government agencies, local communities, environmentalists, and industry representatives. This inclusive process ensures that multiple perspectives are considered, leading to balanced and equitable mining practices.

- **Benefits of District Survey Report**

1. **Environmental Protection**: By identifying and mitigating the environmental impacts of riverbed mining, DSR play a crucial role in protecting river ecosystems, reducing erosion, and maintaining water quality.
2. **Resource Management**: Effective management of mineral resources is achieved through regulated extraction, preventing over-exploitation and ensuring the longevity of resources for future use.
3. **Legal Compliance**: DSR help in ensuring that mining activities adhere to legal requirements, reducing the incidence of illegal mining and associated environmental damage.
4. **Community Welfare**: By considering the socio-economic impacts, DSR help in safeguarding the interests of local communities, ensuring that they benefit from mining activities without suffering undue harm.
5. **Sustainable Development**: The integration of sustainable practices in mining operations contributes to the broader goals of sustainable development, balancing economic growth with environmental stewardship.

- While issuing any fresh permission for mining activity in the district the same is permissible only when the identified stretch is reflected in the DSR with its geo coordinates, quantity and geological profiling.
- The SEIAA/ SEAC while considering the cases for grant of EC need to assess with the help of DSR the proposed mining activity is within the identified stretches of river/ streams/ khads, matching the geo coordinates of proposed site and river stretch where the mineral is available by using ***kml*** files.
- In the DSR '**No Mining Zones**' are also listed which clearly give a view of stretches where no mining activity will be allowed and remain restricted.

"*No Mining Zones*" (NMZs) are critical areas identified within riverbeds where mining activities are strictly prohibited. These zones are delineated based on various environmental, ecological, and social criteria to ensure the protection of sensitive areas. The identification of NMZs is a key component of District Survey Report (DSR) for riverbed mining in India, aimed at promoting sustainable and responsible mining practices.

Criteria for Identifying No Mining Zones in DSR

1. **Ecological Sensitivity**: Areas with high ecological value, such as habitats for endangered species, breeding grounds for aquatic life, and regions with significant biodiversity, are designated as NMZs. Protecting these areas is crucial for maintaining ecological balance and biodiversity.
2. **Hydrological Importance**: Zones critical for maintaining river flow and groundwater recharge are marked as NMZs. This includes regions near riverbanks, floodplains, and areas prone to erosion. Preserving these areas helps in sustaining water quality and quantity.

3. **Proximity to Infrastructure**: Areas close to infrastructure such as bridges, roads, dams, and human settlements are identified as NMZs to prevent structural damage and ensure the safety of human life and property.
4. **Cultural and Archaeological Significance**: Regions with cultural, historical, or archaeological importance are protected as NMZs to preserve heritage sites and prevent any damage due to mining activities.
5. **Community Dependence**: Areas that are vital for the livelihood of local communities, such as regions used for fishing, agriculture, and other traditional activities, are designated as NMZs. This ensures the sustenance of community livelihoods and social well-being.

Basis for appraisal of EC (River Bed Mining Projects)

Sl. No.	PP Details	Location with khasra Nos.	River/ Stream location	Coordinates (Lat Long)	Area of Mining lease (ha)	Period of Mining lease (Initial)		Period of Mining lease	
						From	To	Form	To
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Details of River/ Stream

S. No.	Name of the River or Stream	Total Length in the District (in Km)	Place of origin	Altitude at Origin
(1)				

Portion of the River or Stream Recommended for Mineral Concession	Length of area recommended for mineral concession (in kilometer)	Average width of area recommended for mineral concession (in meters)	Area recommended for mineral concession (in square meter)	Mineable mineral potential (in metric tonne) (60% of total mineral potential)

Mineral Potential

Boulder (MT)	Bajari (MT)	Sand (MT)	Total Mineable Mineral Potential (MT)

S. No.	River or Stream	Portion of the river or stream recommended for mineral concession	Length of area recommended for mineral concession (in kilometer)	Average width of area recommended for mineral concession (in meters)	Area recommended for mineral concession (in square meter)	Mineable mineral potential (in metric tonne) (60% of total mineral potential)
(1)						
Total for the District						

PART I

DISTRICT SURVEY REPORT OF DISTRICT LAHAUL & SPITI H.P

(River Bed Sand Mining and Other Minor Minerals)

1. INTRODUCTION

Minerals are valuable natural resources being finite and non-renewable. They constitute the vital raw materials for many basic industries and are a major resource for development. The history of mineral extraction in India dates back to the days of the Harappan civilization. The wide availability of minerals in the form of abundant rich reserves made it very conducive for the growth and development of the mining sector in India. The country is endowed with huge resources of many metallic and non-metallic minerals. The mining sector is an important segment of the Indian economy. Since independence, there has been a pronounced growth in mineral production both in terms of quantity and value. India produces as many as 87 minerals, which include 4 fuel, 10 metallic, 47 non-metallic, 3 atomic and 23 minor minerals (including building and other materials).

Minerals are classified into two groups, namely (i) Major minerals and (ii) Minor minerals. Amongst these two groups, minor minerals have been defined under section 3(e) of the Mines and Minerals (Regulation and Development) Act, 1957. The minor minerals are further governed by "The Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of Illegal Mining, Transportation and Storage) Rules, 2015". The Minor minerals include building stones, gravel, ordinary clay, ordinary sand, limestone used for lime burning, boulders, kankar, murum, brick earth, bentonite, road metal, slate, marble, stones used for making household utensils etc. and other minerals not defined as minor minerals in the said Act are treated as major minerals. They include coal, kyanite, sillimanite, barites, chromite, fluorite, quartz, sand used for stowing purposes in coal mines and many other minerals used for industrial purposes.

The mining activities in the state of Himachal Pradesh can basically be categorized as in the large sector and in the small sector. The large sector comprises limestone projects for manufacturing cement and other lime products while the small mining sector comprises the mining of minor minerals like sand, stone, bajri, slate, shale and clay etc. which are basically building materials to meet the demand for infrastructure development of the state.

In pursuance to the orders of the Hon'ble Supreme Court dated 27.02.2012 in the matter of Deepak Kumar etc. vs State of Haryana and Others, prior environment clearance has

now become mandatory for mining of minor minerals irrespective of the area of mining lease. In order to comply with the judgment of the Hon'ble Supreme Court, the Ministry issued S.O.141 (E) dated 15.01.2016 vide which the District Level Environment Assessment Committee (DEAC) and District Level Environment Impact Assessment Authority (DEIAA) were constituted. In the said Notification at point No.7 (iii) the procedure to prepare the District Survey Report (DSR) was laid down providing that a survey shall be carried out by the DEIAA with the assistance of Geology/Irrigation/Forest/PWD etc. departments. As, per the aforesaid, Notification dated 15.01.2016 the Geological Wing, assisted the DEIAA in the preparation of the District Survey Report during the year 2016 and the said District Survey Report prepared for District Lahaul & Spiti was approved by the DEIAA, after following the procedure laid down in the aforesaid Notification. It is also provided in the Notification No. S.O. 141 (E) dated 15th January 2016 that the District Survey Report (DSR) shall form the basis for the application for environmental clearance, preparation of reports and appraisal of Projects. The report shall be updated once every 5 years.

In the aforesaid notification dated 15.01.16, the Hon'ble High Court of Jharkhand at Ranchi in its orders dated the 11th April 2018 and 19th June 2018 in W.P. (PIL) No. 1806 of 2015, in the matter of Court on its Own Motion Versus the State of Jharkhand & Others with W.P. (PIL) No. 290 of 2013, in the matter of Hemant Kumar Shilkarwar Versus the State of Jharkhand & Others, has inter-alia directed the preparation of District Survey Report for the Sand mining or riverbed mining and for minor minerals other than Sand and bajri or delegation of the powers for preparation of format of District Survey Report of minor minerals other than sand and bajri to the State Government and/or District Environment Impact Assessment Authority and District Expert Appraisal. Thereafter, the Ministry of Environment, Forests and Climate Change (MoEF & CC) vide notification dated 25.07.2018 provided the procedure for the preparation of the District Survey Document. Accordingly, the survey report for district Lahaul & Spiti has been updated. This District Survey Report has been updated by covering the mineral-bearing areas and overviews of mining activities in the district with all the relevant features pertaining to geology and mineral wealth in replenish-able and non-replenish-able areas of rivers, streams and other sources. The mineral potential has been calculated based on field investigations taking into consideration the geology of the catchment area of the river/streams and other sources.

The District Survey Report (DSR) of District Lahaul & Spiti comprises secondary data on geology, mineral resources, climate, topography, landform, forest, rivers, soil, agriculture, road, transportation, irrigation etc of the district collected from various published

and unpublished literature and reports as well as various websites. The data of deposition or replenishment, the distance of deposits from the river banks, chances of erosion and other geomorphological features of rivers may vary due to floods, heavy rains and other natural calamities.

2. OVERVIEW OF MINING ACTIVITY IN THE DISTRICT

Himachal Pradesh is situated in the western Himalayas covering an area of 55,673 kilometres (34,594 mi). Himachal Pradesh is almost wholly mountainous with altitudes ranging from 350 meters to 6,975 meters above the mean sea level. It is located between Latitude 30º22'40"N to 33º12'20"N and Longitude 75º45'55" E to 79º04'20" E. It has a deeply dissected topography, complex geological structure and a rich temperate flora in the sub-tropical latitudes. The drainage system of Himachal is composed both of rivers and glaciers. Himalayan rivers crisscross the entire mountain chain. Himachal Pradesh provides water to both the Indus and Ganges basins. The drainage systems of the region are the Chandra Bhaga or the Chenab, the Ravi, the Beas, the Sutlej and the Yamuna. These rivers are perennial and are fed by snow and rainfall. They are protected by an extensive cover of natural vegetation. Due to extreme variation in elevation, there is great variation in the climatic conditions of Himachal. The climate varies from hot and sub-humid tropical in the southern tracts to, with more elevation, cold, alpine and glacial in the northern and eastern mountain ranges. The state has areas like Dharamsala that receive very heavy rainfall, as well as those like Lahaul and Spiti that are cold and almost rainless.

The district ***Lahaul & Spiti*** is situated in the northern and north eastern parts of Himachal Pradesh. It is located amidst the grandeur of the great Himalayas interspersed with beautiful landscapes and permanently glowing snowcapped mountain peaks, glaciers, lakes and two river valleys of Chandra Bhaga and Spiti. Lahaul & Spiti is a scarcely populated district, located in the northeastern part of the State. The district is entirely hilly and comprises two major valleys viz. Lahaul & Spiti. The Lahaul Valley is located in the northwestern part of the district while the Spiti Valley is located in the southeastern part. The district, with its headquarters at Keylong, lies between 31°44'57" & 32° 59'57" North latitudes and 76°46'29" & 78°41'34" East longitudes and is covered by Survey of India degree sheets 52C, 52D and 52L. The district is bounded by Jammu & Kashmir State in the north, Tibet (China) in the east, Kinnaur in the southeast, Kullu in the south & Kangra and Kullu in the northwest.

The district has a total geographical area of 13,841 sq km, covers about 25 % of the State's geographical area and ranks 1st in area in the State. There are no towns in the district and has 521 villages of which 287 villages are inhabited and 234 are uninhabited. The district

has been divided into 2 divisions viz. Keylong and Kaza. There are 2 tehsils Keylong & Kaza & 1 sub-tehsils Udaipur

As per the 2011 census, the district has a population of 31,564 persons with a population density of 2 persons per sq km. Population wise it ranks 12th in the State. The male and female population in the district is 16,588 and 14,976 respectively with a female/male sex ratio of 903/1000. The scheduled cast population in the district is 7.08 % and the scheduled tribe population is 81.44 %.

In districts Lahaul and Spiti, soon there will be a boom in the construction activities at a large scale for the development of roads and Hydro projects, but most of the area of the District remains snowbound and landlocked for almost 6 months i.e. from December to May and the working season for developmental activities are limited to 6 months only, resulting in higher costs of construction.

Mainly three types of minor mineral constituents such as sand, stone and bajri are required for any type of construction apart from other materials like cement and steel. In earlier times, the houses/ buildings were constructed in the form of small dwellings with walls made up of mud plaster, stone and interlocking provided with wooden frames and there were negligible commercial as well as developmental activities resulting in less demand for building materials. However, over time, new vistas of developmental activities were started. As such the demand for minor minerals in the District started in increasing trend. To meet the requirement of raw construction materials, the extraction of sand, stone and bajri is being carried out exclusively from the river beds. The demand for sand is mainly met through river-borne sand whereas the demand for bajri/grit is either met through river-borne collection or manufactured grit by stone crushers. The demand of dressed or undressed stone is met through the broken rock material from the hill slope.

The residents used to lift gravel etc. from the river beds to meet their bonafide requirement, however after coming into the Himachal Pradesh Minor Minerals (Concession) Rules 1971 Repealed as Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of Illegal Mining, Storage and Transportation) Rules 2015, the mining is regulated.

3. LIST OF GRANTED MINING LEASES/AUCTIONED AREAS IN THE DISTRICT WITH LOCATION, AREA AND PERIOD OF VALIDITY

At present, only 02 Nos of mining leases (Pvt./Govt. Land) have been granted/executed and are under operation and the demand for furnished material is still high. The details of the Mining lease are as follows:

Sr. No.	Name and Address of the Leases	Area of Mining Lease	Mohal/ Mauza	Tehsil	Date of execution of the lease	Hill slope/river bed	Status
1	Sh. Shiv Dass S/O Sh. Ram Dass VPO & Sub-Tehsil Udaipur, Distt. Lahaul and Spiti HP	18-11 Bighas	Chokhang, Udaipur, Distt. L & S H.P.	Udaipur	31-05-2023 to 30/05/2028	Hill slope	Working
2	Sh. Pratap Singh S/o Nihal Singh, Village Rapey, P.O. Jobrang, Tehsil Lahaul, Distt. L&S, H.P.	04-56 Hectare	Koksar	Lahaul	23/05/20218 to 22/05/2033	Hill slope	Non-working

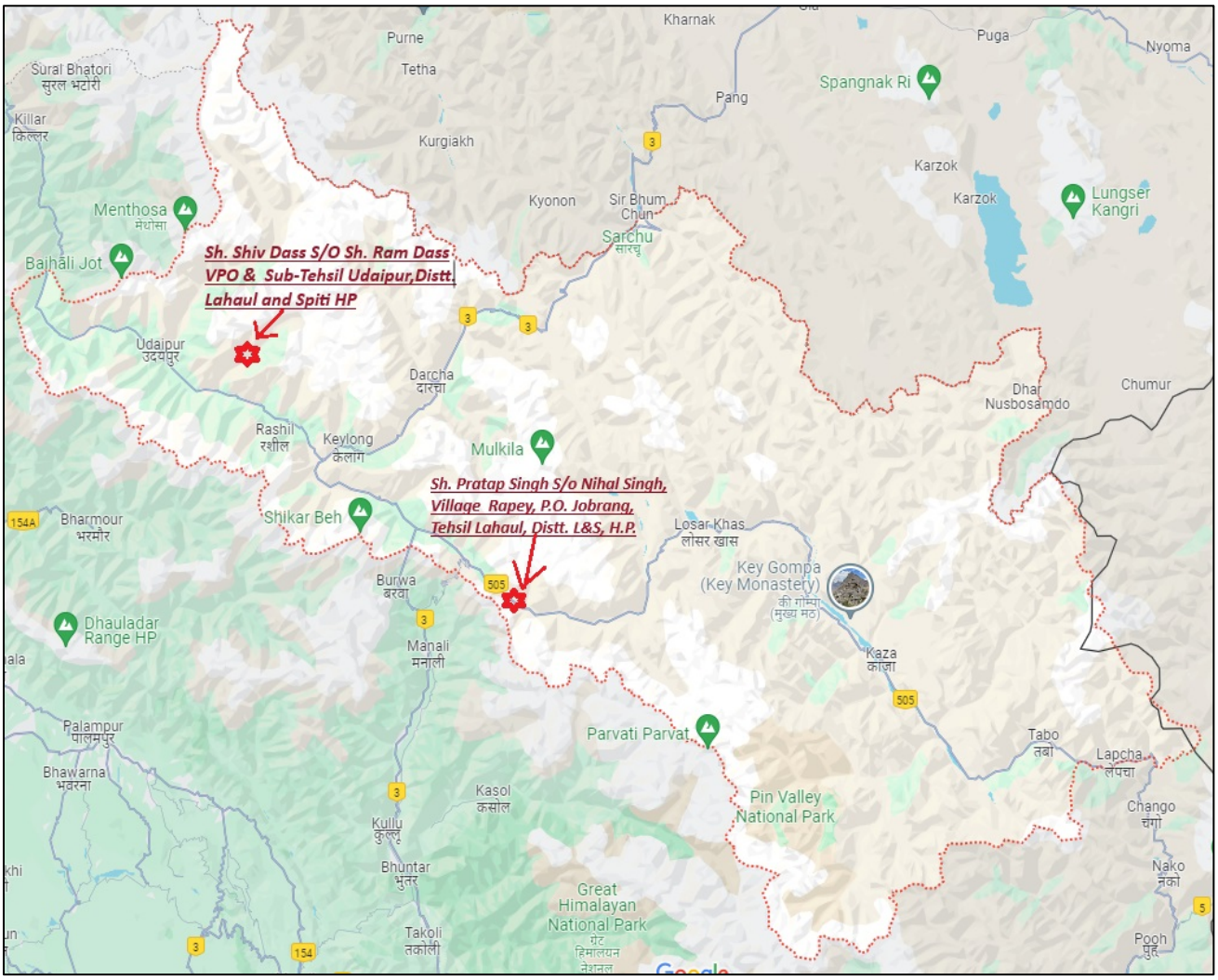


Image showing the location of the mining leases

4. DETAILS OF ROYALTY OR REVENUE RECEIVED IN THE LAST FOUR YEARS

Detail of Revenue Collected by Mining Office Lahaul-Spiti H.P. in Last 03 Years.				
Sr. No.	**Financial Year**	**Revenue collected Offline (In Rs)**	**Revenue Collected Online (In Rs)**	**Total Revenue Collected (In Rs)**
1	2020-21	56763981	24062120	**80826101/-**
2	2021-22	12879017	42970740	**55849757/-**
3	2022-23	51996827	49088240	**101085067/-**
4	2023-24	27860828	21814720	**49675548/-**

5. DETAIL OF PRODUCTION OF MINOR MINERAL IN LAST FOUR YEARS:

Mineral	2019-20	2020-21	2021-22	2022-23
aggregate	321808	4259.5	46593	94242
Clay/ Muck	80255	634168.6	0	0
Bajri	82628	94820	199547	171623.155
Sand	26500	55278	56533	93448
Rough stone	81553.8	96036.3	340529	285298
Building stone	12608	12781	18872.66	15979
Slate	990	1060	526	1127

6. PROCESS OF DEPOSITION OF SEDIMENTS IN THE RIVERS OF THE DISTRICT

Many rivers originate from the Himalayan and Shivalik regions which supply water in down streams. The greatest sediment yields are generally associated with rivers draining areas of intensive tectonic activity therefore, Himalayan rivers cause tremendous erosion and carry large amounts of sediment. The sediment load of a river is commonly considered to be a pollutant that is aesthetically displeasing and environmentally degrading. Sediment load can be divided into bed load and suspended load based on the mode of transport. Bed load is transported close to the bed where particles move by rolling, sliding, or jumping transport in natural rivers is a complicated phenomenon. Its movement is quite uneven in both the transverse and longitudinal directions, which varies considerably. Some sediment particles roll or slide along the bed intermittently and some others saltate (hopping or bouncing along the bed).

The material transported in one or both of these modes is called 'bed load'. Finer particles (with low fall velocities) are entrained in suspension by the fluid turbulence and transported along the channel in suspension. This mode of transport is called 'suspended load'. Sometimes finer particles from upland catchment (sizes which are not present in the bed material), called 'wash load', are also transported in suspension. The combined bed material and wash .load is called 'total load'. Bed load ranges from a few percent of the total load in lowland rivers to perhaps 15% in Mountain Rivers to over 60% in some arid catchments. Although a relatively small part of the total sediment load, the arrangement of bed load sediment constitutes the architecture of sand bed and gravel-bed channels. The rate of sediment

transport typically increases as a power function of flow; that is, a doubling of flow typically produces more than a doubling in sediment transport and most sediment transport occurs during floods.

Natural processes shape the land by various means i.e. fluvial, erosional and Aeolian are slow and steady but any slight change to these processes can imbalance the process and resultant is the catastrophe. Deforestation, industrialization, urbanization, floodplain cultivation, dam and levee construction, and channelization have altered dramatically natural flow regimes. These changes have contributed to flooding, erosion, channel incision, contamination, non-native species introductions, and loss in ecological diversity. Although well-organised techniques to harvest natural resources can sustain the changes still slow and steady.

The multiple and sometimes incompatible services we demand from rivers often lead to social conflicts. The policy and management decisions that surround these conflicts increasingly require the integration of science-based information that crosses traditional disciplines. Unfortunately, gaps in our understanding of river processes often limit our ability to manage rivers optimally.

The mineral process of deposition of sediment includes the Fluvial process i.e. the physical interaction of flowing water and the natural channels of rivers and streams. The process plays an essential and conspicuous role in the denudation of land surfaces and the transport of rock detritus from higher to lower levels.

Over much of the world the erosion of landscape, including the reduction of mountains and the building of plains, is brought about by the flow of water. As the rain falls and collects in watercourses, the process of erosion not only degrades the land, but the products of erosion themselves become the tools with which the rivers carve the valleys in which they flow. Sediment materials eroded from one location are transported and deposited in another, only to be eroded and re-deposited time and again before reaching the ocean. At successive locations, the riverine plain and the river channel itself are products of the interaction of a water channel's flow with the sediments brought down from the drainage basin above.

The velocity of a river's flow depends mainly upon the slope and the roughness of its channel. A steeper slope causes higher flow velocity, but a rougher channel decreases it. The slope of a river corresponds approximately to the fall of the country it traverses. Near the source, frequently in hilly regions, the slope is usually steep, but it gradually flattens out, with occasional irregularities, until, in traversing plains along the latter part of the river's course, it usually becomes quite mild. Accordingly, large streams usually begin as torrents with highly turbulent flow and end as gently flowing rivers.

In flood time, rivers bring down large quantities of sediment, derived mainly from the disintegration of the surface layers of the hills and valley slopes by rain and from the erosion of the riverbed by flowing water. Glaciers, frost, and wind also contribute to the disintegration of the Earth's surface and to the supply of sediment to rivers. The power of a river current to transport materials depends to a large extent on its velocity so that torrents with a rapid fall near the sources of rivers can carry down rocks, boulders, and large stones. These are gradually ground by attrition in their onward course into shingle, gravel, sand, and silt and are carried forward by the main river toward the sea or partially strewn over flat plains during floods. The size of the materials deposited in the bed of the river becomes smaller as the reduction of velocity diminishes the transporting power of the current.

The course of the rivers in the districts is full of occasional irregularities where the river-loaded or flooded material is deposited. Various such locations are given in the next chapters.

6.1 River Science

River Science is the study of processes affecting the river system. River science integrates multiple disciplines; it includes the study of how hydrological, geological, chemical, and ecological processes interact to influence the form and dynamics of riverine ecosystems and how riverine ecosystems in turn influence these processes across multiple spatial and temporal scales.

River science seeks to understand the linkages between river-related processes and patterns at multiple scales, from small streams to large rivers, from pristine to heavily urbanized watersheds, and from daily- to century-scale dynamics. Watersheds range in size from under one to thousands of square kilometres, and a river's physical and biological environment changes as water moves downstream. Small-scale or short-term physical processes may influence reach-scale habitat features that in turn influence ecological processes at broader scales and over longer periods. River science includes the study of relationships between watersheds, riparian zones, floodplains, groundwater, headwaters and downstream Rivers. Thus, river science is not constrained by any arbitrary spatial scale or physical boundaries defined by the morphology of channels, floodplains, or terraces. Rather, its domain and bounds are defined by the scales necessary to understand and predict river processes.

6.2 Major Rivers of Lahaul & Spiti District

The Lahaul area is drained by Chanderbhaga & Spiti district is drained by the Spiti River; In addition to this river, there are some other small areas of three other secondary rivers like Miayr Nala, Jhankar in Lahaul and Pin and Lingiti Nalas in Spiti Valley.

The Chandrabaga and Spiti rivers form the major drainage system in the district. The river is formed by the confluence of two rivers, Chandra and Bhaga, at Tandi, 8 km (5.0 mi) southwest of Keylong, in the Lahaul and Spiti districts.

The drainage pattern of the river in Lahaul Spiti is mostly dendritic to The drainage pattern of river in Lahaul Spiti is mostly dendritic to sub-dendritic i.e. the tributaries meet at low angles and branch at random, like a tree pattern. The study of drainage networks provides an idea about the topography, climate, geology, and hydrological features of the region. Drainage is the most important natural agent in sculpturing landforms. It also has a bearing on settlement patterns in this high-altitude arid region. Lahaul-Spiti occupies higher Himalayan and trans-Himalayan zones, where elements mostly occur along the river valleys. Being, a mountainous area with adverse climatic conditions, these affect the entire population, thus upsetting the entire range of economic activities. Therefore, it becomes necessary to analyse the drainage network in order to assess the role of the natural environment and its impact on socio-cultural and economic aspects. Lahaul-Spiti has three major rivers namely Chandra, Bhaga, and Spiti along with their numerous tributaries. River Chandra and Bhaga after their confluence at Tandi becomes Chandra-Bhaga also known as Chenab.

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Chandra River:

It originates from a huge snow field on the southeastern base of the Baralacha Pass around Chandra Tal. It flows in a south-westerly direction for the first 48 kms. Then, it takes a sharp northwesterly and western direction for a further 64 kms up to Tandi where it joins the Bhaga River. On its upper left bank is situated a beautiful glacial lake known as 'Chandra Tal' straddles between a low ridge and the Kunzum range. The lake is about a kilometre long and half a kilometre wide with an outlet into the river. Chandra River is fed by a number of glaciers.

The biggest being the Shigri on its left bank and the Samundri, and Sonapani glaciers on the right bank. It registers an average fall of about 12.5 metres per kilometre up to its confluence with Bhaga at Tandi.

Bhaga River:

Bhaga River has its origin from the southwestern side of the Baralacha Pass at an altitude of about 4800 metres. It flows in a north-west direction for almost 13 kms and then takes a south-westerly course. It has a total length of about 65 km up to Tandi. The main tributaries are Barsi, Milang nullah Billing nullah etc. Its valley is barren and rocky up to Darcha. It has an average fall of about 28 metres per kilometre.

Chenab River:

After their confluence at Tandi, Chandra and Bhaga rivers are called Chandra- Bhaga or Chenab. The River is entirely fed by a number of glacier tributaries from either side. The right bank tributaries include Shansha nullah, Thirot nullah, Chokang nullah, Miyar nullah etc. Lingar nullah, Rashil nullah, Naida nullah, Ghor nullah, and Galigorh are the left bank tributaries. Among these, Miyar nullah is the largest tributary with a length of about 32 kilometres. Chenab runs in a north-westerly direction for about 75 kilometres
until its exit to the Chamba district. It has an average fall of about 6 metres per kilometre from a height of 2800 metres.

Spiti River:

The Spiti River originates from far north on the eastern slopes of the mountain ranges between Lahaul and Spiti. It begins at the base of the Kunzum range with the confluence of 'Kunzum La Tagpo' and the streams Kabzina and Pinglung. Broad and flat valleys bordered by high vertical cliffs mark the Spiti River. The total length of the river is about 130 kilometres on the southeast of Spiti. It continues up to Khabo in the Kinnaur district where it joins the Satluj River. Several tributaries join the Spiti River on both sides. On its right bank are Chiomo, Gyundi, Rahtang, Pin and Sumra etc.

Thanar, Hanse, Tagling. Shila, Kaza, Lingti, Tabo, and Parechu streams join on the left bank. The Pin River is the most important right-bank tributary of the Spiti River. The length of the Pin River is about 50 kilometres. Lingti River is about 40 kilometres long and is an important left-bank tributary of the Spiti River

6.3 Drainage Density

Drainage density is a product of the total length of streams in a unit area. Images show that an insignificant proportion of the total drainage area lying in the southwestern and south-central parts of Lahaul has very high drainage density. All such portions are situated to the north of the Pir Panjal and south of the Great Himalayan ranges. The entire Lahaul tehsil except

for north-western inhabited portions mainly in the Miyar sub-valley and central parts of Spiti valley along the main river course has high drainage density. A significant proportion of Chenab Valley is located in the north-western parts and minor portions in the north-west of Bhaga Valley have medium drainage density.

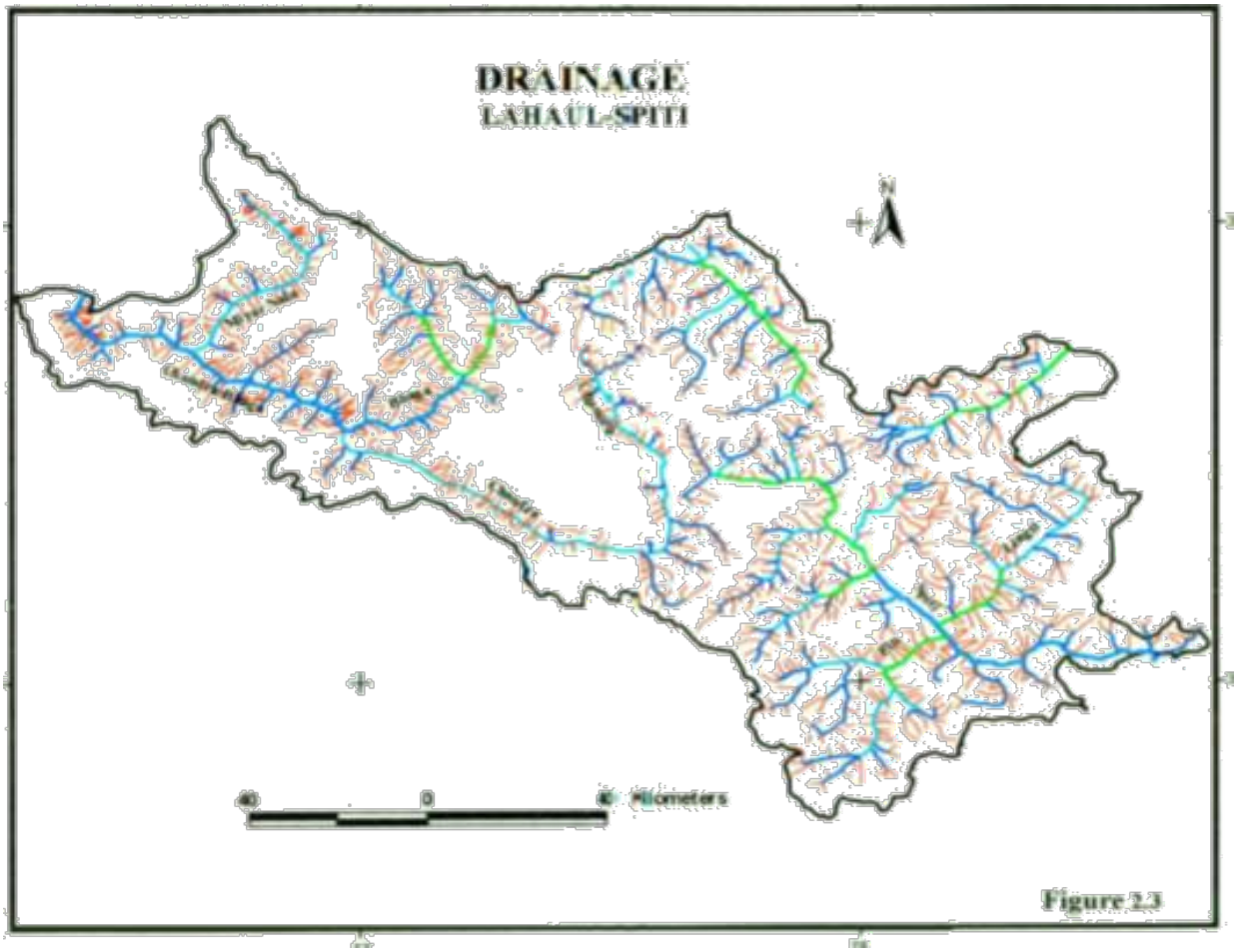
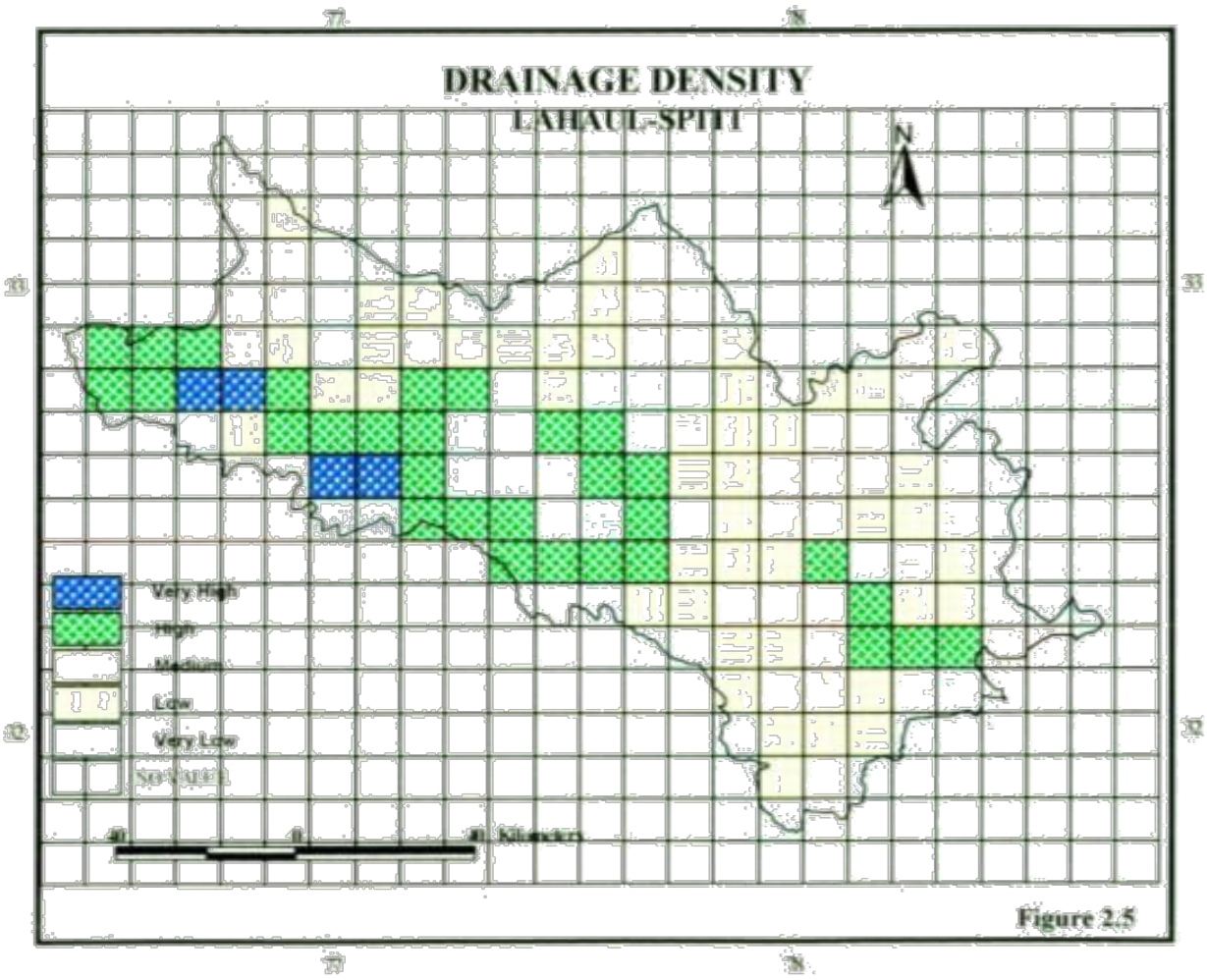


Figure showing Drainage Map of Lahaul-Spiti District



Most of the Spiti valley except south-central inhabited parts has medium drainage density. Low and very low drainage density occurs in all the uninhabited portions lying under ice and snowfields, pastures etc. A less significant proportion lying in the southeast of Lahaul comprising a central triangular mass does not have many streams and is uninhabited.

The above discussion on altitudinal zones, slope of the land, stream ordering and drainage density reflects that most of the area is highly rocky, undulating and characterised by medium to very low drainage density. It is, therefore, important to further discuss this aspect in detail by looking at the relationship between these factors and drainage texture. Drainage texture furnishes an idea regarding the potential land suitable for economic purposes. It is a product of stream frequency and drainage density in a unit area.

6.4 Stream ordering

The stream order hierarchy was officially proposed in 1952 by Arthur Newell Strahler, a geoscience professor at Columbia University in New York City, in his article “Hypsometric (Area Altitude) Analysis of Erosional Topology.” The article, which appeared in the Geological Society of America Bulletin outlined the order of streams as a way to define the

size of perennial (a stream with water in its bed continuously throughout the year) and recurring (a stream with water in its bed only part of the year) streams.

When using stream order to classify a stream, the sizes range from a first-order stream all the way to the largest, a 12th-order stream. A first-order stream is the smallest of the world's streams and consists of small tributaries. These are the streams that flow into and "feed" larger streams but do not normally have any water flowing into them. In addition, first and second-order streams generally form on steep slopes and flow quickly until they slow down and meet the next-order waterway.

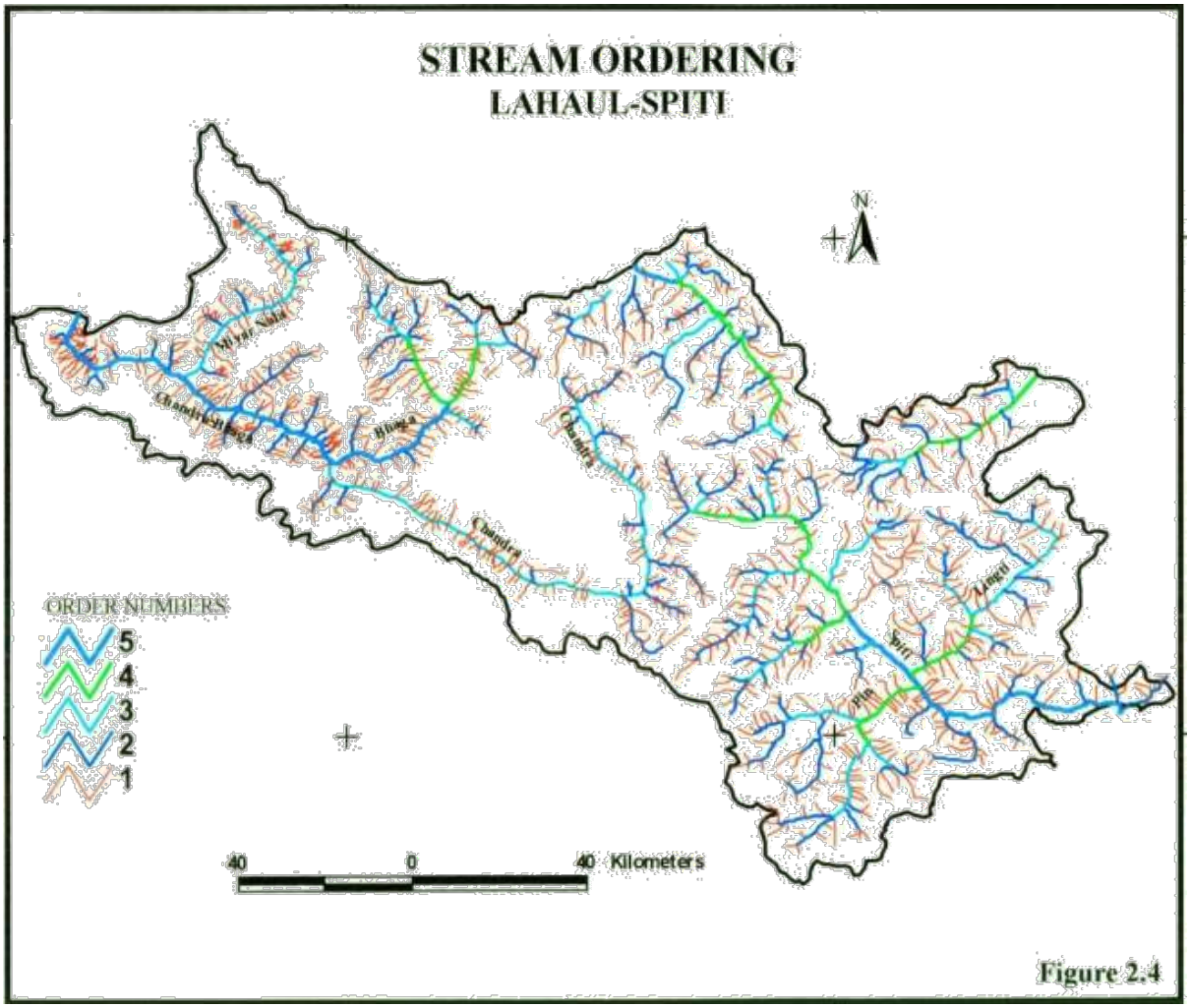


Fig showing Stream Order of Lahaul & Spiti District

Stream ordering provides an idea regarding the dimension of the basin of each tributary and the extent of water discharge. There is generally a positive correlation between water discharge and the width of the valley with the stream order. In other words, the higher the stream order wider the valley and the higher the water discharge. It gives an indirect idea about the water resources of the area. The Chenab River attains fifth order from its starting point at Tandi where Chandra and Bhaga meet. Bhaga is the only important tributary that attains the fourth order before its confluence with the Chandra River. There are one-fifth order, two-fourth

order, twelve-third order, seventy-two-second order and 482 first order streams that join to make the Chenab River. The overall bifurcation ratio between 1 and 2nd order is nearly seven, six between 2nd and 3rd and six between 3rd and 4th order streams. The bifurcation ratio decreases between 4th and 5th order streams i.e. two respectively.

The river Bhaga is the only major stream that has a fourth-order constituted by 5 third-order, 16 second order and 127 first-order streams. The bifurcation ratio between 1 and 2"d order is nearly eight and between 2"d and 3rd order is nearly three. It is five between 3rd and 41 h order streams. The Chandra River basin has one third-order, 18 second-order, and 152 first-order streams. The ratio between its successive streams stands at nearly eight between the first and second order stream and between the second and third order is nearly eighteen.

The Miyar River has 1 third-order stream, 10 second order and 70 first-order streams. The bifurcation ratio is seven between the first and second and ten between the second and third order streams respectively.

The Spiti is the main river in Spiti tehsil of Lahaul-Spiti district becomes a fifth-order stream. It has one-fifth order, 10 fourth order, 17 third order, 67 second order and 362 first order streams. The river has predominately first and second-order streams. It shows a bifurcation ratio of nearly five for the first two successive orders and it is nearly four between the second and third order streams. It is nearly two between third and fourth-order streams. It increases sharply between the fourth and fifth order i.e. ten respectively. The pin is the important right bank tributary of the Spiti River having 89 first-order, 14 second-order, 3 third-order and 1 fourth-order streams. It reflects a bifurcation ratio of nearly 6 between the first and second order and nearly 5 between the second and third order. It is 3 between third and fourth-order streams. Lingti is the left bank tributary having 72 first order, 12-second order, 4 third order and 1 fourth' order streams. It shows a bifurcation ratio of six between the first two successive orders, three between the second and third order and four between the third and fourth order streams respectively.

6.4.1 Going Up in Order

When studying stream order, it is important to recognize the pattern associated with the movement of streams up the hierarchy of strength. Because the smallest tributaries are classified as first order, they are often given a value of one by scientists It then takes a joining of two first-order streams to form a second-order stream. When two second-order streams combine, they form a third-order stream, and when two third-order streams join, they form a fourth and so on.

If however, two streams of different order join, neither increases in order. For example, if a second-order stream joins a third-order stream, the second-order stream simply ends by flowing its contents into the third-order stream, which then maintains its place in the hierarchy.

6.4.2 The Importance of Stream Order

This method of classifying stream size is important to geographers, geologists, hydrologists and other scientists because it gives them an idea of the size and strength of specific waterways within stream networks- an important component of water management. In addition, classifying stream order allows scientists to more easily study the amount of sediment in an area and more effectively use waterways as natural resources. Stream order also helps people like biogeographers and biologists in determining what types of life might be present in the waterway. This is the idea behind the River Continuum Concept, a model used to determine the number and types of organisms present in a stream of a given size. Different types of plants for example can live in sediment-filled, slower-flowing rivers like the lower Ganges than can live in a fast-flowing tributary of the same river

Whether it is used by a GIS, a biogeographer, or a hydrologist, stream order is an effective way to classify the world's waterways and is a crucial step in understanding and managing the many differences between streams of different sizes.

6.6 Relief

Terrain, or land relief, is the vertical and horizontal dimension of the land surface. When relief is described underwater, the term bathymetry is used. Terrain is used as a general term in physical geography, referring to the lay of the land. This is usually expressed in terms of the elevation, slope, and orientation of terrain features. Terrain affects surface water flow and distribution. Over a large area, it can affect weather and climate patterns.In terms of environmental quality, agriculture, and hydrology, understanding the terrain of an area enables the understanding of watershed boundaries, drainage characteristics, water movement, and impacts on water quality. Complex arrays of relief data are used as input parameters for hydrology transport models (such as the SWMM or DSSAM Models) to allow the prediction of river water quality.

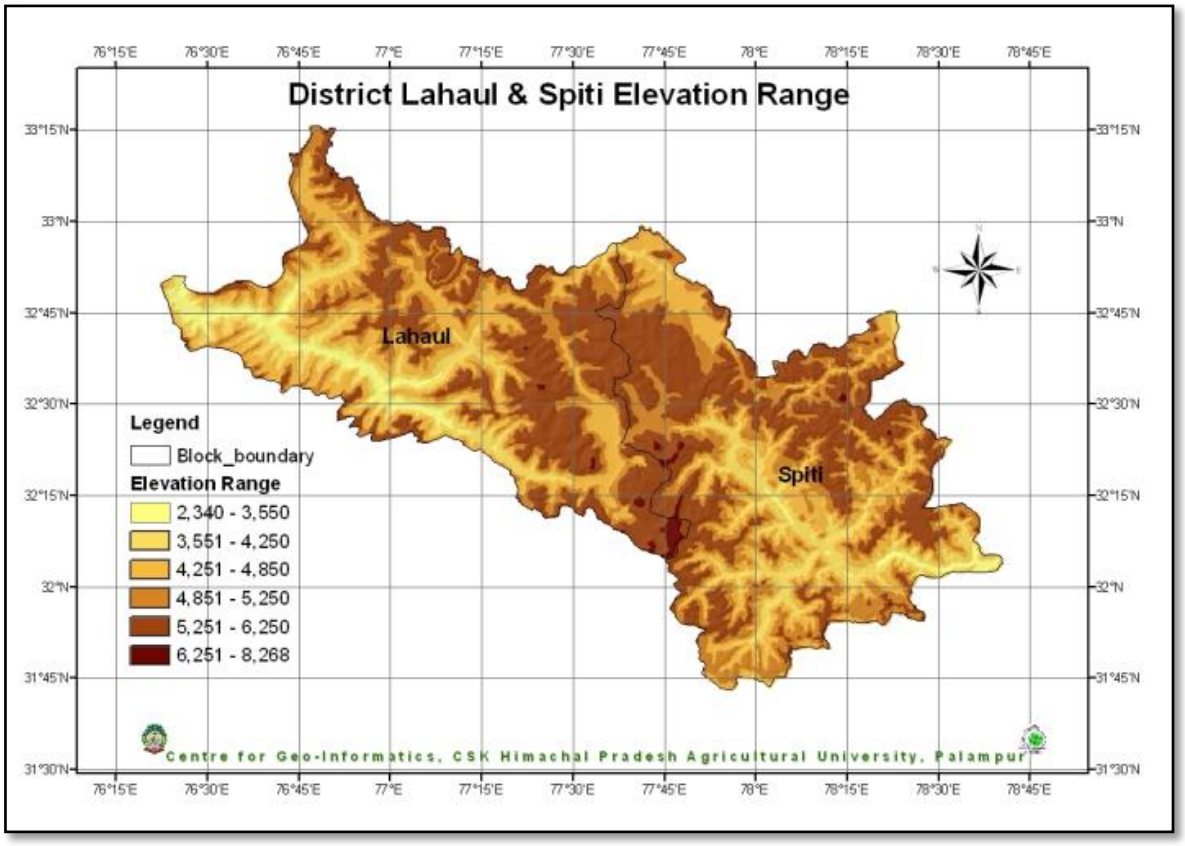


Figure showing elevation map of the district

6.7 Reserve Calculation

The reserve calculations are based on the following expression:

Total reserve = Volume X Tonnage Factor

Where the volume of the deposit is approximated by Length, Breadth and height parameters.

6.7.1. Tonnage Factor

The tonnage factor is the parameter that directly converts the volume of the mineral to the weight of the mineral. In the metric system, the tonnage factor is the specific gravity of the ore and the specific gravity is a function of the mineral composition of the ore. The most accurate method of determination of the specific gravity of the ore is to determine the average specific gravity of the individual mineral of the ore provided with the accurate relative percentages.

The relative percentage of minerals in the Various River System in the Lahaul-Spiti district is as below

Granite = 35 %

Quartzite = 20 %

Phyllite = 15 %

Limestone = 7 %

Dolomite = 10 %

Slate = 3 %

Therefore the total specific gravity of the mineral in the ***Lahaul-Spiti*** district is calculated by

Granite => 2.7 ×0.35 = 0.945

Quartzite => 2.8 × 0.20 = 0.560

Phyllite => 2.6 × 0.15 = 0.390

Limestone => 2.7 × 0.07 = 0.189

Dolomite => 2.7 × 0.10 = 0.270

Slate => 1.8 × 0.03 = 0.054

Total Specific Gravity = 2.4

The average height of the deposit in any mining spot is taken (i.e. 1 meter) by considering the annual replenishment factor.

6.7.2 Annual Replenishment Factor

The sediment load of a river commonly is considered to be a pollutant that is aesthetically displeasing and environmentally degrading. Conversely, part of the sediment load (sand and gravel) may represent a natural resource for use by society. The potential usefulness of the sediment load is enhanced when it is composed of particle sizes found in deposits on the riverbed that would be replenished by newly transported sediment after mining. As such, river deposits become renewable resources, periodically replaced by sediment transport in the river.

The carrying capacity of the river increases or decreases with a change in the type of landform, and competency/capacity at that particular point. The Annual deposition of minerals is almost equal or more than the erosion/lifting of minerals. The river bed mining will also help in the channelization of rivers.

Annual replenishment is based on the location of the depositional spot in the river bed, meandering of the river, geology, weathering conditions and height of the rainfall in the area. The annual replenishment is determined here by the average of the various heights of deposition per year in a specific location. The calculation of the boulders, river-borne Bajri and sand is done by taking the average percentage of each mineral, but it may differ at a specific site, depending upon the type of landform, and competency/capacity at that particular point.

The Rivers in the Lahaul and Spiti Districts are typical of snowmelt-fed streams, with high flows during late spring and early summer. Most of the water and almost all sediments are transported during the months of May to August. The channel bottom consists mainly of large boulders, sand, gravel, and cobbles; detailed size distribution data for bed material are presented later in this report.

The total potential of the Minor mineral is very high as the depth of river-borne material is more than 20.00 meters from the normal surface levels at many locations as per information available in the different publications and the data gathered from the various Government departments and hydro projects in the vicinity. As per the Himachal Pradesh minor mineral river/stream bed policy 2015the minor mineral potential has been calculated up to the depth of one meter and in the workable span. The actual total potential further depends upon the availability of approach roads, distance from the general conditions of policy viz distances from WSS Schemes. bridges etc. and overall the market demand etc.

The annual replenishment is calculated on the basis of the annual deposition profile in the river bed.

For the purpose of calculation of reserve, the minerals are classified as

1. Boulder-- the cobble and boulder i.e. more than 64 mm in size.
2. River-borne Bajri- the portion of gravel between sand and cobble.
3. Sand- less than 6 mm

Sedimentation in any river is dependent on sediment yield which depends on erosional factors in the river's catchment area. Annual replenishment is based on the location of the depositional spot in the river bed, meandering of the river, geology, weathering conditions and height of the rainfall in the area. The annual replenishment is determined here by the average of the various heights of deposition per year in a specific location.

The Sediment load deposition in a river is dependent on the catchment area, weathering index of the various rock types of the catchment area, land-use pattern of the area, rainfall data and grain size distribution of the sediments. Again, the sediment load estimation is not a dependent variable of the district boundary, but it largely depends upon the aerial extents of the catchment areas, which cross the district and state boundaries.

6.8 Mineral Deposits Stretches

In the Lahaul-Spiti district some Mineral Deposit Stretches and some other locations have been observed and discovered in the River Chenab and Satluj (Spiti) basin by a team of Geologists, the Mining officer of the concerned District and other officials from the department.

The purpose of carrying out this study is to understand the behaviour and quantity of deposition in the River Chenab and Spiti and its tributaries. In these rivers river bed material extraction activities have been carried out. In this scenario, it is important to study the replenishable material and amount of deposition taking place before and after monsoon. This study will help in determining the deposition at the mining sites and also the extent of extractable amount of river bed material from the river if any. Furthermore, the continuous flow of rivers is essential for ecological and economic needs such as irrigation and biodiversity etc. Therefore, a replenishment study of the river helps to understand the potential carrying capacity of water during monsoon season.

6.9 MINERAL DEPOSITS OF STRETCHES

In the Lahaul and Spiti district following numbers of Mineral Deposit Stretches have been observed and discovered in the River Chandra Bhaga and River Spiti water basin:

1. **CHANDRA-BHAGA BASIN**

Stretch 1: Along Gramphu-Kaza Road -Batal area (10 KM)

Stretch 2: From Koksar to Sissu (13 Km)

Stretch 3: From Tandi to Tholang (6 Km)

Miscellaneous deposits

I. ***Udaipur-Salpat- Salgran Deposit***

II. ***Zispa-Darcha Deposits***

2. RIVER SPITI WATER BASIN

Stretch 1: Upstream and Downstream of Losar village (5 KM)

Stretch 2: From Moorag to Kaza Deposits (26 Km)

Miscellaneous deposits

I. ***Lugbuh Deposit***

II. ***Sichley Village deposit***

III. ***Tabo Nala deposit***

IV. ***Hurling Deposits***

1. CHANDRA-BHAGA BASIN

Stretch 1: Deposits along Batal -Gramph area (10 KM)

This mineral stretch is located below the foothills of Kunjumpass having a length of 10 km downstream of the Batal area. The total deposition in this length is by the weathering of rock mass due to flood erosion of glaciated material which is calculated at about 4050000 MT.

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Along Gramphu-Kaza Road-Batal area	10000	150	2	2.25	6750000	4050000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
1620000	1215000	1215000	4050000

Stretch 2: Deposits along the Koksar to Sissu area (13 Km)

This area is located along the Manali-Leh Road near the Koksar village located about 19 KMs from Rohtang Pass. The total deposition in this length is by the weathering of rock mass due to flood erosion of glaciated material which is calculated at about 2632500 MT.

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
From Koksar to Sissu	13000	90	2	2.25	5265000	3159000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
1263600	947700	947700	3159000

Stretch 3: From Tandi to Tholang (6 Km)

The location of this stretch is located near the Tandi village which is situated at the confluence of Chandra and Bhaga rivers. Due to the confluence of these two rivers heavy load of minerals is deposited at this location.

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
From Tandi to Tholang	6000	110	1	2.25	2970000	1782000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
712800	534600	534600	1782000

MISCELLANEOUS DEPOSITS IN CHANDRA-BHAGA BASIN

I. Udaipur-Salpat- Salgran Deposit

The location of this stretch is located upstream as well as downstream of Udaipur sub-Tehsil. Small Deposits of Sand and boulders have been identified in this area.

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Udaipur-Salpat-Salgran Deposit	5000	120	2	2.25	2700000	1620000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
648000	486000	486000	1620000

II. Zispa-Darcha Deposits

This location is located about 20 km north of Keylong district headquarters and 7 km south of Darcha, along the Manali-Leh Highway and in the Bhaga River. There are huge deposits of Sand, stone and Bajri is available in this portion and easily approachable from the national highway.

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Zispa-Darcha Deposits	4000	200	2	2.25	3600000	2160000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
864000	648000	648000	2160000

III. Miyar Nala Deposits

This location is located about 15 km north of Udaipur sub-east of the tehsil along the Miyar Nala along the Udaipur-Miyar-Khanjar Road. The mineral deposit sites are located along the Miyar River from Khanjar to Karpet. There are huge deposits of Sand, stone and Bajri is available in this portion and easily approachable from the national highway.

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Miyar Nala Deposits	13000	100	2	2.25	5850000	3510000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
1404000	1053000	1053000	3510000

2. RIVER SPITI WATER BASIN

Stretch 1: Upstream and Downstream of Loser Village (5 KM)

This site is located near the Loser Village which is relatively unexplored, due to its remoteness and its inaccessibility, having a very low population.

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Upstream and Downstream of Loser Village	5000	150	2	2.25	3375000	2025000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
810000	607500	607500	2025000

Stretch 2: From Morang to Kaza Deposits (10.5 Km)

The said area is located upstream and downstream of Kaja town a subdivisional headquarters of the remote Spiti Valley in the Western part of the Himalayas. This area is having largest deposits of Minor minerals extending from mooring to downstream of the Kaza. The details of the Mineral deposits are mentioned in the table below:

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Morang to Kaza Deposits	10500	250	2	2.25	11812500	7087500

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
2835000	2126250	2126250	7087500

MISCELLANEOUS DEPOSITS IN SPITI RIVER BASIN

I. Lingti Deposit

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Lingti Deposit	2500	250	2	2.25	2812500	1687500

MINERAL WISE POTENTIAL			
Boulders (MT)	Bajri (MT)	Sand Mixed Silt (MT)	Total Mineable Mineral Potential (MT)
675000	506250	506250	1687500

II. Shichling Village deposit

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Shichling Village deposit	3000	600	2	2.25	8100000	4860000

MINERAL WISE POTENTIAL			
Boulders (MT)	**Bajri (MT)**	**Sand Mixed Silt (MT)**	**Total Mineable Mineral Potential (MT)**
1944000	1458000	1458000	4860000

III. U/s Sumra Village deposit

Portion of the River or Stream recommended for Mineral Concession	Average Length (M)	Average Breadth (M)	Depth (M)	Tonnage Factor	Material (MT)	Total Mineable Mineral Potential (60%) (MT)
Sumra Village deposit	1500	80	2	2.25	540000	324000

MINERAL WISE POTENTIAL			
Boulders (MT)	Bajri (MT)	Sand Mixed Silt (MT)	Total Mineable Mineral Potential (MT)
129600	97200	97200	324000

7.0 GENERAL PROFILE OF THE DISTRICT

7.1 Introduction

Surrounded by the snowcapped mountain district of Lahaul & Spiti is the smallest district in population as compared to other districts of the state. It shares an international boundary with Tibet. It attained the status of a district only in 1960. Till then it was merely a sub-division of Kullu tehsil which itself form a part of the erstwhile Kangra district of Punjab. It is difficult to connect and coherent past account of the history of the area due to its isolation from the rest of the world. This has been home to the sturdy people who could only endure and withstand the vigours of nature, loved solitude and the extremely hard life of those forbidding mountains. The present district of Lahaul & Spiti comprises two different tracts of Lahaul & Spiti. The name of the district came into existence with the formation of these two parts into a revenue district. It has two distinct entities geographically and historically. Lahaul area includes valleys of the Chandra and Bhaga rivers up to their confluence near Tandi and also the main Chandra Bhaga valley as far as Thirot Nallah. The Spiti area includes the valley of the main Spiti River and the valley of its tributary the Pin River. It is said that the word Laho-Yul means southern country and because of its geographical location to the south of Ladakh, the Ladakhis refer its name as Laho-Yul. Spiti is the name of the river locally known as Piti which in Tibetan language means middle province.

Location:

Lahaul & Spiti is a scarcely populated district, located in the northeastern part of the State. The district is entirely hilly and comprises two major valleys viz. Lahaul & Spiti. The Lahaul Valley is located in the northwestern part of the district while the Spiti Valley in located in the southeastern part. The district, with its headquarters at Keylong, lies between 31°44’57” & 32° 59’57” North latitudes and 76°46’29” & 78°41’34” East longitudes and is covered by Survey of India degree sheets 52C, 52D and 52L. The district is bounded by Jammu & Kashmir State in the north, Tibet (China) in the east, Kinnaur in the southeast, Kullu in the south & Kangra and Kullu in the northwest.

The district has a total geographical area of 13,841 sq km, covers about 25 % of the State's geographical area and ranks 1st in area in the State. There are no towns in the district and has 521 villages of which 287 villages are inhabited and 234 are uninhabited. The district has been divided into 2 divisions viz. Keylong and Kaza. There are 2 tehsils Keylong & Kaza & 1 sub-tehsils Udaipur

As per the 2011 census, the district has a population of 31,564 persons with a population density of 2 persons per sq km. Population wise it ranks 12th in the State. The male and female

population in the district is 16,588 and 14,976 respectively with a female/male sex ratio of 903/1000. The scheduled cast population in the district is 7.08 % and the scheduled tribe population is 81.44 %.

The district is divided into three sub-divisions Udaipur, Lahaul & Spiti with headquarters at Udaipur, Keylong and Kaza respectively. These subdivisions are also co-terminus with tehsils/sub-tehsil having their headquarters at the same places for the administrative purposes. Further district is also divided into two Community Development Blocks viz. Lahaul comprises the tehsil of Lahaul and the tehsil of Udaipur with headquarters at Keylong and Spiti C.D. Block which is co-terminus with tehsil Spiti for development purposes. The Deputy Commissioner along with the Chief Judicial Magistrate, Superintendent of Police, Chief Executive Officer of Zila Parishad, Chief Medical Officer and Senior Officers of the State Government look after the development and regulatory functions in the district. Sub Divisional Magistrate is the head of sub-division while Block Development Officer is the head of the Community Development Block. However, the Spiti subdivision is headed by an Additional Deputy Commissioner who is stationed at Kaza and is vested with administrative control of this sub-division for administration and developmental purposes. At the tehsil/sub-tehsil level, the Tehsildar and Naib-Tehsildar look after their respective departments for development and regulatory functions.

The patwar circles of Triloknath, Tindi, Udaipur and Mayar Nullah of Pattan Valley which formed part of Pangi tehsil prior to 1975 though culturally and ethnically the people were more akin to Lahaulas were transferred from Pangi tehsil to Lahaul tehsil of Lahaul & Spiti district in 1975. The State Government in 1980 carved out Udaipur sub-tehsil out of Lahaul tehsil with 150 villages (118 villages of Triloknath, Tindi, Udaipur and Mayur Nullah of Pangi tehsil transferred to Lahaul tehsil and 32 other villages of Lahaul tehsil) adjacent to Pangi tehsil in it with sub-tehsil headquarter at Udaipur for administratively more convenient. It was upgraded to sub-division level in 1980. 118 new villages were created in Spiti tehsil after the 1991 Census due to the settlement of 17 operations in the area resulting increase in the total number of revenue villages in the district from 403 in 1991 to 521 in the 2001 Census. No jurisdiction changes at the district or tehsil/sub-tehsil have taken place during the decade of 2001-2011.

7.2 District Highlights 2011 Census

- Lahaul & Spiti district is the smallest and ranks at the end of all districts in terms of population in the state but ranks on the top in terms of area as it claims the major chunk of 24.86 per cent of the state area.
- The Sex –ratio of the total population in the census 2011 for Lahaul & Spiti is 903 females per thousand males, which shows an improvement of 101 as compared to the census 2001.
- Lahaul & Spiti is sporadically populated with a population of 2 persons per sq. kilometre though it is the biggest in terms of area in the state.
- It is comprised of entirely rural settlements with no urban component and registered negative growth rate of -5.0 per cent during 2001-2011 against Positive growth of + 6.17 per cent in its population during 2001- 2011 and continues to occupy last position in terms of growth of population in the state.
- It is the smallest district with 3 Subdivisions namely Udaipur, Lahaul and Spiti. 2 Community Development Blocks namely Lahaul and Spiti, 2 Tehsils and one Sub-tehsil in the state.
- It touches the international boundary of Tibet and the adjoining Ladakh region of Jammu and Kashmir. In the old times, it used to provide the trade route between Central Asia to Gartok and Lahasa of Tibet.
- The district is renowned for snowfields, ice caves, glaciers and snow-clad mountains and passes.
- The Lahaul and Udaipur Sub-divisions remain cut off from the rest of the world for about 6 months every year due to the closure of vehicular traffic through Rohtang Pass because of heavy snowfall. Moreover, the valleys of Spiti and Lahaul remain almost cut off from each other for 8 months of the year by the mighty walls of the Himalayan ranges between them.
- The economy of the district is mainly agrarian and 58.18 per cent of workers in the district are engaged in Primary Sector. It has the distinction of being the alone district in the state engaged in the cultivation of ‘hops’ and ‘Kuth’.
- It has attained fame in producing high-quality potato crops and peas which are in much demand not only in the country but also in foreign countries.

Important Statistics						
			State		District	
Number of Villages		Total	20,690		521	
		Inhabited	17,882		280	
		Uninhabited	2,808		241	
Number of Towns		Statutory	56		-	
		Census	3		-	
		Total	59		-	
Number of Households		Normal	1,479,208		6,594	
		Institutional	3,137		78	
		Houseless	935		2	
Population	Total	Persons	6,864,602		31,564	
		Males	3,481,873		16,588	
		Females	3,382,729		14,976	
	Rural	Persons	6,176,050		31,564	
		Males	3,110,345		16,588	
		Females	3,065,705		14,976	
	Urban	Persons	688,552		-	
		Males	371,528		-	
		Females	317,024		-	
Percentage Urban Population			10.03			
Decadal Population Growth 2001-2011			Number	Percentage	Number	Percentage
		Persons	786,702	12.94	(1,660)	-5.00
		Males	393,933	12.76	(1,853)	-10.05
		Females	392,769	13.14	193	1.31
Area (in sq Km.)			55673		13841.00	
Density of Population (Persons per sq Km.)			123		2	
Sex Ratio		Total	972		903	
(Number of females per 1000 males)		Rural	986		903	
		Urban	853			

Important Statistics					
		State		District	
		Number	Percentage	Number	Percentage
Literates	Persons	5,039,736	82.8	21,845	76.81
	Males	2,752,590	89.53	12,897	85.69
	Females	2,287,146	75.93	8,948	66.84
Scheduled Castes	Persons	1,729,252	25.19	2,235	7.08
	Males	876,300	25.17	1,154	6.96
	Females	852,952	25.21	1,081	7.22
Scheduled Tribes	Persons	392,126	5.71	25,707	81.44
	Males	196,118	5.63	12,748	76.85
	Females	196,008	5.79	12,959	86.53
Workers and Non-Workers Total Workers (Main and Marginal)	Persons	3,559,422	51.85	19,295	61.13
	Males	2,043,373	58.69	10,763	64.88
	Females	1,516,049	44.82	8,532	56.97
(i) Main Workers	Persons	2,062,501	30.05	15,190	48.12
	Males	1,438,989	41.33	8,732	52.64
	Females	623,512	18.43	6,458	43.12
(ii) Marginal Workers	Persons	1,496,921	21.81	4,105	13.01
	Males	604,384	17.36	2,031	12.24
	Females	892,537	26.39	2,074	13.85
Non-Workers	Persons	3,305,180	48.15	12,269	38.87
	Males	1,438,500	41.31	5,825	35.12
	Females	1,866,680	55.18	6,444	43.03
Category of Workers (Main & Marginal)					
(i) Cultivators	Persons	2,062,062	57.93	11,227	58.19
	Males	906,154	44.35	4,891	45.44
	Females	1,155,908	76.24	6,336	74.26
(ii)Agricultural Labourers	Persons	175,038	4.92	572	2.96
	Males	103,060	5.04	339	3.15
	Females	71,978	4.75	233	2.73
(iii)Workers in Household	Persons	58,719	1.65	167	0.87
industry	Males	37,167	1.82	99	0.92
	Females	21,552	1.42	68	0.80
(iv) Other Workers	Persons	1,263,603	35.5	7,329	37.98
	Males	996,992	48.79	5,434	50.49
	Females	266,611	17.59	1,895	22.21

8. LAND UTILIZATION PATTERN IN THE DISTRICT

The valley located on the lower elevation of the region produces vegetables like cabbage, cauliflower and tomatoes which are marketed at Keylong, Kullu and Delhi. The people of the area shifted themselves from traditional occupation to that of growing of cash crops. The irrigation facilities are provided by lifting water from streams, shallow dug wells and medium to deep tube wells in the valley area.

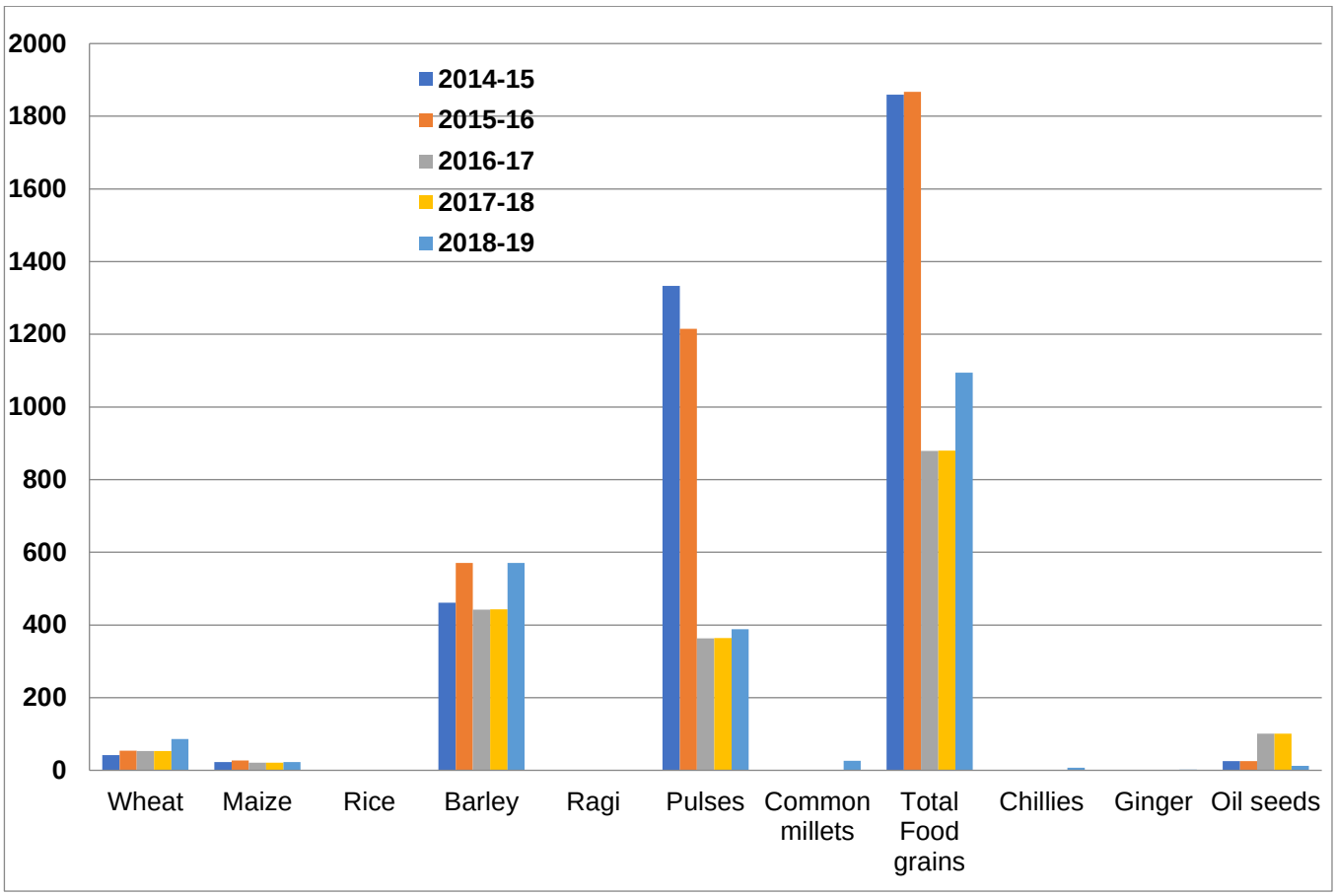
8.1 Agriculture

In Lahaul and Spiti districts, agriculture is the main occupation of the people. Almost all the district is barren and a small portion of the area is under cultivation. The economic distress of the people can very well be imagined in view of the meagre and limited quantity of land available for cultivation. The valleys are extremely narrow with steep mountains and rivers running through deep gorges. In proportion to its vast areas, whatever land fit for agriculture is available, lies in small plots between sixty to one hundred metres above the river beds. What hampers the extent of agricultural operations is not only the shortage of flat lands or lands with gentle slopes safe against erosion but also the non-availability of adequate sources of water for irrigation. The cultivation is possible in small patches of holdings in the high hills or in the basins of streams and khads. It is only in the basins of the river, streams and khads that the land is fertile and a little bit flat and cultivation of cereals and pulses, potatoes and off-season The main cereals grown are wheat, maize, rice, and barley in the district.

Table showing area under Different Crops in Hectares

Table showing Area under Different Crops (in Hectares) at District Lahaul & Spiti											
Year	**Wheat**	**Maize**	**Rice**	**Barley**	**Ragi**	**Pulses**	**Common millets**	**Total Food grains**	**Chillies**	**Ginger**	**Oil seeds**
2014 -15	42	23	...	461	...	1333	...	1859	...	...	25
2015-16	54	27	...	571	...	1215	...	1867	...	...	25
2016 -17	53	21	...	442	...	363	...	879	...	...	101
2017 -18	53	21	...	443	...	364	...	880	...	...	101
2018-19	86	23	…	571	…	388	26	1094	7	2	12

Source: *Directorate of Land Records, HP*

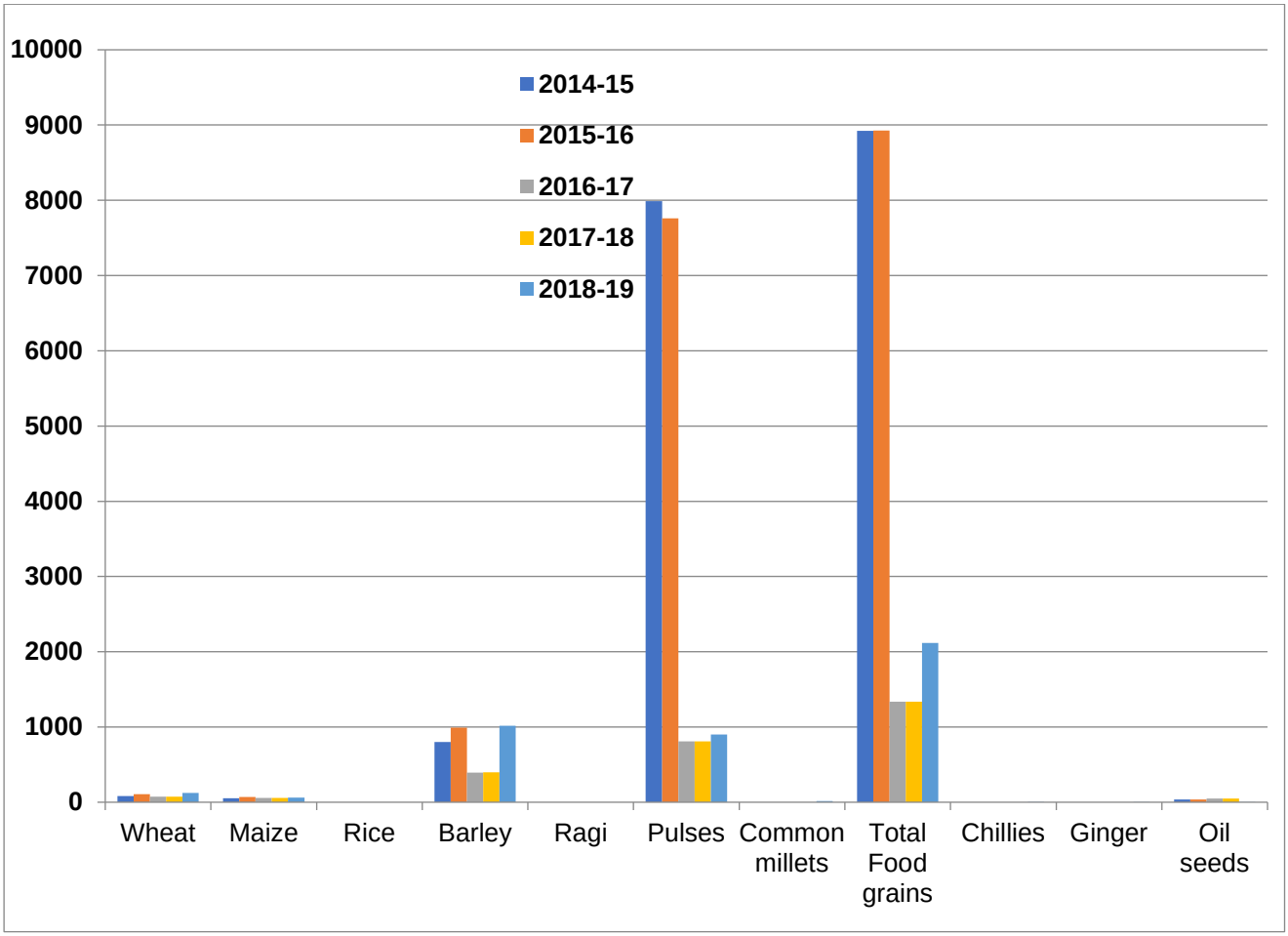


Graph Showing Area under Different Crops in Hectares

Table showing Production of Different Crops in MT

Table showing Production of Different Crops (in MT) at District Lahaul & Spiti											
Year	**Wheat**	**Maize**	**Rice**	**Barley**	**Ragi**	**Pulses**	**Common millets**	**Total Food grains**	**Chillies**	**Ginger**	**Oil seeds**
2014-15	82	53	...	802	...	7987	...	8924	...	...	37
2015-16	106	68	...	993	...	7762	...	8929	...	...	37
2016-17	75	58	...	395	...	807	...	1335	...	...	48
2017-18	75	58	...	396	...	808	...	1336	...	...	48
2018-19	122	63	…	1016	…	900	16	2117	2	5	5

Source: *Directorate of Land Records, HP*

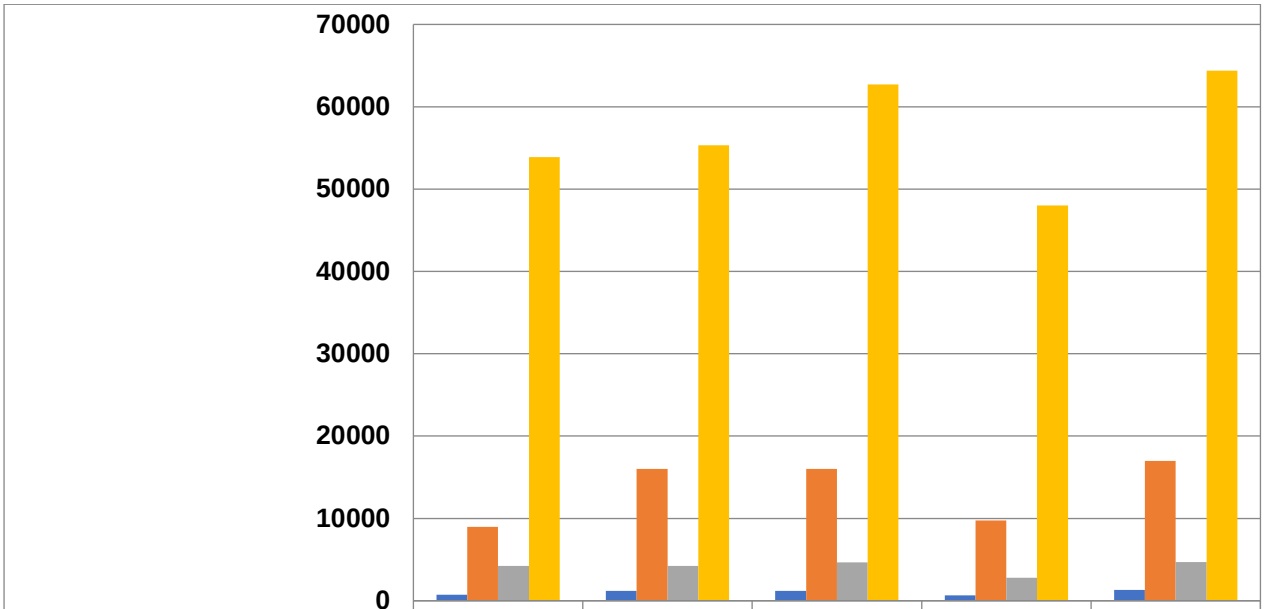


Graph Showing Production of Different Crops in MT

Table showing Area & Production of Vegetables in Tonnes

Area & Production of Vegetables (Distt Lahaul & Spiti)				
Year	**Potato**		**Other Vegetables**	
	Area (In Hectares)	**Production (In Tonnes)**	**Area (In Hectares)**	**Production (In Tonnes)**
2015-16	720	8982	4220	53876
2016-17	1200	16000	4218	55338
2017-18	1200	16000	4650	62706
2018-19	650	9750	2788	48019
2019-20	1300	16990	4714	64366

Source: *Directorate of Land Records, HP*



	2015-16	2016-17	2017-18	2018-19	2019-20
Potato Area (In Hectares)	720	1200	1200	650	1300
Potato Production (In Tonnes)	8982	16000	16000	9750	16990
Other Vegetables Area (In Hectares)	4220	4218	4650	2788	4714
Other Vegetables Production (In Tonnes)	53876	55338	62706	48019	64366

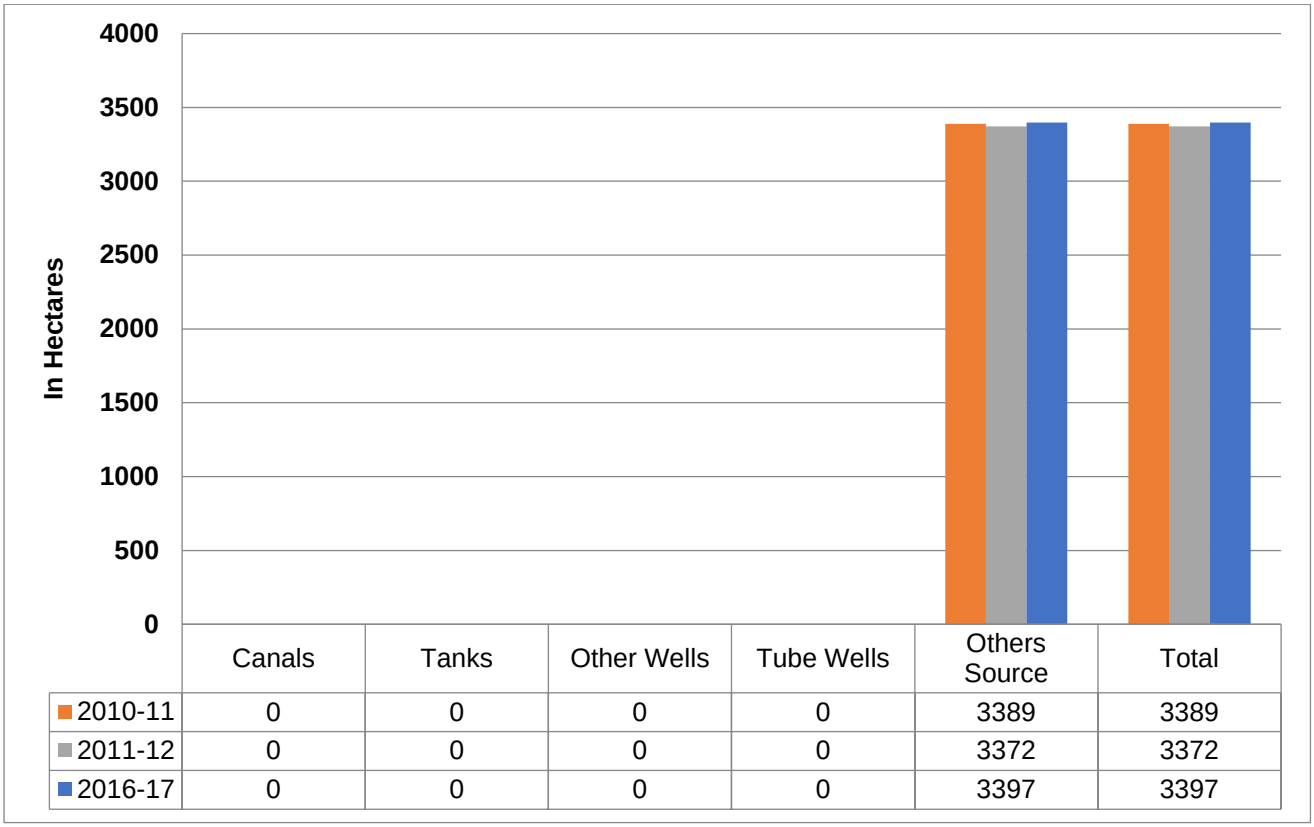
Graph showing the production of vegetables in District Lahaul & Spiti

Table showing Net Irrigated Area of District by source in Hectares

Table showing Net Irrigated Area of Lahaul & Spiti by source (in Hectares)

Year	Canals	Tanks	Other Wells	Tube Wells	Others Source	Total
2010-11	…	…	…	…	3389	3389
2011-12	…	…	…	…	3372	3372
2016-17	…	…	…	…	3397	3397

***Source**: Directorate of Land Records, HP*



	Canals	Tanks	Other Wells	Tube Wells	Others Source	Total
2010-11	0	0	0	0	3389	3389
2011-12	0	0	0	0	3372	3372
2016-17	0	0	0	0	3397	3397

Graph showing the Net Irrigated Area of the District Lahaul & Spiti from 2010 to 2017

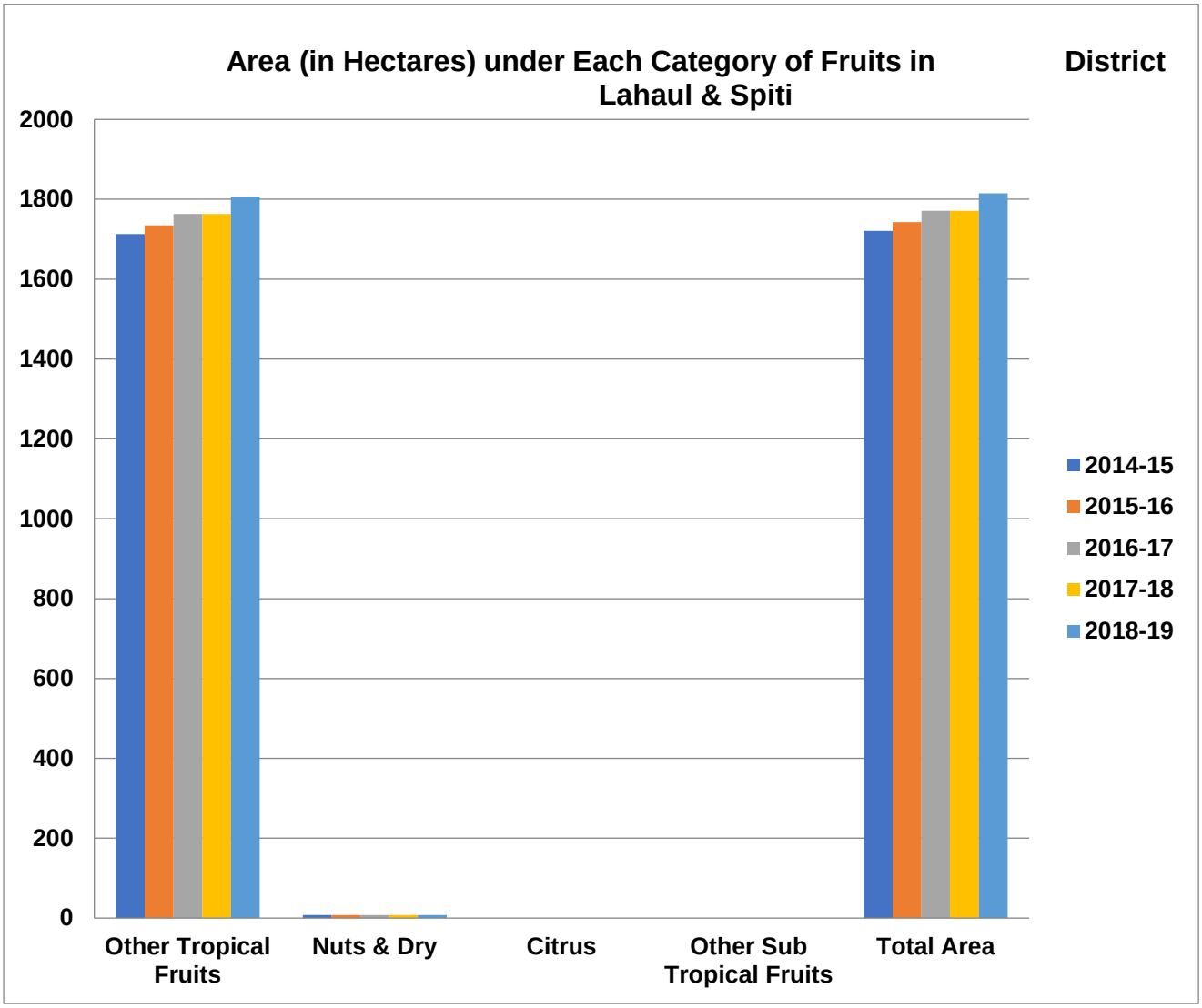
8.2 HORTICULTURE

Horticultural development bears special significance for this district. With the change in climate, even the harsh cold areas of Spiti are becoming suitable for apple plantations, which is quite evident from the increase in the area under apples in recent years. The area under fruit in this district can be increased from the existing 389.25 hectares to 868.25 hectares. The number of households planting apple orchards would also increase from the existing 3,393 to 5,447. There lies more potential in Spiti for Apple as compared to Lahaul.

Table showing area under Each Category of Fruits in District Lahaul & Spiti

Table showing Area (In Hectares) under Each Category of Fruits in District Lahaul & Spiti					
Year	**Other Tropical Fruits**	**Nuts & Dry**	**Citrus**	**Other Sub Tropical Fruits**	**Total Area**
2014-15	1713	8	...	...	1721
2015-16	1735	8	...	...	1743
2016-17	1763	8	...	...	1771
2017-18	1763	8	...	...	1771
2018-19	1807	8	…	…	1815

Source: *Directorate of Horticulture, HP*

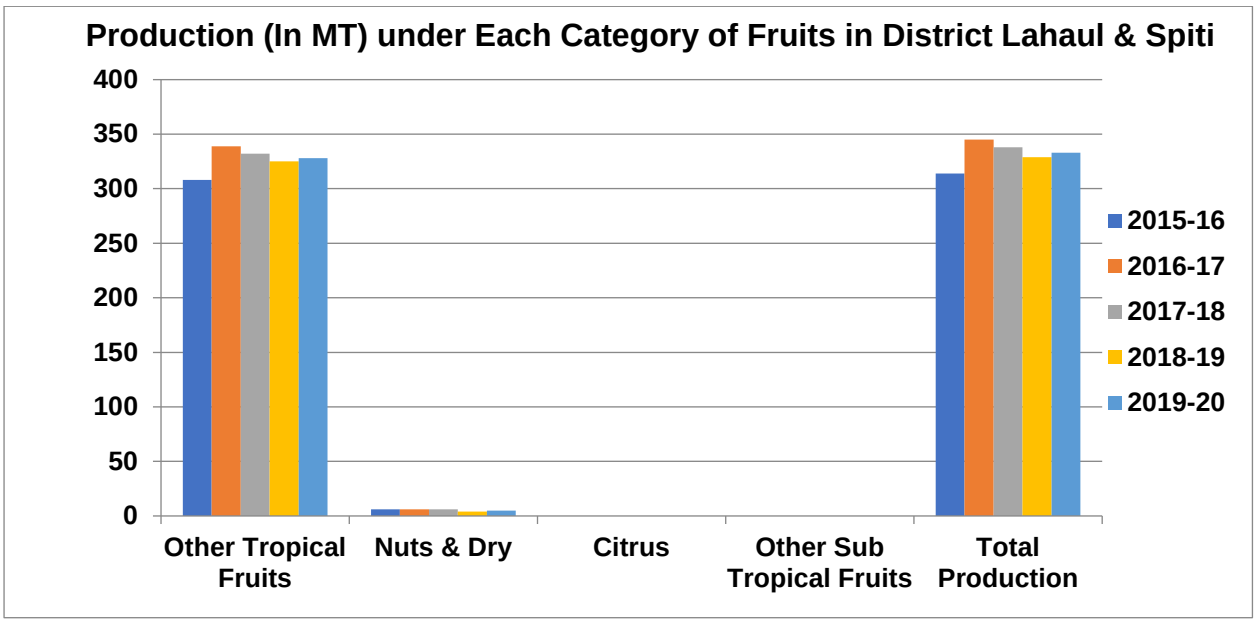


Graph Showing Area under Each Category of Fruits in District Lahaul & Spiti

Table showing Production under Each Category of Fruits in District Lahaul & Spiti

Table showing Production (In MT) under Each Category of Fruits in District Lahaul & Spiti					
Year	**Other Tropical Fruits**	**Nuts & Dry**	**Citrus**	**Other Sub Tropical Fruits**	**Total Production**
2015-16	308	6	...	...	314
2016-17	339	6	...	...	345
2017-18	332	6	...	...	338
2018-19	325	4	...	...	329
2019-20	328	5	…	…	333

***Source**: Directorate of Horticulture, HP*



Graph Showing Production under Each Category of Fruits in District Lahaul & Spiti

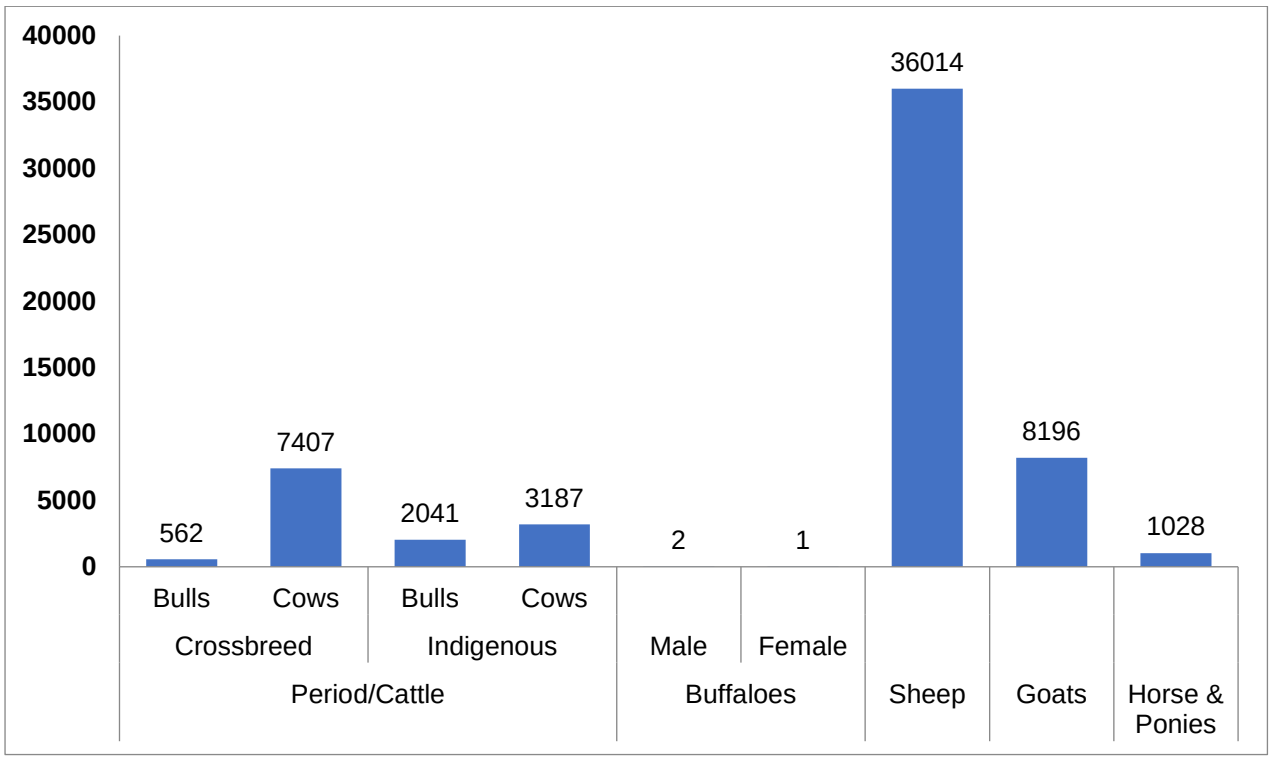
8.3 ANIMAL HUSBANDRY

Livestock rearing has remained an integral part of farming, particularly in hilly areas due to the vast area under forests and pastures and the important role it plays in human nutrition, draft farm power and transportation. The estimated livestock population in Lahaul and Spiti blocks shows the predominance of sheep and goats especially in Lahaul. During summer, shepherds from other areas (particularly Gaddi) migrate along with their flocks to graze sheep and goats on lush green alpine pastures in Lahaul & Spiti. The population of cross-bred cows is increasing over the years. Bullocks and equines also hold an important place as a means of draft power and transportation (beasts of burden Due to the cold climate, poultry is not so popular. The farmers generally keep a few birds to meet the domestic requirements. The population of poultry is higher in Lahaul as compared to Spiti. It has been found that improved breeds of poultry may not thrive well in this cold region but indigenous breeds have been found quite suitable. During the summer season, broilers can be taken up successfully for which there is a need to provide broiler chicks from poultry breeding farms from other districts.

Table showing Livestock census of District Lahaul & Spiti

Animal Husbandry Population in District Lahaul & Spiti										
Year	**Status**	**Period/Cattle**				**Buffaloes**		**Sheep**	**Goats**	**Horse & Ponies**
		Crossbreed		**Indigenous**		**Male**	**Female**			
		Bulls	**Cows**	**Bulls**	**Cows**					
2012	***Lahaul & Spiti***	562	7407	2041	3187	2	1	36014	8196	1028

***Source**: Directorate of Animal Husbandry, HP*

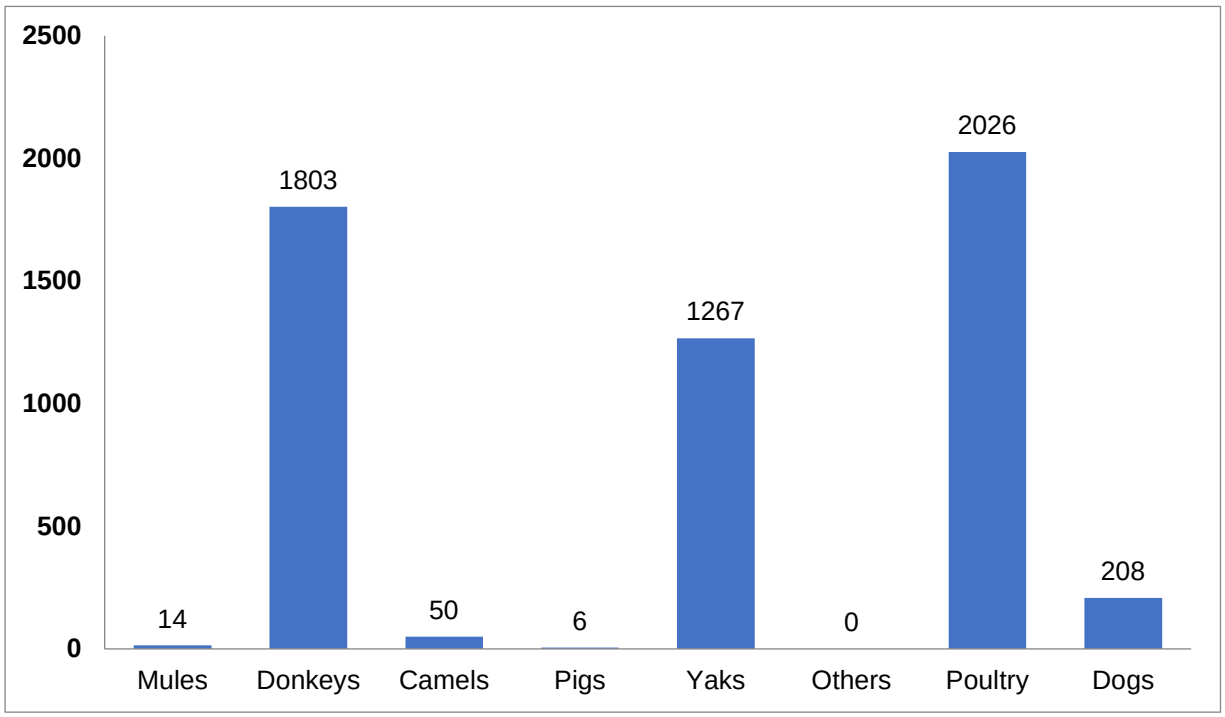


Graph Showing Livestock census of the Lahaul & Spiti

Table showing other Livestock census of District Lahaul & Spiti

Other Livestock							
Mules	**Donkeys**	**Camels**	**Pigs**	**Yaks**	**Others**	**Poultry**	**Dogs**
14	1803	50	6	1267	...	2026	208

***Source**: Directorate of Animal Husbandry, HP*



Graph Showing other Livestock censuses of the Lahaul & Spiti District

8.4 FISHERIES

There is no special effort to take up fishery enterprise in the district. However, there is a scope to introduce cold-water fish culture at certain places where river flow is mild in the valley area. There is also scope for rearing trout that can be sold at a premium price. To harness this potential, the major interventions have been depicted

8.5 FOREST, FLORA AND FAUNA

The Forests of Himachal Pradesh known for their grandeur and majesty are like a green pearl in the Himalayan crown. These life-supporting systems are presently under great stress due to the impact of modern civilization, economic development and growth in human and cattle populations. According to the National Forest Policy, 1988, at least two-thirds i.e. 66% of the geographical area should be under forest in hilly states like Himachal Pradesh. However, keeping in view that about 20 % of the area is inaccessible and beyond the tree limit, the State Government aims to bring 50% of the geographical area under forest cover.

FLORA

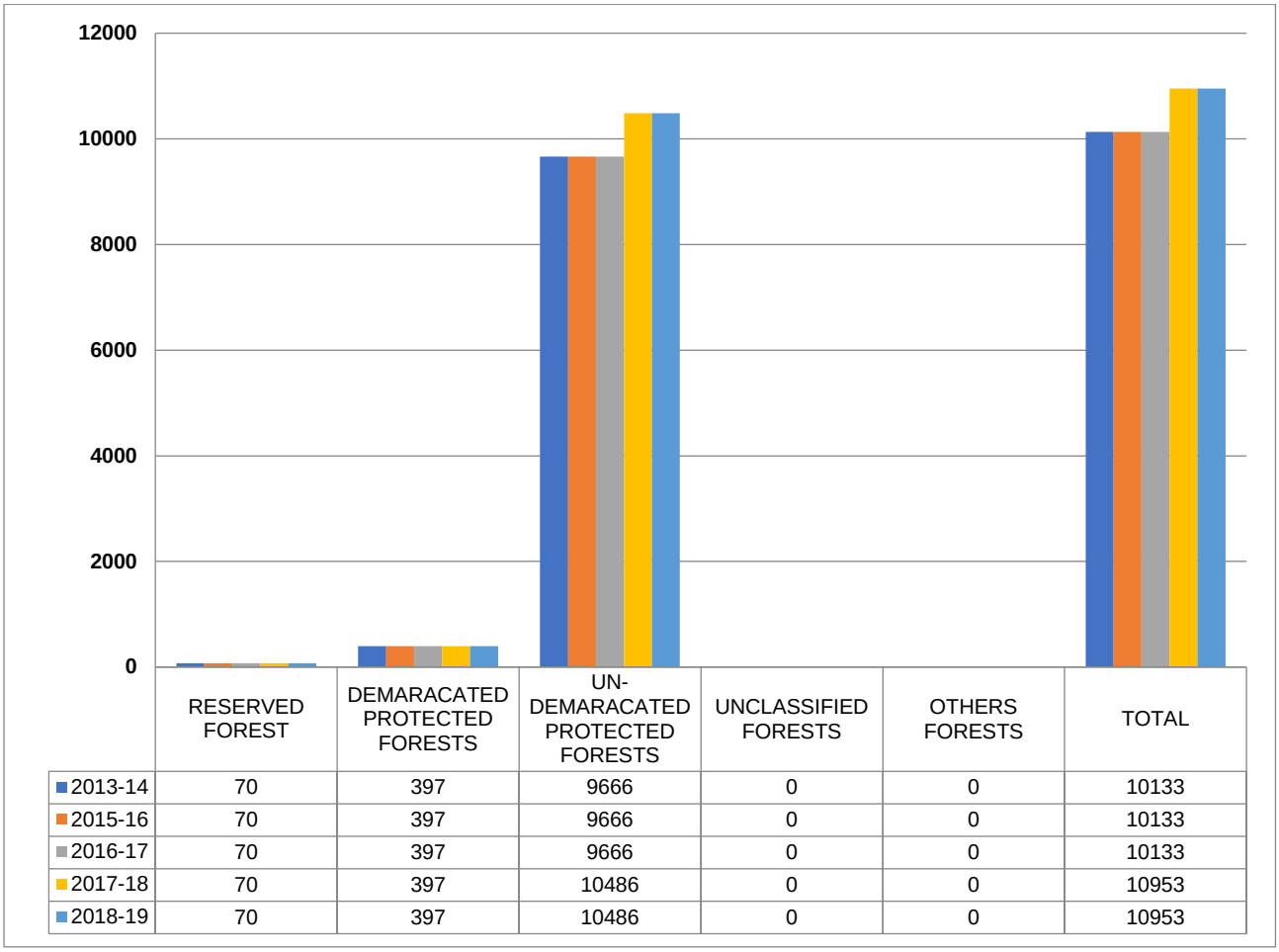
The flora of the two districts falls under the Himalayan dry temperate, dry alpine (cold deserts) in the Lahaul-Spiti and Pooh division of Kinnaur, whereas the forests in Nichar, Sangla and Kalpa areas fall under the moist alpine forests. Nichar, Sangla and Kalpa areas are dominated by tree species of Cedrus deodara, Pinus wallichiana, Picea, smithiana, Abies pindrow, Taxus wallichiana, Quercus floribunda, Q. semecarpifolia, Q. ballot (Peo and Kalpa region). The vegetation in the other parts of the area covering Pooh, Lahaul and Spiti is sparse, discontinuous and scattered, clearly showing the rugged landscape with brown sand and barren rocks, but at the same time is most varied and attractive owing to the dry alpine nature. Curiously shaped bushes, the majority of which form spinescent cushions, dominate vegetation stunted forms, twisted and bent nature of stems, succulency, cushiony and matted habits and strong root systems are the characteristic features of the vegetation. The only green patches, soothing to the eyes are available around the villages with activated fields and irrigated hay lands. Only a cluster of trees of Populus balsamifers, P. ciliata, Salix fragilis, S. elegans and dilapidated Juniperus macropoda are seen next to the villages and Gompas. Monumental trees of Poplars, Junipers, Salix and Betula can be seen at Rangrik, Lossar, Pomrang, Gue, Gulling, Tabo, Pooh, Mane, Kungri, Chud, Nako etc. Many of the trees survive because they are considered to be the abode of deities. Birth (Bhojpatra) patch exists opposite Pooh bridge near Saran in Spiti, Baspa valley in Kinnaur has plenty, while in Lahaul, small trees can be seen on the right side slopes beyond Gramphoo. A thick forest patch of Hippophae exists in Mane village, a tree size Myricaria can be seen at Gue and a dilapidated Juniper patch is in evidence

near Gue and Kaa loops reminding us of the past forests and the present-day destruction by biotic interference. Lahaul and Kinnaur are greener than Spiti. Mini Manali at Udaipur has a thick forest patch of Deodar (Cedrus deodara). Vast tracts of hill slopes are covered by Juniperus macropoda; between Udaipur and Keylong. Whereas, in the Pooh area the Juniper trees are badly damaged. Faxinus xanthoxyloides grows as a medium-sized tree in both Pooh and Udaipur areas. The afforestation efforts by DDP projects in the Spiti and Pooh area have created green patches of Populus, Salix, Robinia and fruit trees. Most prominent shrubs include Rosa macrophylla (wild rose), species of Hippophae, Myricaria, Salix flabellaris, S. hastate, S. lindeleyana, Juniperus recurva, Ribes orientale, R. alpestre, Lonicera spinosa (Thapp), L. obovata, L. rupicola, Capparis spinosa, Caragana brevifolia (Trama). Rhododendron lepidotum, Colutea nepalensis, Ephedra gerardiana, Clematis vernayii, Cotoneaster microphylla etc. The scrub and spiny cushions are formed by the species of Caragana, Astragalus, Artemisia, Cousinia, Saussurea, Lonicera and Arnebia. Herbaceous element is dominated by the species of Astragalus, Chesneya, Oxtropis, Cicer, Lindelophia, Allium, Rumex, Nepeta, Heracleum, Chenopodium, Artemisia, Lactuca, Gentiana, Gentianella, Hyssopus, Pedicularis, Rheum, Aquilaria, Caltha, Taraxacum, Plantagos, Aconitum, Thymus, Delphinium, Lepidium, Crepis, Mentha, Geranium, Bergenia, Senecio and Mertensia. Hyoscyamus niger (Tukhlang) is frequent near villages in Gulling and Kibber, Linum perenne (Linseed) in Pin Valley and Rangrik Hill slopes; Cicer microphyllum (Chirri, Wild gram) in Demul pastures Pin Valley; Eremurus himalaicus (Fox tail lily) in Sagnam glacier and Hyssopus officinalis (Tengu) in BurrGulling area and sparsely in Attargu and Kaa slopes.

Table Showing classification of forest area (in sq.km.) of District Lahaul & Spiti

CLASSIFICATION OF FOREST AREA (IN SQ.KM.) OF DISTRICT LAHAUL & SPITI						
YEAR	**RESERVED FOREST**	**DEMARCATED PROTECTED FORESTS**	**UN-DEMARCATED PROTECTED FORESTS**	**UNCLASSIFIED FORESTS**	**OTHERS FORESTS**	**TOTAL**
2013-14	70	397	9666	…	...	10133
2015-16	70	397	9666	…	...	10133
2016-17	70	397	9666	…	...	10133
2017-18	70	397	10486	...	...	10953
2018-19	70	397	10486	...	...	10953

***Source**: Forest Department, HP*



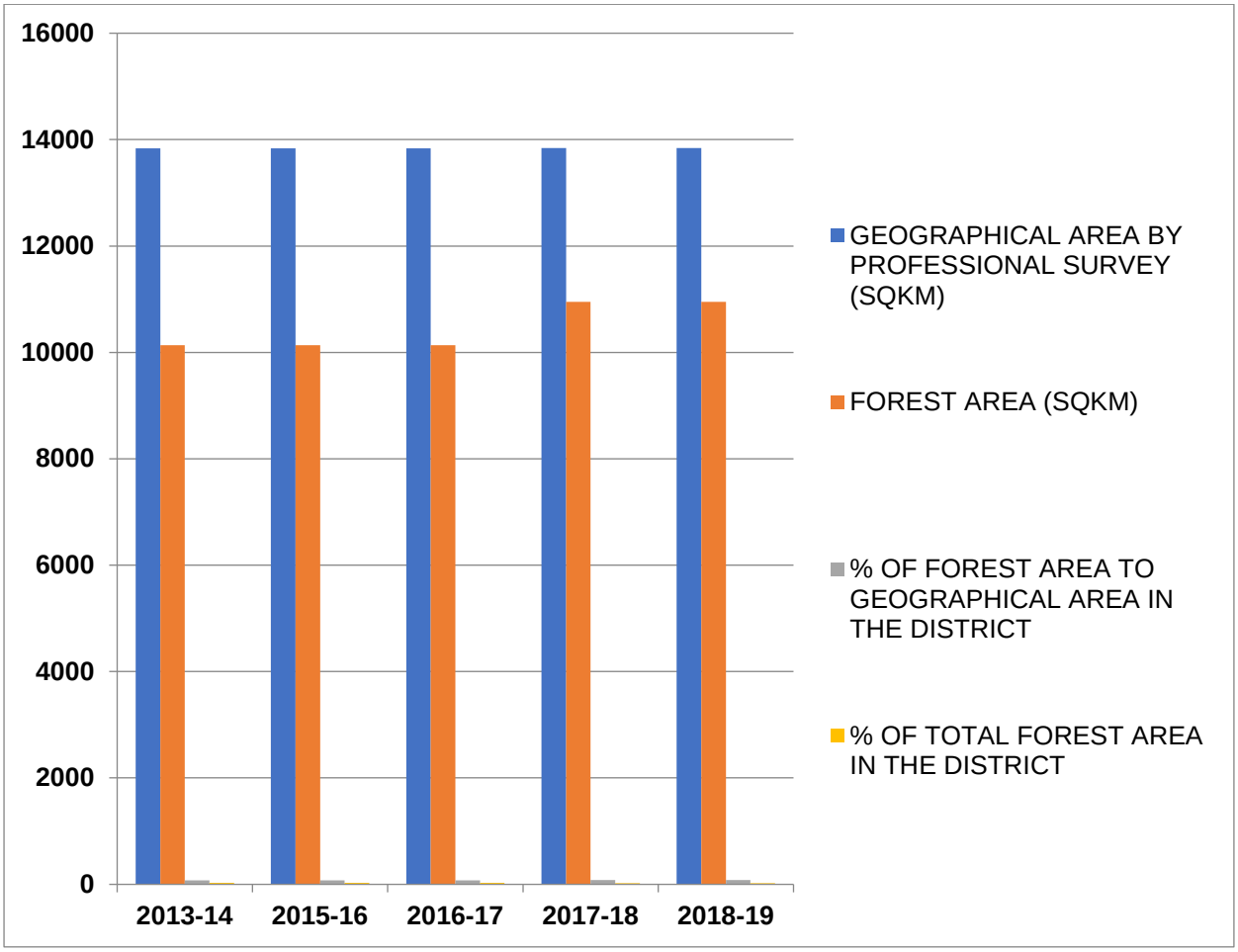
	RESERVED FOREST	DEMARACATED PROTECTED FORESTS	UN-DEMARACATED PROTECTED FORESTS	UNCLASSIFIED FORESTS	OTHERS FORESTS	TOTAL
2013-14	70	397	9666	0	0	10133
2015-16	70	397	9666	0	0	10133
2016-17	70	397	9666	0	0	10133
2017-18	70	397	10486	0	0	10953
2018-19	70	397	10486	0	0	10953

Graph showing the classification of forest area (in sq.km.) of District Lahaul & Spiti

Table showing forest area of District Lahaul & Spiti

FOREST AREA OF DISTRICT LAHAUL & SPITI				
YEAR	**GEOGRAPHICAL AREA BY PROFESSIONAL SURVEY (SQKM)**	**FOREST AREA (SQKM)**	**% OF FOREST AREA TO GEOGRAPHICAL AREA IN THE DISTRICT**	**% OF TOTAL FOREST AREA IN THE DISTRICT**
2013-14	13835	10133	73.2	26.8
2015-16	13835	10133	73.2	26.8
2016-17	13835	10133	73.2	26.8
2017-18	13841	10953	79.1	20.9
2018-19	13841	10953	79.1	20.9

***Source**: Forest Department, HP*



Graph showing forest area (in sq.km.) of District Lahaul & Spiti

FAUNA

The wild animals of Lahaul and Spiti are not numerous. The fauna is quite unique with Palaearctic affinities and Tibetan fauna like Ibex, Bharal, Brown bear, Tibetan wolf, Nayan, Marmot, Snow leopard, Ibex, Weasel, Vole, Snow cock, Snow partridge, Chukor, Chough, Raven etc. Two sanctuaries namely Pin Valley National Park in Spiti and the Sechu Tuan Nala in Chamba have been formed in the Cold Deserts of Himachal Pradesh. Lippa Asrang Sanctuary is located in a high latitude area and one of the few in India from where the Yak has been reported, though it may well be feral. Musk Deer and Ibex are also present. The area is largely flat, like a huge plateau and apart of it is a barren cold desert. This sanctuary is among the few in Himachal Pradesh, which is not open to tourists.

Species, that are believed to be locally threatened, are Himalayan Black Bear, Brown Bear, Musk Deer, Ghoral, Ibex, Leopard, Blue Sheep and Yak. Rakchham Chittul Sanctuary is located at a high altitude and is a good habitat for the endangered Musk Deer. Rupi Bhaba Sanctuary. A remarkably wide variation in altitude supports a large diversity of habitats and wildlife in this catchment area of the Sutlej River. The Great Himalayan and Pin Valley National Parks are located on its Western and Northern boundaries, respectively.

9 PHYSIOGRAPHY OF THE DISTRICT

Lahaul & Spiti is a scarcely populated district, located in the northeastern part of the State. The district is entirely hilly and comprises two major valleys viz. Lahaul & Spiti. The Lahaul Valley is located ted in the northwestern part of the district while the Spiti Valley is located in the southeastern part. The district, with its headquarters at Keylong, lies between 31°44'57" & 32°59'57" North latitudes and 76°46'29" 8°41'34" East longitudes. The district has a totalValleyaphical area of 13,841 sq km, covers about 25 % of the State's geographical area and ranks 1st in the area in the State. The district has been divided into 2 divisions viz. Keylong and Kaza. There are 2 tehsils [Keylong & Kaza] & 1 sub-tehsils [Udaipur].

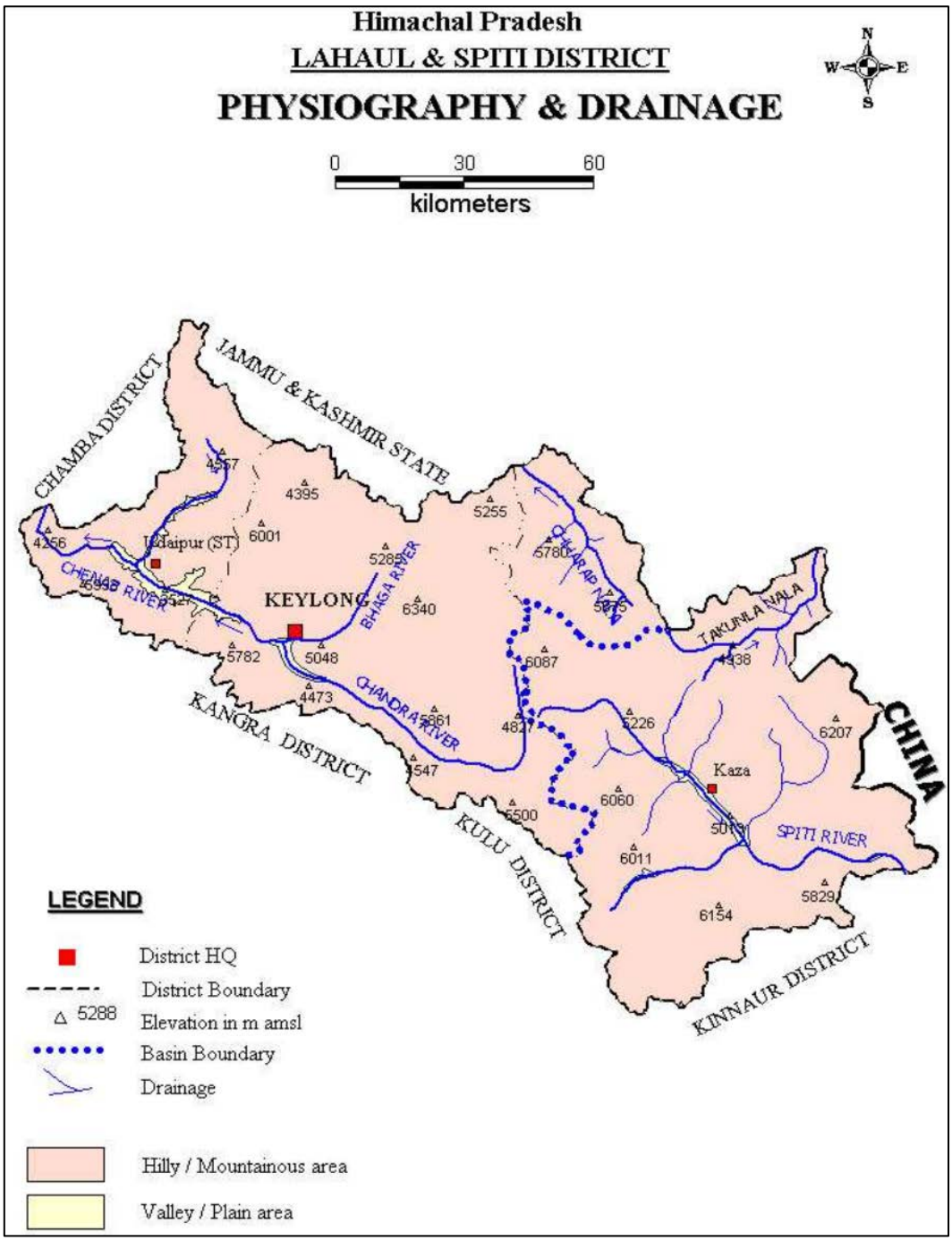


Image showing Physiography and drainage of the district

The geomorphological set-up of the area is highly complex. The terrain has an immature topography and is traversed by deep valleys and high hill ranges. The district can be divided into two major geomorphological units viz. Structural hills and valley fills. Structural hills are underlain by rocks belonging to the pre-Cambrian, palaeozoic, Mesozoic and Cenozoic eras. The rocks are generally trending in NNE-SSW and NE-SW direction with steep slopes. Escarpments and hogbacks are common features. Valley fills include both fluviatile deposits and moraines. These deposits occur as narrow and elongated strips along the main streams. The glacial deposits are under the influence of running water and have been termed glacial-fluviatile deposits. Fluviatile terrain is demarcated in the lower reaches of both the Chenab and Spiti rivers. These have thick vegetation. The width of these deposits is generally less than 3 km and is not uniformly distributed.

Glacio-fluviatile deposits are confined to the upper reaches of the drainage system of the watersheds. These areas are either along the snowline or near it. Mostly these are demarcated along the river/stream courses. These valleys are broad and gently slopping, generally devoid of any vegetation cover. The width of these deposits is more in the northern parts of Lahaul Valley. In Spiti Valley, the important glacial-fluviatile deposits are along Kasima Nadi, Puigulung Takpo, Perang River and Khemenger River. Glaciers are widely distributed over the central and northern parts of the district. The main glaciers are aligned in EW or WWN-EES direction with their offshoot glaciers in a north-south direction feeding the tributaries Valleyiiss rivers in either direction. Bara Shingiri Glacier is located in the southern part along the Great Himalayan Ranges contributing water to both the Chenab and Spiti rivers.

Most of the area of Spiti Valley is drained by the river Spiti, a major tributary of the Satluj River. The river passes through the valley area and bisects the valley in almost two equal parts. Spiti River originates near Tango (5870 m amsl) and flows from northwest to Southeast (Fig. 2). The River takes a southerly turn near Sumdo to join River Satluj. The River valley is broad and wide upstream of Dankar Gompa.

The major tributaries of the Spiti River are the Pin River and the Lingthi River. The Pin River originates at a height of about 5590 m amsl. The river travels northerly and then northeasterly to join the Spiti River near Dhankar. The major tributaries of Pin River are the Parahio River, Khamengar River, Kuokli Gad and Debra Khad. All these rivers and Khads are perennial. Pin River has developed downstream along its bank very fertile lands in patches where cultivation for the major crops is done. During summer, the discharge of Pin River increases and many a time, the flow in the river is turbulent. Pin Valley also presents a scenic beauty as one travels along its course.

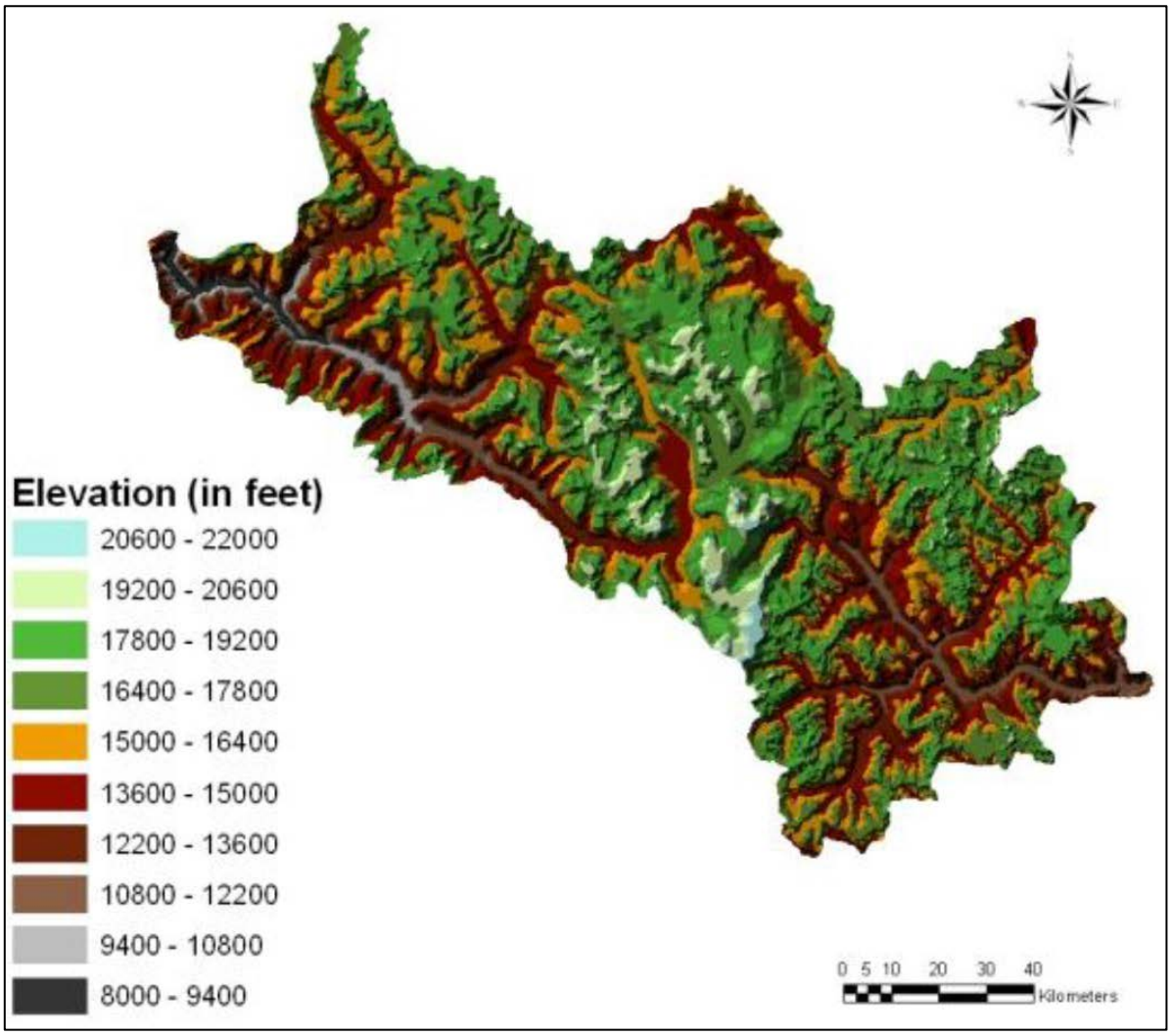


Image showing the Elevation profile of the District

Lingthi River is another major tributary of the Spiti River and travels through a more or less deep valley. The major tributaries of the Lingthi River are the Tangma River, Khukhe River, Sheru Nala and Shama Nadi. The river is perennial and during summer the discharge increases because of the melting of the glaciers. In comparison with the Pin River, the Lingthi River has a narrow river valley and has not developed fertile lands. A small part of the Spiti valley in its north-eastern part is drained by the river Parang also locally called as Pare Chu River. This is a perennial river and originates from the village Parang La located at a height of 5648 m amsl. The river travels north easterly and crosses the boundary of Spiti Valley near the village of Narbu Sumdo. The river then travels southerly and runs parallel to the boundary of Spiti valley and again re-enters the valley near the village of Shugar. The river then joins the Spiti River near Sumdo.

Chharap nala drains a small part of Spiti valley at its northernmost end. The major tributaries of this nala are Mlung nadi and Lungar Lumpa nadi both originate at a height of about 6100 m amsl. The Chharap nala drains into the Ladakh region of Jammu & Kashmir.

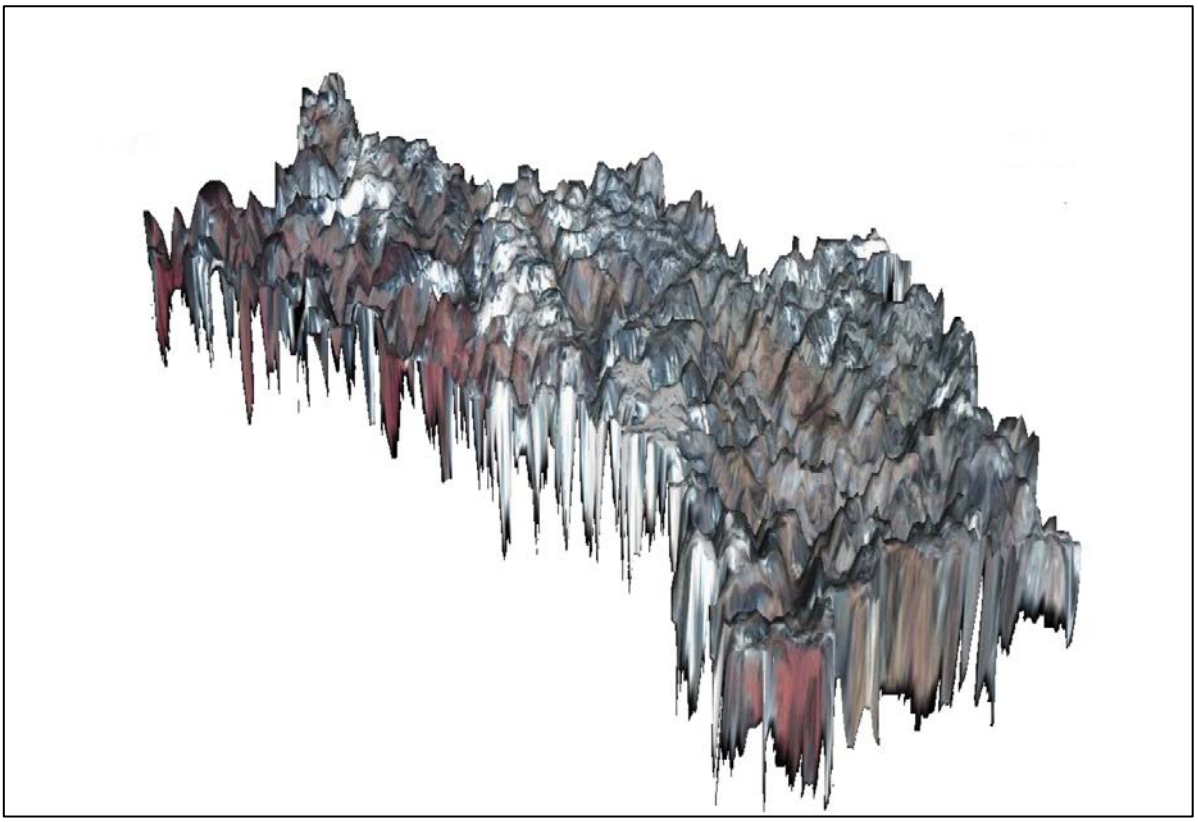


Image showing 3-D Surface View of District

10 RAINFALL

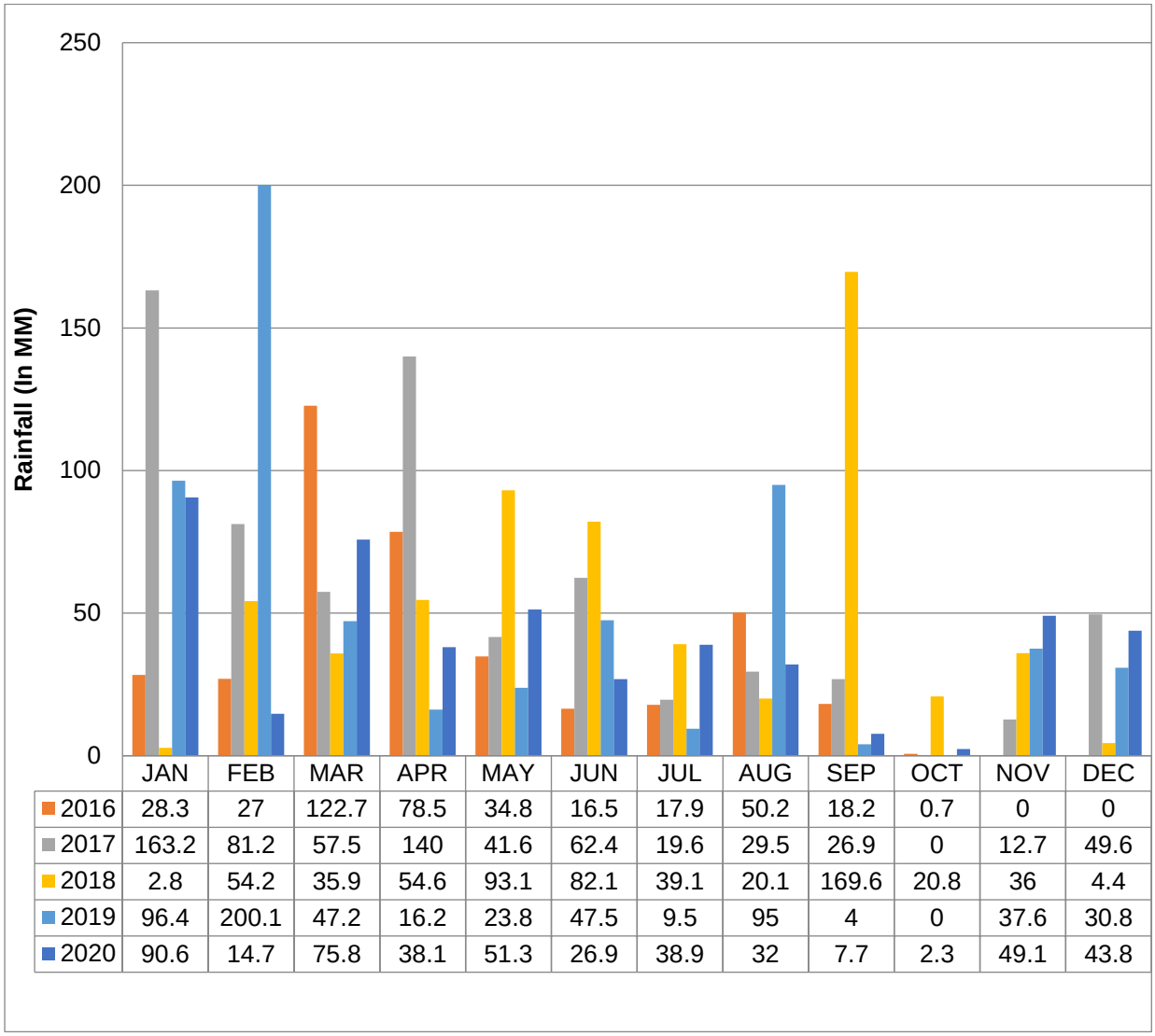
The monsoon hardly penetrates the district as its enormous mid-Himalayan mountain ranges almost divert the monsoon waves. The Spiti region of the district is also a typical mountainous desert and rains reach there in the form of misty drizzles. The district receives lower precipitation in comparison to other districts of the State. The winter is the only season when precipitation is normally received in the form of snow. The average annual rainfall for five years (In mm) in the State and the Lahaul and Spiti is shown in statement-A. The highest average annual rainfall was recorded for the district in the year 2005 i.e. 795.4mm as well as for the State was 1189.6 mm whereas the highest difference of the same was recorded in the year 2008 of 729.4 mm.

The sky becomes heavily clouded or overcast when the district is affected by western disturbances during December to May and there is some moderate cloudiness during summer. The winds are generally light in valleys and lower elevations while it is stronger at the higher elevations. The direction of the wind at the surface depends very much on the nature of the terrain and it flows generally from northerly to north-easterly in the summer and westerly to north-westerly in the remaining seasons. The following table shows the quantum of rainfall during the last 5 years from 2016 and 2020 in the district as per IMD.

Table Showing monthly rainfall data of the district

LAHAUL & SPITI DISTRICT RAINFALL IN MILLIMETERS (R/F)												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	RAINFALL (IN mm)											
2016	28.3	27	122.7	78.5	34.8	16.5	17.9	50.2	18.2	0.7	0	0
2017	163.2	81.2	57.5	140	41.6	62.4	19.6	29.5	26.9	0	12.7	49.6
2018	2.8	54.2	35.9	54.6	93.1	82.1	39.1	20.1	169.6	20.8	36	4.4
2019	96.4	200.1	47.2	16.2	23.8	47.5	9.5	95	4	0	37.6	30.8
2020	90.6	14.7	75.8	38.1	51.3	26.9	38.9	32	7.7	2.3	49.1	43.8

Source: Meteorological Department, Govt. of India



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2016	28.3	27	122.7	78.5	34.8	16.5	17.9	50.2	18.2	0.7	0	0
2017	163.2	81.2	57.5	140	41.6	62.4	19.6	29.5	26.9	0	12.7	49.6
2018	2.8	54.2	35.9	54.6	93.1	82.1	39.1	20.1	169.6	20.8	36	4.4
2019	96.4	200.1	47.2	16.2	23.8	47.5	9.5	95	4	0	37.6	30.8
2020	90.6	14.7	75.8	38.1	51.3	26.9	38.9	32	7.7	2.3	49.1	43.8

Average monthly rainfall data of the district from the year 2016 to 2020

11. GEOLOGY AND MINERAL WEALTH

The Regional Geology of the Area

Tethys Himalayan tectogen: Lahual and Spite Valley

The Lahual and Spiti basins constitute an exceptional area, where a thick pile of sedimentary sequences was deposited on the northern margin of the Indian plate. The Tethyan basin provides largely uninterrupted Proterozoic-Mesozoic-Tertiary succession and is bounded by the Vaikrite Group of the Central Crystalline Zone on the SW side and by the Indus tectonic zone in the NE and the Lahual and Spiti valley exposes an excellent sedimentary succession with preserved primary sedimentary depositional features (Bhargava, O.N., Kanha, S.B., 1998).

The Central Crystalline Zone, of which the Vaikrita Group is the main constituent, occurs in the basal part of the Tethyan sedimentary sequence and is enveloped by schists and migmatitic rock of the Salkhala Group intermittently. The Batal (Terminal Proterozoic) and Kunzum La (Lower – Middle Cambrian) Formation of the Haimanta Group, which is essentially a Tethyan cover rock, are weakly metamorphosed to un-metamorphosed lies over the Vaikrita-Salkhala rocks. There is a fall in the grade of metamorphism from the Vaikrita-Salkhala Group towards the Haimanta Group. The project area exposes rocks belonging to the Batal Formation of the Haimanta Group (Bhargava, O.N., Kanha, S.B., 1998).

LITHO-STRATIGRAPHIC FRAMEWORK

The Miyar HEP falls in the Great Himalayan range which is extended from Lahual in the northwest to Kinnaur in the southeast. The area stratigraphically represents a complete Phanerozoic sequence of Lahaul-Spiti-Kinnur basins with Proterozoic crystalline basement with granitoids of variable age (Table 1.1). It is bounded by the Vaikrita group on the SW and by the Indus Suture Zone (ISZ) on the NE side. The following description of the litho stratigraphy has been adopted from Bhargava, O.N and Kanha, SB., 1998.

VAIKRATA GROUP

The term Vaikrita system was first proposed by Griesbach (1891) for the schistose series overlying gneisses and underlying the Haimantas in the central Himalayas. The Vaikrata group comprising the Giambal and Rohtang crystalline complex constitutes a thick succession of crystalline rocks of proterozoic age and can be broadly divided into two units. The lower unit comprises streaky and banded gneisses together with porphyroblastic gneiss, augen gneiss and garnetiferous staurolite, kyanite and sillimanite

gneiss with interpolated melanocratic schist bands within gneiss. Alternate bands of coarse biotite gneiss and the leucocratic quartzo-feldspathic gneiss rich in muscovite and tourmaline are seen along with several bands of amphibolite. The gneissic complex is intruded by several phases of granitoids.

The upper unit is characterized by metasediments, migmatite and gneiss with melanocratic quartz-biotite schist, quartz-feldspar-biotite schist, muscovite schist, marble, calc Phyllite, amphibolite schist, quartzitic and quartz schist.

Table - Lithstratigraphy of tethyan succession in Lahual, Spiti and Kinnaur (adopted from Bhargava, O.N and Kanha, SB., 1998).

AGE	FORMATION	GROUP	LITHOLOGY
CARBONIFEROUS	PO	KANAWAR	Shale with Sandstone Bands
	LIPAK		Limestone (Shell, Coral, Algal), Sandstone, Shale, and Gypsum in
DEVONIAN	MUTH		White Quartzite
SILURIAN	TAKCHE	SANUGBA	Calcareous Sandstone, Shale, Coral-
ORDOVICIAN	THANGO		Purple Quartzite, Shale, Silt Stone, Grit,
LOWER MIDDLE	KUNZAM LA	HAIMANTA	Green to Grey Slate, Subarkose Locally Gritty, Pyroclastic Beds at Base,
TERMINAL PROTEROZOI	BATAL		Dark Grey Phyllite, Local Carbonaceous subarcose
MESO-NEO PROTEROZOI		SALKHALA	Grey, Green Purple Quartzite with Schist
		VAIKRATA	Biotite-Garnet-Staurolite-Kyanite-Sillimanite Schist, Quartzite Interbeds
			Kyanite-Sillimanite Bearing Schist, Gneiss and Migmatites

SALKHALA GROUP

The Salkhala is delimited by the Vaikrita group of the central crystalline zone below and the Batal formation of the Haimanta Group in the Lahaul-Spiti-Kinnaur area of Himachal Pradesh of the Proterozoic age. The Salkhala group is comprised of laminated chloritic slate with metagreywacke and intercalated carbonaceous slate and quartzite, greyish-green phyllite and schists, garnetiferous biotite schist, micaceous quartzites, psammitic gneiss and interbedded with sporadic crystalline limestone. The important feature of the Salkhala group is the presence of a linear belt of concordant granitoid plutons.

HAIMANTA GROUP

The term Haimanta group was proposed by Greisbach (1891) to describe the rocks overlaying the Vaikrita group and underlying the Sanugba group and can be broadly divided into two units.

Batal Formation

The Batal Formation the name proposed by Srikantia (1981) forms the basal part of the Tethyan Phanerozoic succession. It has conformable contact with the Vaikrita. At places particularly along the contact between the Batal and the gneissic rocks of Vaikrita, tectonization and disharmonic folding are prominent due to competency differences in these two rock groups. In many sections, the sediments are welded to the basement.

The Batal Formation in the basal part comprises grey-green phyllite, grey quartzite and carbonaceous Phyllite. Sporadically migmatites and paragneisses with garnetiferous-biotite schist are also present in some sections. In the middle part of the sequence, the batal formation is composed of quartzite alternating with pyritous carbonaceous phyllite forming the dominant lithology. The upper part of the Batal formation comprises green- coloured chlorite Phyllite, carbonaceous Phyllite, and quartzose Phyllite with interbeds of pale white to grey quartzite. Good exposure of Batal rocks is exposed in Chandra Valley. There is a general paucity of sedimentary structures. Stratification is identifiable. Locally cross-stratification of thin sedimentation units and ripple marks are seen. The litho-assemblage suggests a mixed environment of euxinic to broad peri-tidal conditions. The Batal formation has been invaded by granitoid bodies. Granite is porphyritic and contains sporadic dissemination of arsenopyrite. At places, it is a coarse biotite granite and porphyritic with veins of pegmatite, tourmaline-bearing leucogranite and aplite. There are smaller boudins of granite in the carbonaceous phyllite and quartzite.

The Batal formation is assigned a terminal Proterozoic age based on its stratigraphic position below the Kunzam La, the basal part of which contains an early Cambrian trace fossil zone. The Precambrian-Cambrian boundary is located in the uppermost of the Batal Formation (Kumar et al.1984).

Kunzam La Formation

The Kunzam La Formation named after the Kunzam La (Pass) in Lahual by Srikantia (1981) is made up of greenish-grey siltstone, shale/slate, quartzite, sandstone, dolomite (in the upper part) and local pebble beds. IN Baspa and Tidong valleys it contains gritty and pebble bedsand magnetic tuffs.

Broadly the Kunzam La Formation can be divided into two divisions. The lower division also called Debsa Khad Member consists of grey quartzite, flaggy quartzite to

massive with slate partings; greyish green shale, slate, siltstone, sandstone and flaggy quartzite. The Upper-division also called as the Parahio Member is characterized by the development of brown dolomite associated with cross-bedded calcarenite and quartzite in alteration with olive green shale and siltstone.

The bedding features and sedimentary structures present in this formation include sandy rhythmite with parallel bedding, wavy ripple and lenticular bedding, ripple marks, channel fills of sand and syndepositional slumps in the basal part, low angle truncations, rare flute casts in the middle part and cross-bedding, herringbone cross-bedding and mud cracks in the upper part. The age of the Kunzam La Formation is regarded to range from Early Cambrian to Middle Cambrian.

SANUGBA GROUP

The Thango and Takche formations are included under the Sanugba group.

Thango Formation:

Thanpo formation consists of purple quartzite, shale, siltstone, grit, conglomerate and dolomite. The Thanpo Formation shows a transgressive relationship with the Kunzam La Formation over which it rests on angular unconformity. However, the contact at many places is sharp and conformable and is characterized by a band of gritty purple sandstone and at places by a lenticular band of conglomerate.

The Thango sequence is characterized by herringbone, festoon and planner cross-bedding, ripple layer, ripple marks with bifurcating crests mud cracks and current crescents, indicating an overall shallow tidal sea environment. Conglomerates seem to have fluvial origins which were reworked on a beach. On the basis of the available fossil record the age of Thango Formation varies from Lower Ordovician to lower Silurian.
Takche Formation

The Takche Formation comprises a sequence of limestone, dolomite, Shale, siltstone and sandstone. The arenaceous elements, dominate in the western part, East of Ratang nala, Pin Valley and Kinnaur it is calcareous. The Takche Formation shows several prograding cycles showing parallel and low-angle cross-beds in the basal part and cross-bedding and low-angle discordance in the upper part broadly indicating shoaling from low energy environment in the middle lower shoreface affected by mild intensity storms. The Takche Formation is rich in fossil content. An Ordovician age has been assigned to this formation by Kato et al (1987).

MUTH QUARTZITE

The term Muth series was first used by Stoliczka (1865) from Muth village in the Spiti. Srikantia (1981) gave the term Muth formation to the white quartzite sequence of the Muth series. The Muth formation is the most striking maker unit in the Palaeozoic sequence of the Tethys Himalaya from Kashmir to Kumaun. This Formation rests over the Takche Formation along a sharp contact including a possible break in sedimentation indicating a possible break in sedimentation. The Muth formation is constituted of compact to granular, medium to fine-grained, white to mottled, locally grey quartzarenite. At places, olive green shales are associated with dolomite and sporadic conglomerate lenses. The quartzarenite shows low-angle cross-bedding with subparallel to low-angle truncation indicative of transgressive upper shore facies in the beach environment. Based on a conformable relationship with the overlying carboniferous Lipak formation an age within Devonian is suggested for the Muth Formation.

KANAWAR GROUP

The name Kanawar system was first used by Hayden (1908) to include certain Devonian and Carboniferous strata in Spiti overlying the Muth quartzite. He divided the Kanawar system into the Lipak and Po series. Later on, Srikantia gave a group status to Kanawar System.

Lipak Formation

This Formation is named after Lipak valley in Kinnaur (Hayden, 1904). The Lipak Formation comprise dominantly of dark grey to black limestone and dolomite, grey shale and pink limestone and lenticular snow white and powdery gypsum beds in the upper part. There are interbeds of quartz arenite within the carbonate sequence. The presence of limestone, dolomite and gypsum suggests an evaporate sequence. The environment of sedimentation varies from sub-tidal to inter-tidal, with the acquisition of supra-tidal conditions in the terminal part to form an evaporate basin Lipak Formation is rich in fossils indicating a late Devonian to early carboniferous age to Lipak Formation.

Po Formation

The name of this formation was proposed by Hayden (1904). This formation is exposed in Lahual and in the NW, SW and SE corner of the Spiti valley. The Po Formation has conformable and gradational contacts with the underlying Lipak and overlying Ganmachidam Formation. It comprises a thick sequence of white to grey medium-grained quartzarenite, siltstone, sandstone and grey- black, locally pale green shale with rare cherty partings. The shale is dominant in the middle part whereas the upper part

develops pebbles and gritstones. The lithologic assemblage and bedding features indicate several prograding cycles from mid-shelf to upper shoreface. Gothan and Sahni (1937) based on plant remains suggest the middle carboniferous age for the Formation; however, the invertebrate fauna suggests a lower –middle carboniferous age (Waterhouse, 1985)

MINERAL WEALTH

Himachal Pradesh is blessed with mineral wealth. As per an investigation by the Geological Survey of India, the minerals available in Himachal Pradesh include limestone, barytes, clays, mica, iron pyrites, salt, gypsum, slate, antimony and lead. The distribution of these minerals is scattered all over the State and includes limestone in Bilaspur, Sirmaur and Kangra districts; salt and slates in Mandi District; and gypsum in Rajban, and Bharli Sirmour districts.; Lahaul & Spiti and Sapatu in Solan distt.; byryte in Sirmour, iron ore in Mandi and Kangra; and Uranium in Kullu and Hamirpur districts.

There is no major mineral available in the district. The economy of the district is predominantly agriculture-based. About 80% of the population is engaged in agriculture and its allied activities. Potato, Peas, Hops and Seabakthorn fetch good prices to the inhabitants of the district. Besides agriculture, animal husbandry also plays an important role in the life of the people in Lahaul & Spiti. The entire area of Lahaul & Spiti remains under snow from November to April each year. The climate is dry temperate, which is suitable for the cultivation of apples, dry fruits and hops. Due to the geographical factors and the bulk of the workforce being engaged in agriculture and its allied activities, the district is industrially most backwards in the state.

There is no Industrial Area in Lahaul &Spiti. Lahaul & Spiti district which is the tribal district of Himachal Pradesh is industrially underdeveloped. There are very few industrial enterprises in the district on account of topographical constraints and severe climatic conditions. Most of the industrial units as given in the subsequent sections are handloom-based units such as shawls, caps, patti and other woollen garments manufactured on handloom. There are 400 industrial enterprises registered in the district

- **MINERAL WEALTH OF DISTRICT LAHAUL-SPITI**

Limestone

Limestone is a calcareous sedimentary rock composed of the mineral calcite (CaCO3) which upon calcination yields lime (CaO) for commercial use. Cement and Iron & Steel industries are the major consumers of limestone. It is also consumed in chemical industries like calcium carbide, bleaching powder, soda ash, precipitated calcium carbonate, etc. Besides, it is used as fluxing material in Ferro-alloys, pelletization plants, foundries and in the production of

sponges from iron, as refining materials in the production of sugar; as an additive in the glass industry; as a coating material in the fertilizers industry etc.

In the Higher Himalayan sector of Lahaul-Spiti, the Early Carboniferous Lipak Formation and the Triassic-Early Jurassic Lilang Group are the important carbonate belts.

Details of Limestone Reserve (In Million tonnes)				
District	**Proved**	**Probable**	**Possible**	**Total**
Lahaul-Spiti	--	--	1000	1000

Clay

Two lacustrine clay pockets have been reported at Kioto (32°56': 77° 55') and Atargoo (32° 78’ 10”). The first one is about 500 metres in length with a maximum width of 80 metres while the latter one is 250 metres in length with a maximum thickness of 15 metres.

Copper

Malachite staining is occasionally noticed in association with quartz veins in Chandra Tal (320 39': 770 37') and Sarchhu (320 42' 30": 77° 32’) areas. Copper mineralisation in the form of chalcopyrite, malachite and azurite is seen along brecciated zones and within quartz veins associated with limestone of the Kunzam-La Formation in between Chander Tal & Bara Lacha pass (32° 44' : 77° 26’). In this area, two types of veins have been encountered: The veins which show the mineralization of chalcopyrite are ferruginous and is restricted to the peripheries.

The veins which do not show any mineralization are white in colour. Copper mineralization is also reported in the Shitikar area(320 25': 770 40') . Here the quartz veins are the mineralized body and vary in length from 5 cm to 30 metres. The breath also varies from 1 cm to 2 metres. About 6 veins show chalcopyrite mineralization occurring as stringers. Out of 126 samples analyzed by the Geological Survey of India, only four sample shows 150 ppm of copper otherwise most of the sample shows 50 or less than 50 ppm of copper.

Galena

The occurrence of galena in small quartz vein infiltrated along a fault plane in upper Triassic limestone between Po (32° 03' :78° 23') and Dankhar (32° 05’ 78° 16') in the Spiti valley has been noted by Haden. Galena associated with vein quartz occurs in the quartzite of the Po Formation near Tabo. Specks of galena are associated with Muth Quartzite in the Chandra Tal area. A 12 cm thick E-W trending quartz vein intrusive within the quartzites of

the Tandi Formation contains galena in the form of thin stringers and specks along the road section between Tandi (320 34' 77° 59') and Sissu (32° 29'77° 58').

Gypsum

Gypsum associated with the Lipak Formation occurs on the right bank of Spiti river, east of Losar (32° 25' : 77° 45'), along the right bank between Hurling (32° 04' : 78° 31') and Sumdo (320 04': 780 36'), in Gyundi Valley (320 16': 770 50') and at Dhuma Dangse (320 25': 770 40'). The occurrence between Hurling and Sumdo is quite extensive. Anhydrite and selenite are locally associated with gypsum in this stretch. Elongated crystals of transluscent gypsum are present in the Spiti Formation, east of Lamayuru (32° 52' 30": 770 44' 15").***Coal***
A carbonaceous horizon is traceable for about 90 metres near Mansai (31° 34/: 76° 51'). There is another 91 centimetre thick seam traceable for 45m, 750m to the south of the earlier one. A coal seam near Dehar (31° 251: 76° 491) crops out in and near the steep right bank of Sutlej River about 280m upstream of the suspension bridge. The carbonaceous horizon is interbedded with limestone with almost vertical dips. Two carbonaceous seams, 180cm and 90cm thick could be traced for a distance of about 90m. Small discontinuous patches of coal outcrops are noted near Kaphai (31° 32': 76° 51'). An outcrop of coal is seen on the right bank of a small stream about 600m southeast of Arthi (31° 32': 76° 52'). The coal is sheared and stained dull greyish yellow, rusty on the surface.

Iron Ore

About five km South east of village Muth the occurrence of red hematite in the Thango Formation is reported by Hayden (310 57' : 770 00') Lenticular hematite quartzite occurs in the Tango Formation at Tango (320 02' : 770 57') and Shitekar (320 26' : 770 40'). The main band of Tango is 1.5 to 2.5 metres thick and extends for 130 metres along the strike.

Kyanite

Significant kyanite mineralisation associated with metasediments of the Batal Formation (Precambrian) has been reported from the Thanpattan (320 56' 00": 760 54' 30") area of Miyar Valley. The main zone rich in mineralization is 40m in thickness and traceable for over one kilometre

Pyrite

Dissemination and stringers of pyrite were observed in the Shatul Gneiss near Dulgi Ghati (31° 26': 78° 05') and in the rocks of Jutogh Group west of Brandy Khagau (31° 26' : 78° 06').

SPITI SHALE

In Lahaul & Spiti Phosphatic nodules ranging in size from four to 10 cm from the Spiti Shales have analysed 5- 15 % P2O5

Stibnite

The history of the discovery of Stibnite goes back to 1854. A letter dated 15th November, written by Capt. W.E. Hay, Assistant Commissioner Kullu, to Mr M.P. Edgeroth, Commissioner and Superintendent of Trans Satluj States, contains the earliest reference of official papers to the antimony deposit near Bara Sigri Glacier. According to this letter, the main bed of 10-15 feet thick consist of Iron ore, with antimony and other metals on the sides. An analysis of antimony ore from this locality was done by Mr Mons Mocardieu, Geological Surveyor of Punjab in 1855 and it showed 60%Sb.In 1875 J. Calvert claimed the discovery of antimony at Sigri and asserted the existence of several antimony lodes, the widest being about 40 feet. Capt. Charles Henwood, Manager of Subathu Mines submitted a report on 1886 after a days visit to Sigri Mines. He writes about silver lead ore which gives 60 percent lead and 66 ozs of silver per tonne of ore and a trace of gold. He also describes one 5 feet thick antimony –lead vein at Sigri from where 20 tons of antimony ore were recovered by four labourers in one month. He also described two other antimony loads 10 feet and 11 feet thick respectively. Mr. Ball mentions a second smaller lode being discovered in 1872 by A.G. Yung who found a 20 feet 20-foot-thick bed of Stibnite in a mineralized zone twice its thickness. In 1905 Colonel R.H. E. Rennich held the mining lease of the Sigri area and shipped 15 tonne of ore to England, making use of migratory flocks of sheep. The export stopped on account of low price. There was mention of the ore by H. Walker and Mr. E.H. Pasco of the Geological Survey of India in 1907 who were deputed to study the behaviour of Bara Sigri Glacier in 1906. After a long gap in mining activity, the prospecting work was resumed in 1940 and this area seems to have been prospected by Mr. Moi and Major H.M. Banon on behalf of Messrs Govan Brothers, Delhi. In 1956 G. N. Dutt and F. Ahmad of the Geological Survey of India described the occurrence of two separate ore bodies in the area. The area was in detail investigated by the S. V. Srikantia and R. N. Padhi of the Geological Survey of India in 1963. The lithology of the area is as under:-

- Pegmatite with or without tourmaline ;
- Slate, phyllite with limestone lenses;
- Grey - brown slate, siltstone and quartzite
- Amphibole and dolerite;
- Grano- diorite, partially gneissose with pegmatite;
- Conglomerate and

- Ganetiferous, biotite, hornblende – schist.

The Grano-diorite contains two sets of pegmatite, one along the foliation, consisting principally of quartz, feldspar, mica and garnet. The other set which appears to have intruded along the main joint plane of the granodiorite contains the ore bodies. Besides pegmatites, the granodiorite is also intruded by the basic dykes of amphiboles and dolerites. The ore-bearing pegmatites traverse along the main joint plane of the granodiorite in an NE- SW direction. Besides containing lead and zinc, the outer most ore body contains some copper also. Thus there appears to be a crude zoning of these ore minerals according to the principles of zonal ore deposition around batholithic intrusion. The one ore body is about 7 cm thick and the length of the outcrop is about 7 metres. An average sample yields about 10.5 % lead and 15.20 % zinc. Another vein is about 150 metres with an average thickness is about 3 cm. The average yield is about 23.9% zinc and 4.22 % lead. The average grade of ore body is about 45 % Sb which occurs as a pure crystal in the pegmatite. The Sb %age can be increased to upward of 60% only by hand trimming and sorting and perhaps higher by other suitable methods of ore concentration. The proved reserves by the Geological Survey of India are about 24 tonnes of ore per foot of length for one 600 ft long vein (G. N Datta & Dr. F. Ahmad, 1957). The mineralization in this area is confined to the granitic batholith. Generally, the pegmatites seen in the granitic rocks are ore-bearing and occasionally quarzo- felspathic rocks show splashes of ore. The fractures and joints traversing the pegmatite are structural controls for mineralization. The mineralization in the area can be grouped into three categories:- 1. Mineralization of stibnite, galena and zinc as mostly splashes along the fracture and joint planes and at places as specks and disseminated products in the host rock, pegmatite. 2. Mineralization of pyrite and chalcopyrite as specks and strings 3. Certain dark mineralization stains along fracture planes and joint plains. Stibnite and the associated lead ore and zinc minerals are seen to grow over quartz crystals along the planes. Occasionally they show association with clay bands and ferruginous matter. They also occur as splashes along the fractured zone. The general ore genetic sequence started with the formation of granitic rocks which are the result of early magmatic intrusion at phased intervals, followed by the late magmatic activity resulting in the formation of pegmatite with tourmaline at places. During the final phase, the hydrothermal solutions travelled along the fracture planes and developed the pegmatite and quartzo-feldspathic granites, depositing antimony and the associated ore minerals as a cavity filling. Seven stibnite and associated sulphide ore veins and splashes are seen in the area.

There are 9 old working pits reported in the area. The other ore bodies are also located in the area which varies in width form 0.5 cm to 1.5 cm . The rough estimate of the anticipated reserves are about 10,000 tonnes with 1.65 % of Sb.

Sulphur

A small quantity of Sulphur is associated with Gypsum Near Losar (32^0 25' N -$77^0$45' E) and also small quantity of sulphur is associated with other gypsum deposits of Lahaul & Spiti The deposition of the sulphur can be grouped into three categories:- 1. Associated with hot springs; 2. Associated with gypsite and 3. Associated with river terrace.

Sulphur associated with hot springs:- Various sulphur springs are situated along the Parechu and on the thrust in the vicinity of Giu Nala. Sulphur, Borax and Gypsum are associated and are deposited at the orifice of the spring. The Sulphur occurs as precipitate, however the quantity associated is too insignificant for economic use.

Sulphur associated with Gypsite:- This type of deposit occurs associated with gypsite and limestone. This sulphur is powdery or at places oolitic. It occurs in various shades of yellow and red. The sulphur thus found is small in quantity and occurs irregularly. At most of the places, they do not continue beyond a depth of more than 0.9 metres.

Sulphur deposits associated with river terrace:- The river Parechu has a course roughly parallel to the thrust and hence the river terraces with sulphurous soil also have same trend. It occupy an area of 0.03 Sq Km . The deposit occurs within thick beds of river terrace. With subsequent deepening of the valley the terrace are now much above the present river level. It is during the geological time the hot springs exists at this height, parallel to thrust and along the banks of the river and sulphur precipitated got diffused in the loose matrix in between the pebble and cobble of the river terraces now found at higher level, thus leaving sulphurous soil all along the slope of the valley. The quantity is too insignificant for economic use.

Zinc

Zinc blende is sparingly disseminated through the gangue of the antimony ore at Bukkanbudi (310 42' :750 49').

PART II

DISTRICT SURVEY REPORT FOR MINOR MINERALS OTHER THAN SAND MINING OR RIVER BED MINING

DISTRICT- LAHAUL AND SPITI

HIMACHAL PRADESH

(Hill Slope Mining)

1. INTRODUCTION:

Minor Minerals (Hill Slopes or riverbeds) are valuable natural resources being the vital raw material for infrastructure, capital goods and basic industries. As a major resource for development, the extraction and management of minerals have to be integrated into the overall strategy of the country's economic development. The exploitation of minerals has to be guided by long-term state goals and perspectives. Just as these goals and perspectives are dynamic and responsive to the changing global economic scenario so also the state minor mineral protection policy has to be dynamic taking into consideration the changing needs of industry in the context of the domestic and global economic environment. To exploit the country's geological potential it is important that scientific and detailed prospecting is carried out in search of its mineral resources.

Mineral deposits in the Lahaul and Spiti District occur largely in the form of rocks (Hill Slope) or River bed material such as Granite, Gneiss, Quartzite, Phyllite, Schist, pegmatite etc. They constitute the vital raw materials for many construction activities (roads and building projects) and hence are a major source for the development of infrastructure in the District and in the nearby towns and villages of the neighbouring State. The Government of India through the Ministry of Environment, Forest & Climate Change (MoEF& CC) has brought out a Notification on 25" July 2018, further amending the Erstwhile Environment Impact Assessment Notification 2006. Based on the amendment introduced by the Ministry, a District Survey Report for minor minerals available in the District is to be prepared separately which shall form the basis for application of environmental clearance and appraisal of projects. Such a Report shall be updated once every five years. A Task Force comprising of team of Geologists, the Mining officer of the concerned District and other officials from the department was constituted for the purpose of preparation of the District Survey Report (DSR).

The need for a District Survey Report (DSR) has been necessitated by the Ministry of Environment, Forest and Climate Change (MoEF& CC) vide there Notification No. 125 (Extraordinary, Part II Section 3, Sub-section ii), S.O. 141 (E), dated 15th January 2016. The notification was addressed to bring certain amendments with respect to the EIA notification 2006 and in order to have better control over the legislation. As a part of this notification, the preparation of District Survey Reports has been introduced. Subsequently, MOEF& CC has published Notification No. 3611 (E), dt. 25th July 2018 regarding the inclusion of the ***"Minerals Other than Sand"*** and the format for preparation of the DSR has been specified. Enforcement & Monitoring Guidelines for Sand Mining (EMGSM) January 2020, Issued by MoEF& CC is prepared in consideration of various orders/directions issued by Hon'ble NGT in matters pertaining to illegal sand mining and also based on the reports submitted by expert

committees and investigation teams. This DSR has been prepared in conformity with the S O 141 (E), S O 3611 (E) and other sand mining guidelines published by MOEF& CC from time to time as well as the requirement specified in Himachal Pradesh Minor Mineral Concession Rule, 2015.

The purpose of the District Survey Report (DSR) is to identify the mining potential areas where mining can be allowed; and also to distinguish areas where mining will not be allowed due to proximity to infrastructural structures and installations, and areas of erosion. The Preparation of this District Survey Report (DSR) involved both primary and secondary data generation. The primary data generation involved the site inspection, survey, ground truthing etc. while secondary data has been acquired through various authenticated sources and satellite imagery studies. The district survey report of Murshidabad district also describes the general geographical profile of the district, distribution of natural resources, livelihood, climatic condition and sources of revenue generation

To ensure systematic mining by way of proper planning, replenishment and reclamation of the area, the period of lease shall be 5 years. The extension can be considered only after Joint Inspection by Sub-Divisional Committee and keeping in view its recommendations, depending upon the availability of raw material and the requirement of mineral-based industry under Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of Illegal. Mining, Transportation and Storage) Rules, 2015.

2. OVERVIEW OF MINING ACTIVITY IN THE DISTRICT

Hillslopes are one of the dominant landform features on Earth. Many types of processes act to create, modify, and attenuate slopes. Most of the districts of Himachal Pradesh have the mightiest mountain ranges having the Highest elevation of 6,813 m (22,352 ft) and the Lowest elevation of 232 m (761 ft). In districts Lahaul and Spiti, soon there will be a boom in the construction activities at a large scale for the development of roads and Hydro projects, but most of the area of the District remains snowbound and landlocked for almost 6 months i.e. from December to May and the working season for developmental activities are limited to 6 months only, resulting in higher costs of construction. Mainly three types of minor mineral constituents such as sand, stone and bajri are required for any type of construction apart from other materials like cement and steel. In earlier times, the houses/ buildings were constructed in the form of small dwellings with walls made up of mud plaster, stone and interlocking provided with wooden frames and there were negligible commercial as well as developmental activities resulting in less demand for building materials. However, with the passage of time,

new vistas of developmental activities were started. As such the demand for minor minerals in the District started in increasing trend. In order to meet the requirement of raw construction materials, the extraction of sand, stone and bajri is being carried out exclusively from the river beds. The demand for sand is mainly met through river-borne sand whereas the demand for bajri/grit is either met through river-borne collection or through manufactured grit by stone crushers. The demand for dressed or undressed stone is met through the broken rock material from the hill slope.

Mainly three types of minor mineral constituents such as sand, stone and bajri are required for any type of construction apart from other materials like cement and steel. In earlier times, the houses/ buildings were constructed in the form of small dwellings with walls made up of mud plaster, stone and interlocking provided with wooden frames and there were negligible commercial as well as developmental activities resulting in less demand for building materials. However, with time, new vistas of developmental activities were started. In district Lahaul-Spiti, there is a boom in construction activities especially in roads and Hotel industries, after the commissioning of the ***Atal Tunnel,*** the demand for minor minerals in the District started to increase trend.

The minor minerals available in the district are Boulder, Bajri (Gravels), Sand, Clay etc. from the river bed as well as Slate and Rough Stone, Project Stone, and Terrace mineral deposits from the hill slope. However, there are no major mineral industrial enterprises that can be set up in the district. Other minerals like semi-precious stones, Beryl-bearing pegmatites, China clay, Garnet crystals, Bands of haematite-quartzite etc. are also present in very small quantities which are not of much economic value.

The local residents used to lift gravel etc. from the river beds to meet out their bonafide requirement, however after coming into being the Himachal Pradesh Minor Minerals (Concession) Rules 1971 Repealed as Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of illegal Mining, Storage and Transportation) Rules 2015, the mining is regulated.

Hill slope mining and terrace mining are two methods employed in the extraction of minerals and resources from sloped or hilly terrain. Here's a brief note on each:

Hill Slope Mining:

Hill slope mining involves the extraction of minerals or resources from the sides of hills. This method is commonly used when the mineral deposit extends horizontally along the slope.

The process usually includes the following steps:

1. **Exploration:** Identifying the location and extent of the mineral deposit.
2. **Excavation:** Breaking the rock into manageable fragments. Mining activities are carried out after the formation of benches of usually 6mX6m, with an angle of repose of 45º.
3. **Transportation:** Moving the extracted material down the slope, often using conveyors or trucks.
4. **Processing:** Refining and processing the raw material to extract the desired minerals. The extracted raw material i.e., stone can be directly sold in the open market or can be used as a captive use for stone crusher units which are crushed in the form of angular grit.

Hill slope mining can be challenging due to issues such as soil erosion, landslide risks, and environmental concerns. Proper planning and environmental safeguards are essential to mitigate the negative impacts on the ecosystem.

Terrace deposits, in a geological context, refer to accumulations of sediments, minerals, or other materials that have been deposited on flat, elevated surfaces known as terraces. Terraces are often formed by the erosion and weathering of landscapes over time, and they can be found along river valleys, coastal areas, or on the slopes of hills and mountains. These deposits can be of various types, including sediments, alluvium, or even mineral deposits, depending on the geological processes that led to their formation. Here are a few examples:

Fluvial Terraces:

These terraces form along river valleys and are the result of river downcutting and lateral erosion over time. The sediments deposited on these terraces can include gravel, sand, and silt. Fluvial terraces are often indicative of changes in the river's course or base level.

Alluvial Terraces:

Alluvial terraces are associated with the floodplains of rivers. As rivers meander and change their course, they leave behind elevated terraces with deposits of alluvial materials. These terraces can contain valuable minerals and are often targeted in mining operations.

Mineral Deposits on Terraces:

In a mining context, terrace deposits specifically refer to mineral accumulations found on terraced slopes or elevated flat surfaces. These deposits can include valuable minerals like gold, silver, copper, or others. Terrace mining may be employed to extract these minerals from the flat benches or terraces created on the slopes.

Understanding terrace deposits is crucial in geological and mining studies, as they provide insights into past environmental conditions, sedimentation processes, and the history of the landscape. Geologists and mining professionals analyse terrace deposits to determine the

potential for valuable resources and to plan appropriate extraction methods while considering environmental and safety factors.

Terrace Mining:

Terrace mining, also known as bench mining, is a method of extracting minerals from a series of flat benches or terraces created on the sides of a hill or mountain. This technique is employed when the mineral deposit is found in layers parallel to the surface. The process typically involves the following stages:

Cutting Benches:

Creating a series of flat, horizontal steps or benches on the slope. Mining activities are carried out after the formation of benches of usually 6mX6m, with an angle of repose of 45º.

Excavation: The excavation process is done manually or semi-mechanical methods may be applied such as poclain or JCB after taking permission from the competent authorities.

Hauling: Transporting the mined material from each terrace to a collection point.

Processing: Refining and processing the extracted material to obtain the desired minerals.

Terrace mining helps minimize the environmental impact compared to some other methods as it reduces the risk of soil erosion and landslide occurrences. However, proper land reclamation measures must be implemented to restore the landscape post-mining.

Both hill slope mining and terrace mining have environmental and safety considerations. Sustainable practices and adherence to regulations are crucial to minimize the ecological footprint and ensure the safety of workers and surrounding communities. Additionally, community engagement and consultation are essential to address concerns and incorporate local perspectives into the mining operations.

3. GENERAL PROFILE OF THE DISTRICT

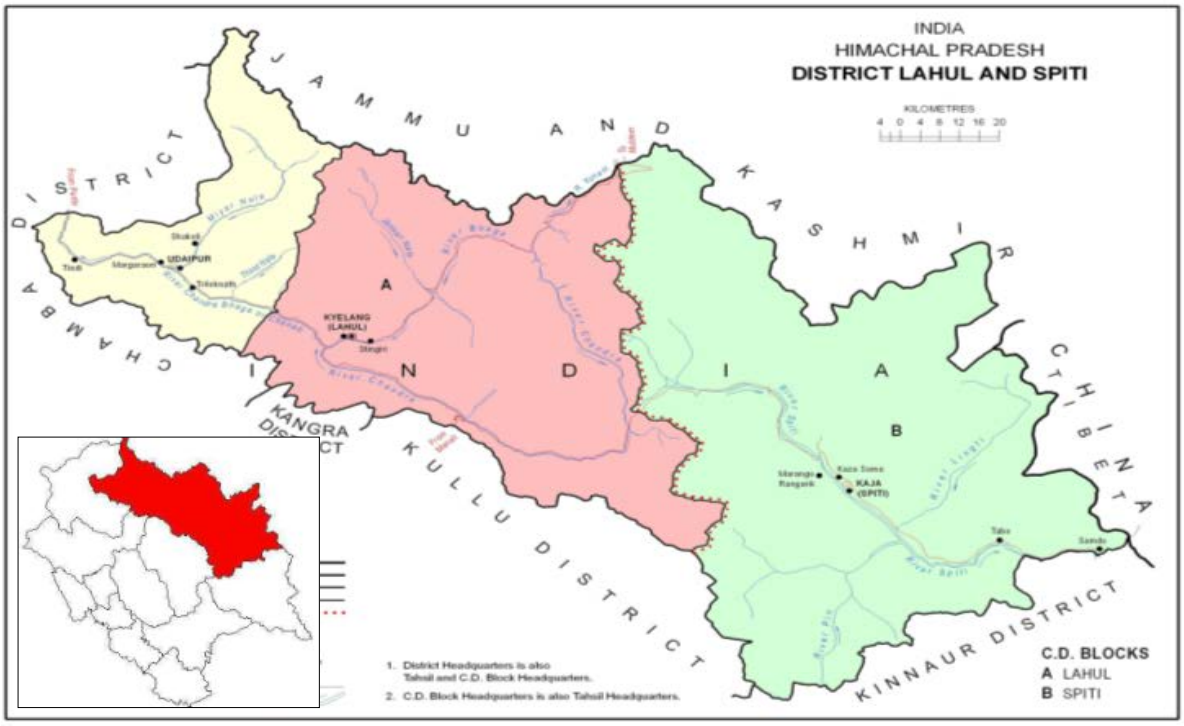
Himachal Pradesh is situated in the western Himalayas covering an area of 55,673 kilometres (34,594 mi). Himachal Pradesh is almost wholly mountainous with altitudes ranging from 350 meters to 6,975 meters above the mean sea level. It is located between Latitude 30°22’40”N to 33°12’20”N and Longitude 75°45’55”E to 79^{O}04’20”E. It has a deeply dissected topography, complex geological structure and a rich temperate flora in the sub-tropical latitudes. The drainage system of Himachal is composed both of rivers and glaciers. Himalayan rivers criss-cross the entire mountain chain. Himachal Pradesh provides water to both the Indus and Ganges basins. The drainage systems of the region are the Chandra Bhaga or the Chenab, the Ravi, the Beas, the Sutlej and the Yamuna. These rivers are perennial and are fed by snow and rainfall. They are protected by an extensive cover of natural vegetation. Due to extreme variation in elevation, there is great variation in the climatic conditions of Himachal. The climate varies from hot and sub-humid tropical in the southern tracts to, with

more elevation, cold, alpine and glacial in the northern and eastern mountain ranges. The state has areas like Dharamsala that receive very heavy rainfall, as well as those like Lahaul and Spiti that are cold and almost rainless.

Lahaul & Spiti is a scarcely populated district, located in the northeastern part of the State. The district is entirely hilly and comprises two major valleys viz. Lahaul & Spiti. The Lahaul Valley is located in the northwestern part of the district while the Spiti Valley is located in the southeastern part. The district, with its headquarters at Keylong, lies between 31°44'57" & 32° 59'57" North latitudes and 76°46'29" & 78°41'34" East longitudes and is covered by Survey of India degree sheets 52C, 52D and 52L. The district is bounded by Jammu & Kashmir State in the north, Tibet (China) in the east, Kinnaur in the southeast, Kullu in the south & Kangra and Kullu in the northwest.

The district has a total geographical area of 13,841 sq km, covers about 25 % of the State's geographical area and ranks 1st in area in the State. There are no towns in the district and has 521 villages of which 287 villages are inhabited and 234 are uninhabited. The district has been divided into 2 divisions viz. Keylong and Kaza. There are 2 tehsils Keylong & Kaza & 1 sub-tehsils Udaipur

As per the 2011 census, the district has a population of 31,564 persons with a population density of 2 persons per sq km. Population wise it ranks 12th in the State. The male and female population in the district is 16,588 and 14,976 respectively with a female/male sex ratio of 903/1000. The scheduled cast population in the district is 7.08 % and the scheduled tribe population is 81.44 %.



4. GEOLOGY OF THE DISTRICT

Tethys Himalayan tectogen: Lahual and Spite Valley

The Lahual and Spiti basins constitute an exceptional area, where a thick pile of sedimentary sequences was deposited on the northern margin of the Indian plate. The Tethyan basin provides largely uninterrupted Proterozoic-Mesozoic-Tertiary succession and is bounded by the Vaikrite Group of the Central Crystalline Zone on the SW side and by the Indus tectonic zone in the NE and the Lahual and Spiti valley exposes an excellent sedimentary succession with preserved primary sedimentary depositional features (Bhargava, O.N., Kanha, S.B., 1998).

The Central Crystalline Zone, of which the Vaikrita Group is the main constituent, occurs in the basal part of the Tethyan sedimentary sequence and is enveloped by schists and migmatitic rock of the Salkhala Group intermittently. The Batal (Terminal Proterozoic) and Kunzum La (Lower – Middle Cambrian) Formation of the Haimanta Group, which is essentially a Tethyan cover rock, are weakly metamorphosed to un-metamorphosed lies over the Vaikrita-Salkhala rocks. There is a fall in the grade of metamorphism from the Vaikrita-Salkhala Group towards the Haimanta Group. The project area exposes rocks belonging to the Batal Formation of the Haimanta Group (Bhargava, O.N., Kanha, S.B., 1998).

LITHO-STRATIGRAPHIC FRAMEWORK

The Miyar HEP falls in the Great Himalayan range which is extended from Lahual in the northwest to Kinnaur in the southeast. The area stratigraphically represents a complete Phanerozoic sequence of Lahaul-Spiti-Kinnur basins with Proterozoic crystalline basement with granitoids of variable age (Table 1.1). It is bounded by the Vaikrita group on the SW and by the Indus Suture Zone (ISZ) on the NE side. The following description of the litho stratigraphy has been adopted from Bhargava, O.N and Kanha, SB., 1998.

VAIKRATA GROUP

The term Vaikrita system was first proposed by Griesbach (1891) for the schistose series overlying gneisses and underlying the Haimantas in the central Himalaya. The Vaikrata group comprising the Giambal and Rohtang crystalline complex constitutes a thick succession of crystalline rocks of proterozoic age and can be broadly divided into two units. The lower unit comprises streaky and banded gneisses together with porphyroblastic gneiss, augen gneiss and garnetiferous staurolite, kyanite and sillimanite gneiss with interfoliated melanocratic schist bands within gneiss. Alternate bands of coarse biotite gneiss and the leucocratic quartzo-feldspathic gneiss rich in muscovite and

tourmaline are seen along with several bands of amphibolite. The gneissic complex is intruded by several phases of granitoids.

The upper unit is characterized by metasediments, migmatite and gneiss with melanocratic quartz-biotite schist, quartz-feldspar-biotite schist, muscovite schist, marble, calc Phyllite, amphibolite schist, quartzitic and quartz schist.

Table - Lithstratigraphy of tethyan succession in Lahual, Spiti and Kinnaur (adopted from Bhargava, O.N and Kanha, SB., 1998).

AGE	FORMATION	GROUP	LITHOLOGY
CARBONIFEROUS	PO	KANAWAR	Shale with Sandstone Bands
	LIPAK		Limestone (Shell, Coral, Algal), Sandstone, Shale, and Gypsum in
DEVONIAN	MUTH		White Quartzite
SILURIAN	TAKCHE	SANUGBA	Calcareous Sandstone, Shale, Coral-
ORDOVICIAN	THANGO		Purple Quartzite, Shale, Silt Stone, Grit,
LOWER MIDDLE	KUNZAM LA	HAIMANTA	Green to Grey Slate, Subarkose Locally Gritty, Pyroclastic Beds at Base,
TERMINAL PROTEROZOI	BATAL		Dark Grey Phyllite, Local Carbonaceous subarcose
MESO-NEO PROTEROZOI		SALKHALA	Grey, Green Purple Quartzite with Schist
		VAIKRATA	Biotite-Garnet-Staurolite-Kyanite-Sillimanite Schist, Quartzite Interbeds
			Kyanite-Sillimanite Bearing Schist, Gneiss and Migmatites

SALKHALA GROUP

The Salkhala is delimited by the Vaikrita group of the central crystalline zone below and the Batal formation of the Haimanta Group in the Lahaul-Spiti-Kinnaur area of Himachal Pradesh of the Proterozoic age. The Salkhala group is comprised of laminated chloritic slate with metagreywacke and intercalated carbonaceous slate and quartzite, greyish-green phyllite and schists, garnetiferous biotite schist, micaceous quartzites, psammitic gneiss and interbedded with sporadic crystalline limestone. The important feature of the Salkhala group is the presence of a linear belt of concordant granitoid plutons.

HAIMANTA GROUP

The term Haimanta group was proposed by Greisbach (1891) to describe the rocks overlaying the Vaikrita group and underlying the Sanugba group and can be broadly divided into two units.

Batal Formation

The Batal Formation the name proposed by Srikantia (1981) forms the basal part of the Tethyan Phanerozoic succession. It has conformable contact with the Vaikrita. At places particularly along the contact between the Batal and the gneissic rocks of Vaikrita, tectonization and disharmonic folding are prominent due to competency differences in these two rock groups. In many sections, the sediments are welded to the basement.

The Batal Formation in the basal part comprises grey-green phyllite, grey quartzite and carbonaceous Phyllite. Sporadically migmatites and paragneisses with garnetiferous-biotite schist are also present in some sections. In the middle part of the sequence, the batal formation is composed of quartzite alternating with pyritous carbonaceous phyllite forming the dominant lithology. The upper part of the Batal formation comprises green- coloured chlorite Phyllite, carbonaceous Phyllite, and quartzose Phyllite with interbeds of pale white to grey quartzite. Good exposure of Batal rocks is exposed in Chandra Valley. There is a general paucity of sedimentary structures. Stratification is identifiable. Locally cross-stratification of thin sedimentation units and ripple marks are seen. The litho-assemblage suggests a mixed environment of euxinic to broad peri-tidal conditions. The Batal formation has been invaded by granitoid bodies. Granite is porphyritic and contains sporadic dissemination of arsenopyrite. At places, it is a coarse biotite granite and porphyritic with veins of pegmatite, tourmaline-bearing leucogranite and aplite. There are smaller boudins of granite in the carbonaceous phyllite and quartzite.

The Batal formation is assigned a terminal Proterozoic age based on its stratigraphic position below the Kunzam La, the basal part of which contains an early Cambrian trace fossil zone. The Precambrian-Cambrian boundary is located in the uppermost of the Batal Formation (Kumar et al.1984).

Kunzam La Formation

The Kunzam La Formation named after the Kunzam La (Pass) in Lahual by Srikantia (1981) is made up of greenish-grey siltstone, shale/slate, quartzite, sandstone, dolomite (in the upper part) and local pebble beds. IN Baspa and Tidong valleys it contains gritty and pebble bedsand magnetic tuffs.

Broadly the Kunzam La Formation can be divided into two divisions. The lower division also called Debsa Khad Member consists of grey quartzite, flaggy quartzite to massive with slate partings; greyish green shale, slate, siltstone, sandstone and flaggy quartzite. The Upper-division also called as the Parahio Member is characterized by the development of brown dolomite associated with cross-bedded calcarenite and quartzite in alteration with olive green shale and siltstone.

The bedding features and sedimentary structures present in this formation include sandy rhythmite with parallel bedding, wavy ripple and lenticular bedding, ripple marks, channel fills of sand and syndepositional slumps in the basal part, low angle truncations, rare flute casts in the middle part and cross-bedding, herringbone cross-bedding and mud cracks in the upper part. The age of the Kunzam La Formation is regarded to range from Early Cambrian to Middle Cambrian.

SANUGBA GROUP

The Thango and Takche formations are included under the Sanugba group.

Thango Formation:

Thanpo formation consists of purple quartzite, shale, siltstone, grit, conglomerate and dolomite. The Thanpo Formation shows a transgressive relationship with the Kunzam La Formation over which it rests on angular unconformity. However, the contact at many places is sharp and conformable and is characterized by a band of gritty purple sandstone and at places by a lenticular band of conglomerate.

The Thango sequence is characterized by herringbone, festoon and planner cross-bedding, ripple layer, ripple marks with bifurcating crests mud cracks and current crescents, indicating an overall shallow tidal sea environment. Conglomerates seem to have fluvial origins which were reworked on a beach. On the basis of the available fossil record the age of Thango Formation varies from Lower Ordovician to lower Silurian. Takche Formation

The Takche Formation comprises a sequence of limestone, dolomite, Shale, siltstone and sandstone. The arenaceous elements, dominate in the western part, East of Ratang nala, Pin Valley and Kinnaur it is calcareous. The Takche Formation shows several prograding cycles showing parallel and low-angle cross-beds in the basal part and cross-bedding and low-angle discordance in the upper part broadly indicating shoaling from low energy environment in the middle lower shoreface affected by mild intensity storms. The Takche Formation is rich in fossil content. An Ordovician age has been assigned to this formation by Kato et al (1987).

MUTH QUARTZITE

The term Muth series was first used by Stoliczka (1865) from Muth village in the Spiti. Srikantia (1981) gave the term Muth formation to the white quartzite sequence of the Muth series. The Muth formation is the most striking maker unit in the Palaeozoic sequence of the Tethys Himalaya from Kashmir to Kumaun. This Formation rests over the Takche Formation along a sharp contact including a possible break in sedimentation

indicating a possible break in sedimentation. The Muth formation is constituted of compact to granular, medium to fine-grained, white to mottled, locally grey quartzarenite. At places, olive green shales are associated with dolomite and sporadic conglomerate lenses. The quartzarenite shows low-angle cross-bedding with subparallel to low angle truncation are indicative of transgressive upper shore facies in the beach environment. Based on a conformable relationship with the overlying carboniferous Lipak formation an age within Devonian is suggested for the Muth Formation.

KANAWAR GROUP

The name Kanawar system was first used by Hayden (1908) to include certain Devonian and Carboniferous strata in Spiti overlying the Muth quartzite. He divided the Kanawar system into the Lipak and Po series. Later on Srikantia gave a group status to Kanawar System.

Lipak Formation

This Formation is named after Lipak valley in Kinnaur (Hayden, 1904). The Lipak Formation comprise dominantly of dark grey to black limestone and dolomite, grey shale and pink limestone and lenticular snow white and powdery gypsum beds in the upper part. There are interbeds of quartz arenite within the carbonate sequence. The presence of limestone, dolomite and gypsum suggests an evaporate sequence. The environment of sedimentation varies from sub-tidal to inter-tidal, with the acquisition of supra-tidal conditions in the terminal part to form an evaporate basin Lipak Formation is rich in fossils indicating a late Devonian to early carboniferous age to Lipak Formation.

Po Formation

The name of this formation was proposed by Hayden (1904). This formation is exposed in Lahual and in the NW, SW and SE corner of the Spiti valley. The Po Formation has conformable and gradational contacts with the underlying Lipak and overlying Ganmachidam Formation. It comprises a thick sequence of white to grey medium-grained quartzarenite, siltstone, sandstone and grey black, locally pale green shale with rare cherty partings. The shale is dominant in middle part whereas upper part develops pebbles and gritstones. The lithologic assemblage and bedding features indicate several prograding cycles from mid-shelf to upper shoreface. Gothan and Sahni (1937) based on plant remains suggest the middle carboniferous age for the Formation; however, the invertebrate fauna suggests a lower –middle carboniferous age (Waterhouse, 1985)

5. DRAINAGE OF IRRIGATION PATTERN

The drainage pattern of the river in Lahaul Spiti is mostly dendritic to sub dendritic i.e. the tributaries meet at low angles and branch at random, like a tree pattern. The study of drainage networks provides an idea about the topography, climate, geology, and hydrological features of the region. Drainage is the most important natural agent in sculpturing landforms. It also has a bearing on settlement patterns in this high-altitude arid region. Lahaul-Spiti occupies higher Himalayan and trans-Himalayan zones, where settlements mostly occur along the river valleys. Being, a mountainous area with adverse climatic conditions, these affect the entire population, thus upsetting the entire range of economic activities. Therefore, it becomes necessary to analyse the drainage network in order to assess the role of the natural environment and its impact on socio-cultural and economic aspects. Lahaul-Spiti has three major rivers namely Chandra, Bhaga, and Spiti along with their numerous tributaries. River Chandra and Bhaga after their confluence at Tandi becomes Chandra-Bhaga also known as Chenab.

Chandra River:

It originates from a huge snow field on the southeastern base of the Baralacha Pass around Chandra Tal. It flows in a south-westerly direction for the first 48 kms. Then, it takes a sharp northwesterly and western direction for a further 64 kms up to Tandi where it joins the Bhaga River. On its upper left bank is situated a beautiful glacial lake known as 'Chandra Tal' which straddles between a low ridge and Kunzum range. The lake is about a kilometre long and half a kilometre wide with an outlet into the river. Chandra River is fed by a number of glaciers. The biggest being the Shigri on its left bank and the Samundri, and Sonapani glaciers on the right bank. It registers an average fall of about 12.5 metres per kilometre up to its confluence with Bhaga at Tandi.

Bhaga River:

Bhaga River has its origin from the southwestern side of the Baralacha Pass at an altitude of about 4800 metres. It flows in a north-west direction for almost 13 kms and then takes a south-westerly course. It has a total length of about 65 km up to Tandi. The main tributaries are Barsi, Milang nullah and Billing nullah etc. Its valley is barren and rocky up to Darcha. It has an average fall of about 28 metres per kilometre.

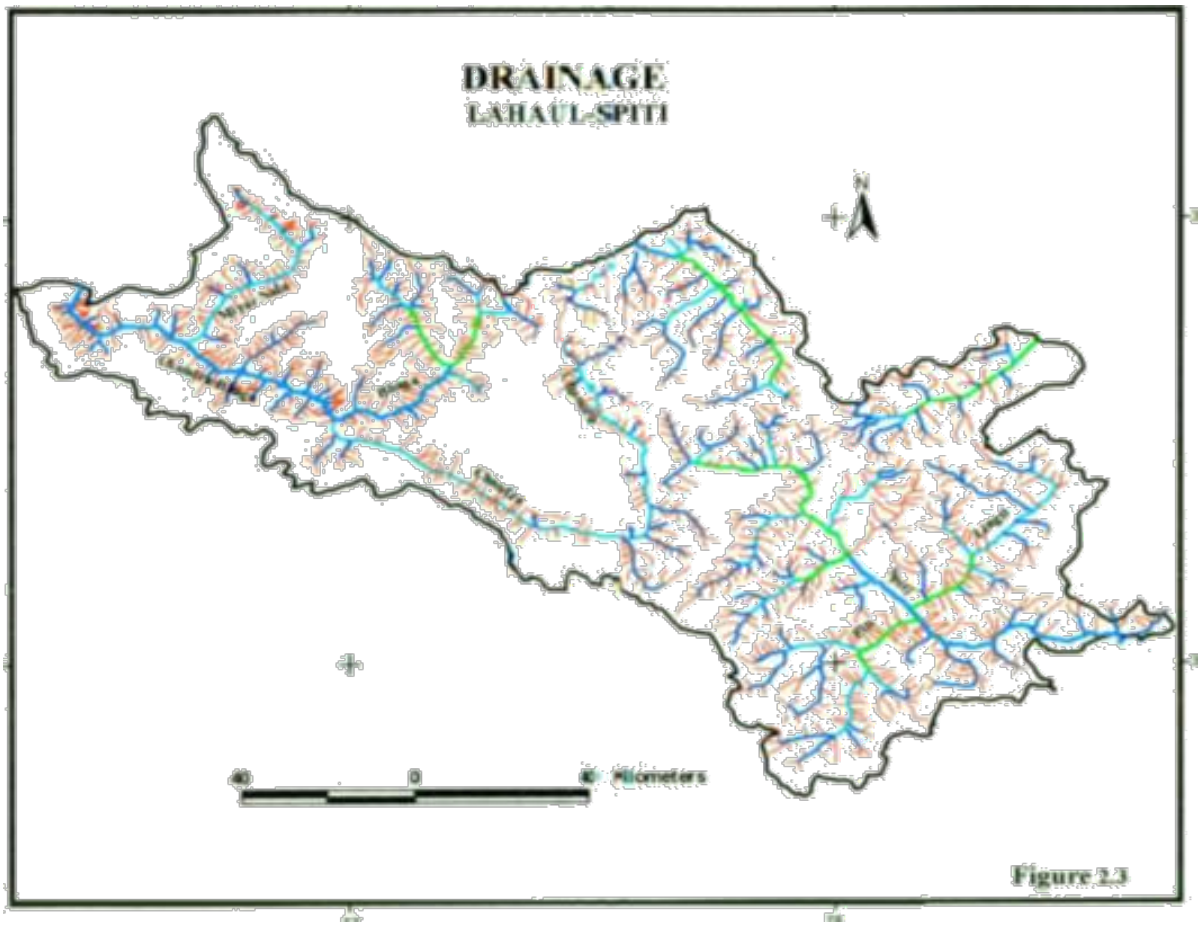
Chandra- Bhaga or Chenab River:

After their confluence at Tandi, Chandra and Bhaga rivers are called Chandra- Bhaga or Chenab. The River is entirely fed by a number of glacier tributaries from either side. The right bank tributaries include Shansha nullah, Thirot nullah, Chokang nullah, Miyar nullah etc. Lingar nullah, Rashil nullah, Naida nullah, Ghor nullah, and Galigorh are the left bank

tributaries. Among these, Miyar nullah is the largest tributary with a length of about 32 kilometres. Chenab runs in a north-westerly direction for about 75 kilometres
until its exit to Chamba district. It has an average fall of about 6 metres per kilometre from a height of 2800 metres.

Spiti River:

The Spiti River originates from far north on the eastern slopes of the mountain ranges between Lahaul and Spiti. It begins at the base of the Kunzum range with the confluence of 'Kunzum La Tagpo' and the streams Kabzina and Pinglung. Broad and flat valleys bordered by high vertical cliffs mark the Spiti River. The total length of the river is about 130 kilometres on the southeast within Spiti. It continues up to Khabo in the Kinnaur district where it joins the Satluj River. Several tributaries join the Spiti River on both sides. On its right bank are Chiomo, Gyundi, Rahtang, Pin and Sumra etc.



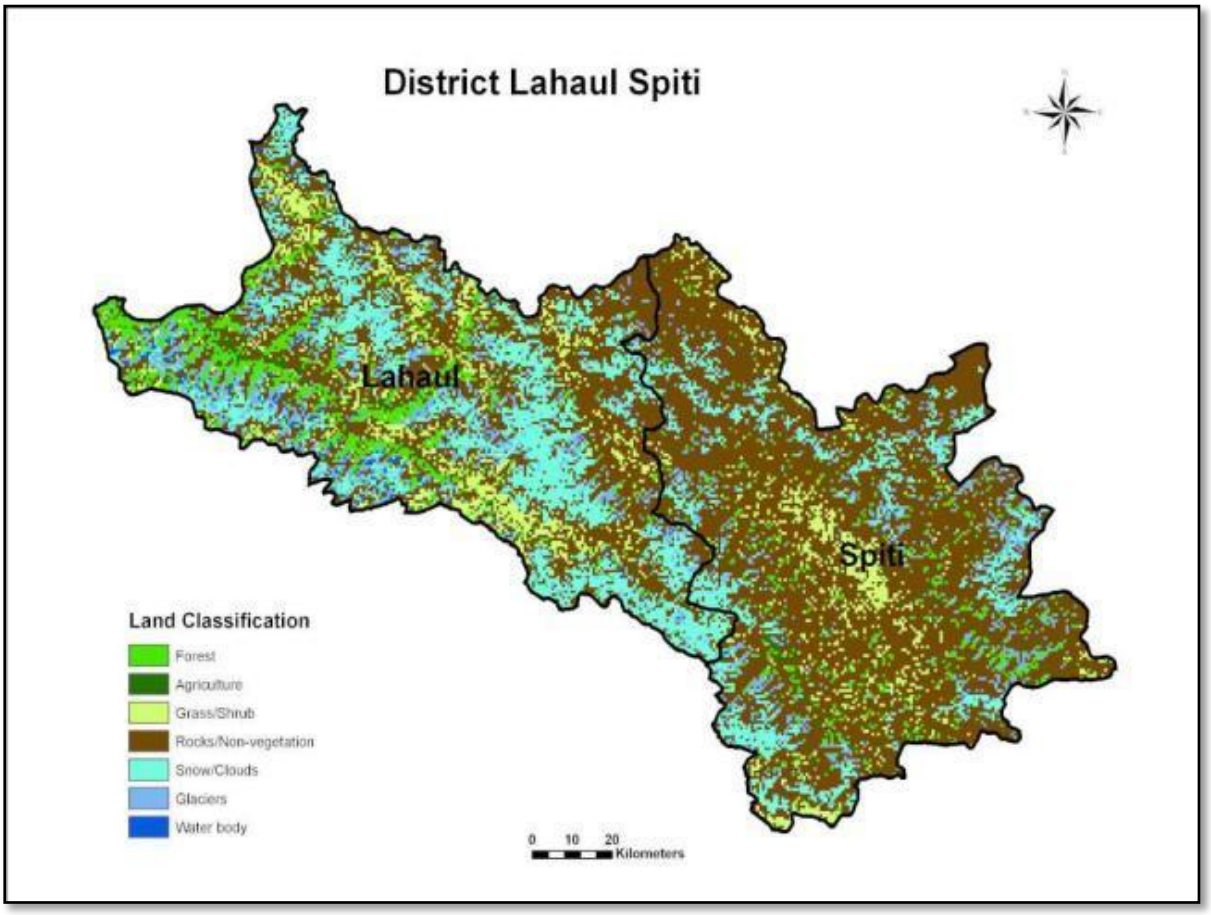
Thanar, Hanse, Tagling. Shila, Kaza, Lingti, Tabo, and Parechu streams join on the left bank. The Pin River is the most important right-bank tributary of the Spiti River. The length of the Pin River is about 50 kilometres. Lingti River is about 40 kilometres long and is an important left-bank tributary of the Spiti River

6. LAND UTILIZATION PATTERN IN THE DISTRICT

The mountain systems are complex ecological entities endowed with a vast resource base for their populace; they also support livelihood and developmental activities in the adjacent lowland areas. Lahaul Spiti is the largest district in terms of area in the state with a minimum population density of 2/sq. km. The 2-D area of the district is 13835.01 sq. km and calculated three-dimensional surface areas are 22892.628 sq. km. The 2-D area was estimated from latitudinal and longitudinal computation from the GIS software of the district. The district possesses about 8890.919 sq. km of additional area. The Lahaul & Spiti district is mainly covered by rocks/non-vegetation areas (58%).

Distribution of Land Cover Classes for District Lahaul Spiti

Class	Area (Sq. Km)	Percent
Forest	1102.53	8
Agriculture	142.08	1
Grass/Shrub	1127.91	8
Rocks/Non-vegetation	8021.02	58
Snow/Clouds	2183.49	16
Glaciers	1162.44	8
Water body	95.54	1
Total	**13835.01**	**100**



Map Showing Land Use and Land Cover of District Luaul and Spiti

Forest cover and agriculture are 8 and 1 percent of the total area. Snow/clouds and grass/shrubs have 16% and 8 % area respectively. Distributions of Land Cover classes are shown in Table 11. The entire area has sloppy Mountains and agriculture is practised on sloppy lands. The Lahaul & Spiti District of Himachal Pradesh is situated between 31 0 42' and 33 0 15'N latitudes, and 760 22' and 780 40' E longitudes. The range of elevation varies from 2344m to 8203m above sea level. According to the Department of Land Records, Himachal Pradesh (Table 3) the total area under agriculture is 40 sq km (0.29%) which is less than the mapped and estimated area. The legally defined forests are 10133 sq km (74%) of the total geographical area of the district which is 66 percent less than the estimated area. This might be due to spectral confusion with clouds and steep and high mountains. The total geographical area of the district is 13693 sq km which shows 142 sq km less area than the estimated area through GIS software.

Class	**Area (Sq. Km)**
Forest	1102.53
Agriculture	142.08
Grass/Shrub	1127.91
Rocks/Non-vegetation	8021.02
Snow/Clouds	2183.49
Forest Glaciers	1162.44
Waterbody	95.541
Total	13835.01

Land Cover of District Lahaul & Spiti Figure

6.1 Agriculture

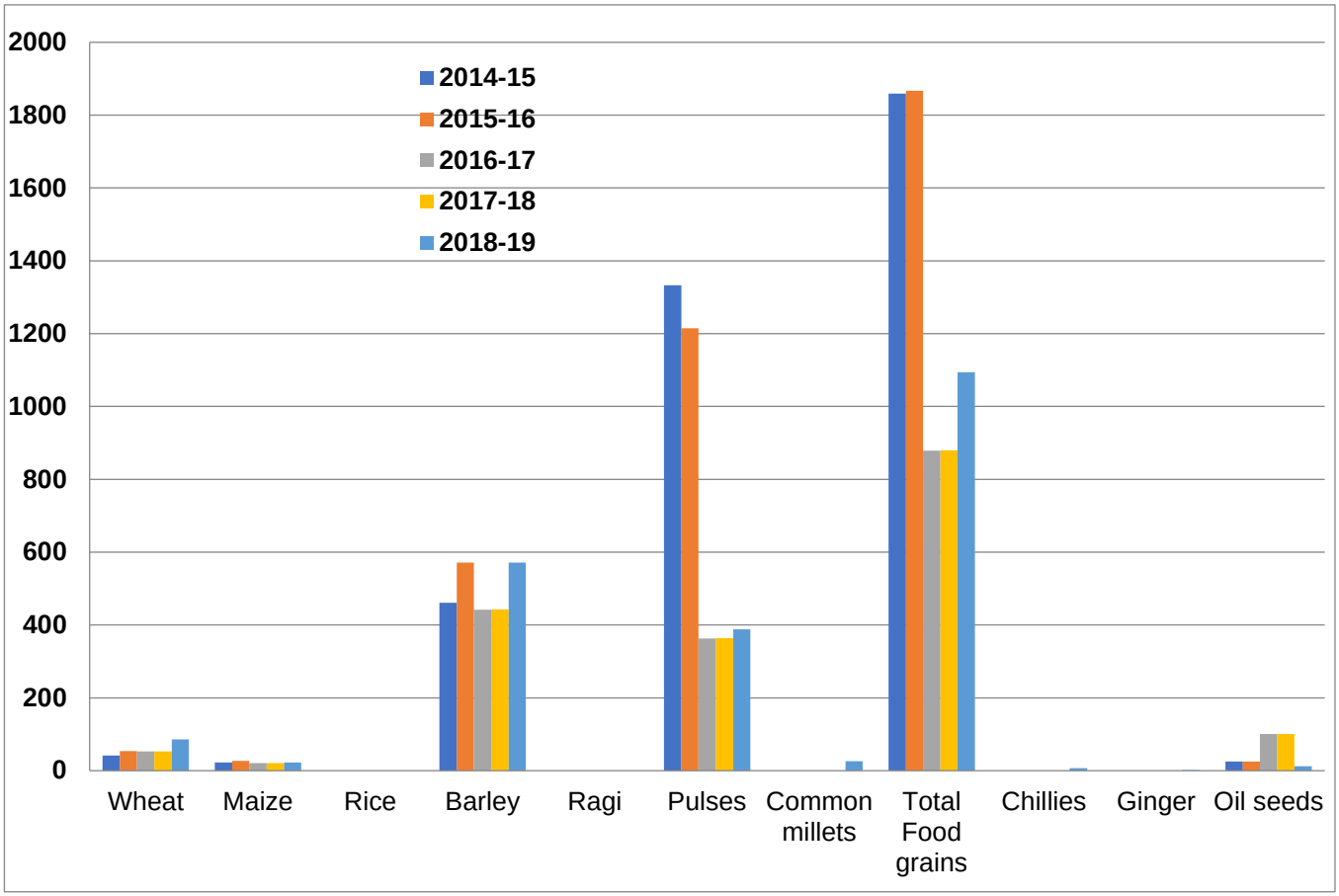
In Lahaul and Spiti districts, agriculture is the main occupation of the people. Almost all the district is barren and a small portion of the area is under cultivation. The economic distress of the people can very well be imagined in view of the meagre and limited quantity of land available for cultivation. The valleys are extremely narrow with steep mountains and rivers running through deep gorges. In proportion to its vast areas, whatever land fit for agriculture is available, lies in small plots between sixty to one hundred metres above the river beds. What hampers the extent of agricultural operations is not only the shortage of flat lands or lands with gentle slopes safe against erosion but also the non-availability of adequate sources of water for irrigation. The cultivation is possible in small patches of holdings in the high hills or in the basins of streams and khads. It is only in the basins of the river, streams and khads

that the land is fertile and a little bit flat and cultivation of cereals and pulses, potatoes and off-season The main cereals grown are wheat, maize, rice, and barley in the district.

Table showing area under Different Crops in Hectares

Table showing Area under Different Crops (in Hectares) at District Lahaul & Spiti											
Year	**Wheat**	**Maize**	**Rice**	**Barley**	**Ragi**	**Pulses**	**Common millets**	**Total Food grains**	**Chillies**	**Ginger**	**Oil seeds**
2014-15	42	23	...	461	...	1333	...	1859	...	...	25
2015-16	54	27	...	571	...	1215	...	1867	...	...	25
2016-17	53	21	...	442	...	363	...	879	...	...	101
2017-18	53	21	...	443	...	364	...	880	...	...	101
2018-19	86	23	…	571	…	388	26	1094	7	2	12

Source: *Directorate of Land Records, HP*

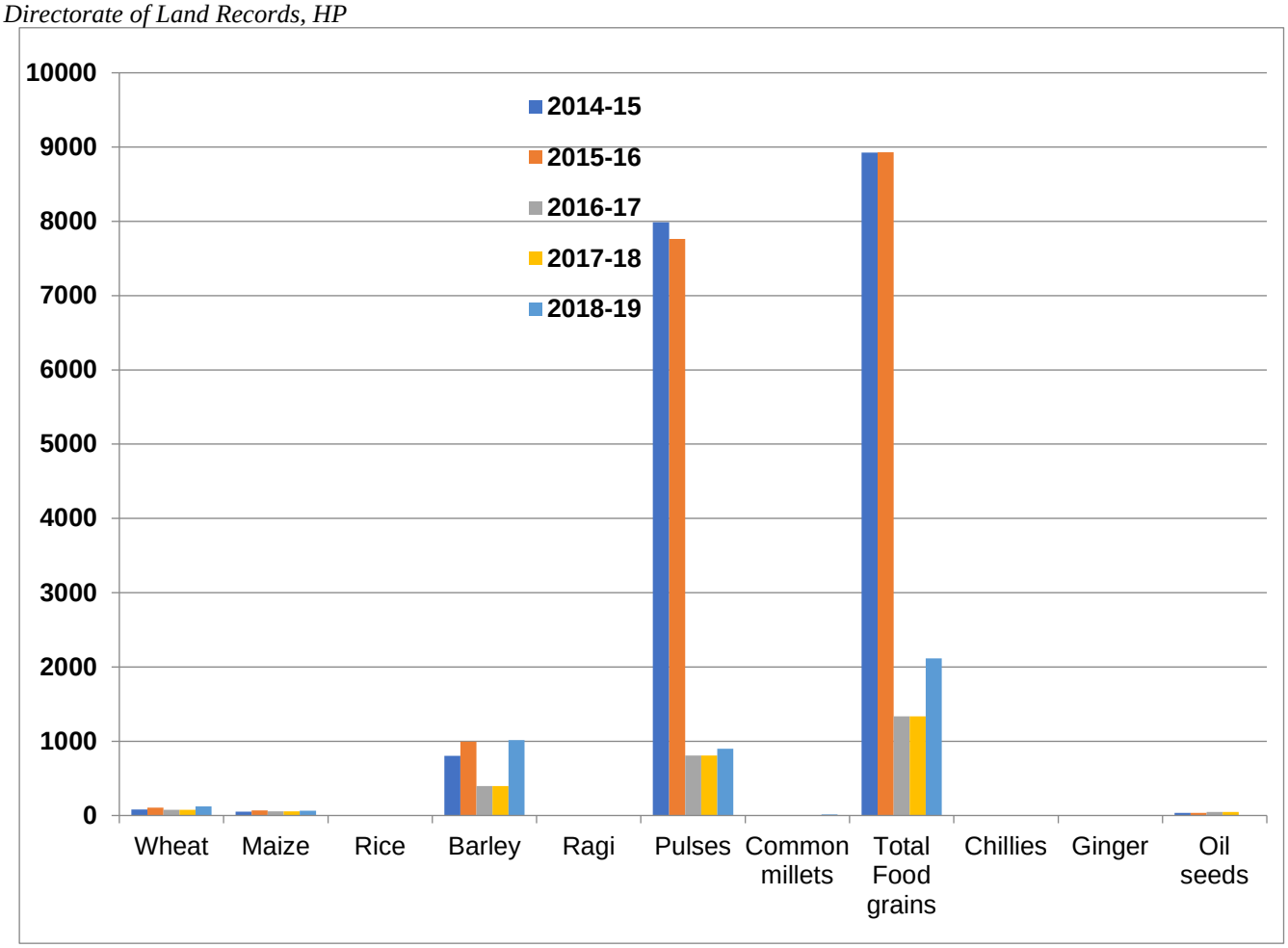


Graph Showing Area under Different Crops in Hectares

Table showing Production of Different Crops in MT

Table showing Production of Different Crops (in MT) at District Lahaul & Spiti											
Year	**Wheat**	**Maize**	**Rice**	**Barley**	**Ragi**	**Pulses**	**Common millets**	**Total Food grains**	**Chillies**	**Ginger**	**Oil seeds**
2014-15	82	53	...	802	...	7987	...	8924	...	...	37
2015-16	106	68	...	993	...	7762	...	8929	...	...	37
2016-17	75	58	...	395	...	807	...	1335	...	...	48
2017-18	75	58	...	396	...	808	...	1336	...	...	48
2018-19	122	63	…	1016	…	900	16	2117	2	5	5

Source: *Directorate of Land Records, HP*

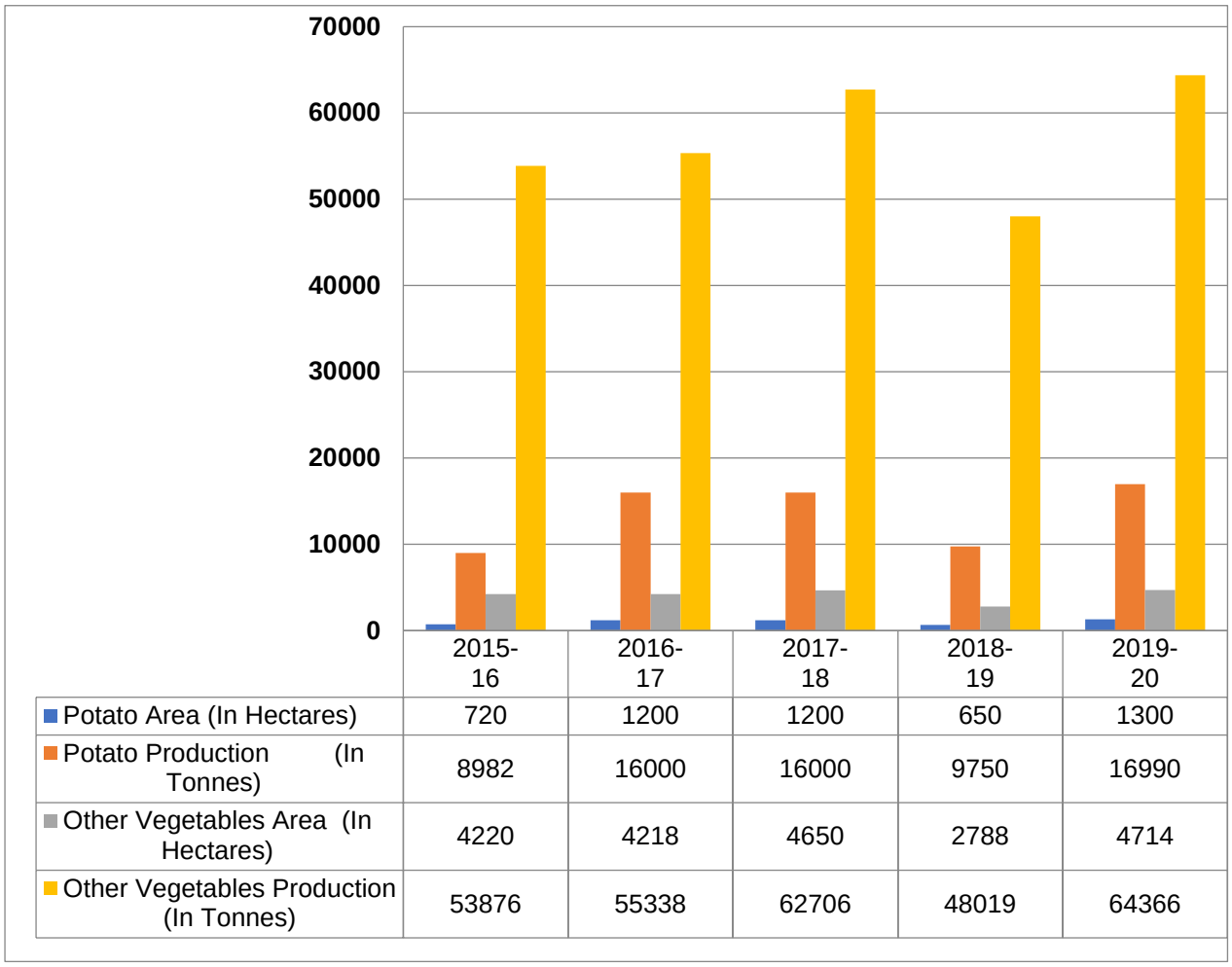


Graph Showing Production of Different Crops in MT

Table showing Area & Production of Vegetables in Tonnes

Area & Production of Vegetables (Distt Lahaul & Spiti)				
Year	**Potato**		**Other Vegetables**	
	Area (In Hectares)	**Production (In Tonnes)**	**Area (In Hectares)**	**Production (In Tonnes)**
2015-16	720	8982	4220	53876
2016-17	1200	16000	4218	55338
2017-18	1200	16000	4650	62706
2018-19	650	9750	2788	48019
2019-20	1300	16990	4714	64366

Source: *Directorate of Land Records, HP*

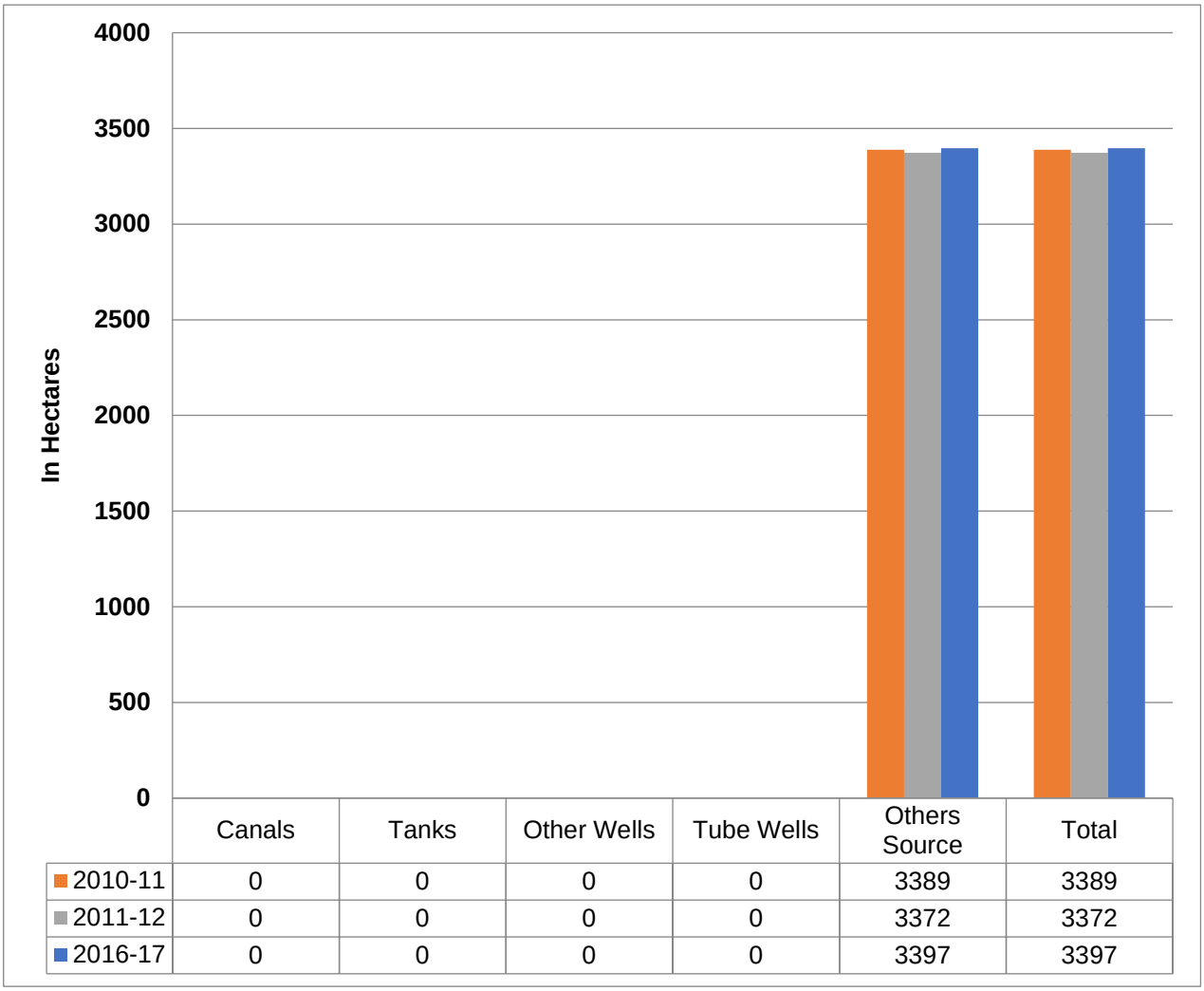


Graph showing the production of vegetables in District Lahaul & Spiti

Table showing Net Irrigated Area of District by source in Hectares

Table showing Net Irrigated Area of Lahaul & Spiti by source (in Hectares)						
Year	**Canals**	**Tanks**	**Other Wells**	**Tube Wells**	**Others Source**	**Total**
2010-11	…	…	…	…	3389	3389
2011-12	…	…	…	…	3372	3372
2016-17	…	…	…	…	3397	3397

***Source**: Directorate of Land Records, HP*



	Canals	Tanks	Other Wells	Tube Wells	Others Source	Total
2010-11	0	0	0	0	3389	3389
2011-12	0	0	0	0	3372	3372
2016-17	0	0	0	0	3397	3397

Graph showing the Net Irrigated Area of the District Lahaul & Spiti from 2010 to 2017

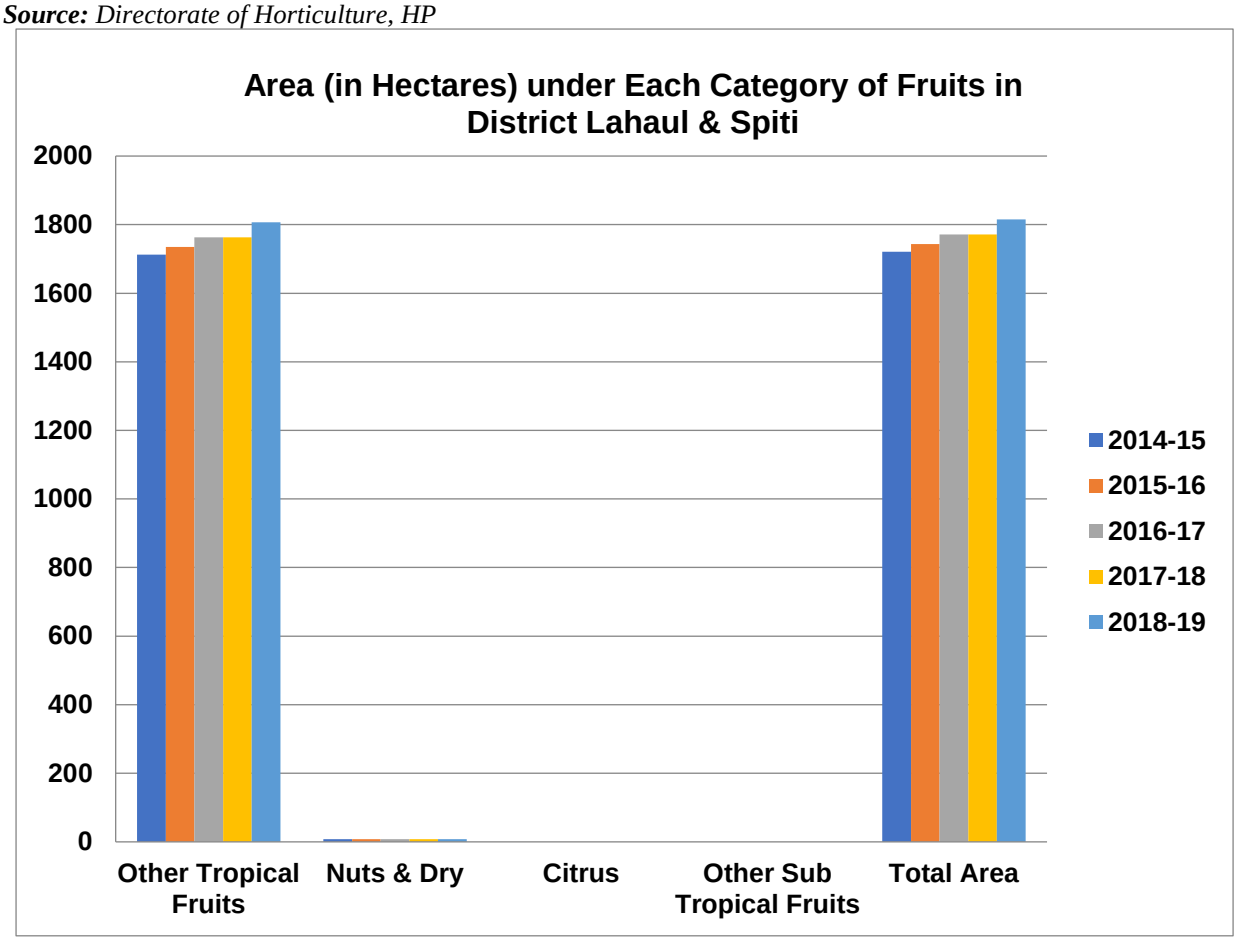
6.2 Horticulture

Horticultural development bears special significance for this district. With the change in climate, even the harsh cold areas of Spiti are becoming suitable for apple plantations, which is quite evident from the increase in the area under apples in recent years. The area under fruit in this district can be increased from the existing 389.25 hectares to 868.25 hectares. The number of households planting apple orchards would also increase from the existing 3,393 to 5,447. There lies more potential in Spiti for Apple as compared to Lahaul.

Table showing area under Each Category of Fruits in District Lahaul & Spiti

Table showing Area (In Hectares) under Each Category of Fruits in District Lahaul & Spiti					
Year	**Other Tropical Fruits**	**Nuts & Dry**	**Citrus**	**Other Sub Tropical Fruits**	**Total Area**
2014-15	1713	8	...	...	1721
2015-16	1735	8	...	...	1743
2016-17	1763	8	...	...	1771
2017-18	1763	8	...	...	1771
2018-19	1807	8	…	…	1815

Source: *Directorate of Horticulture, HP*

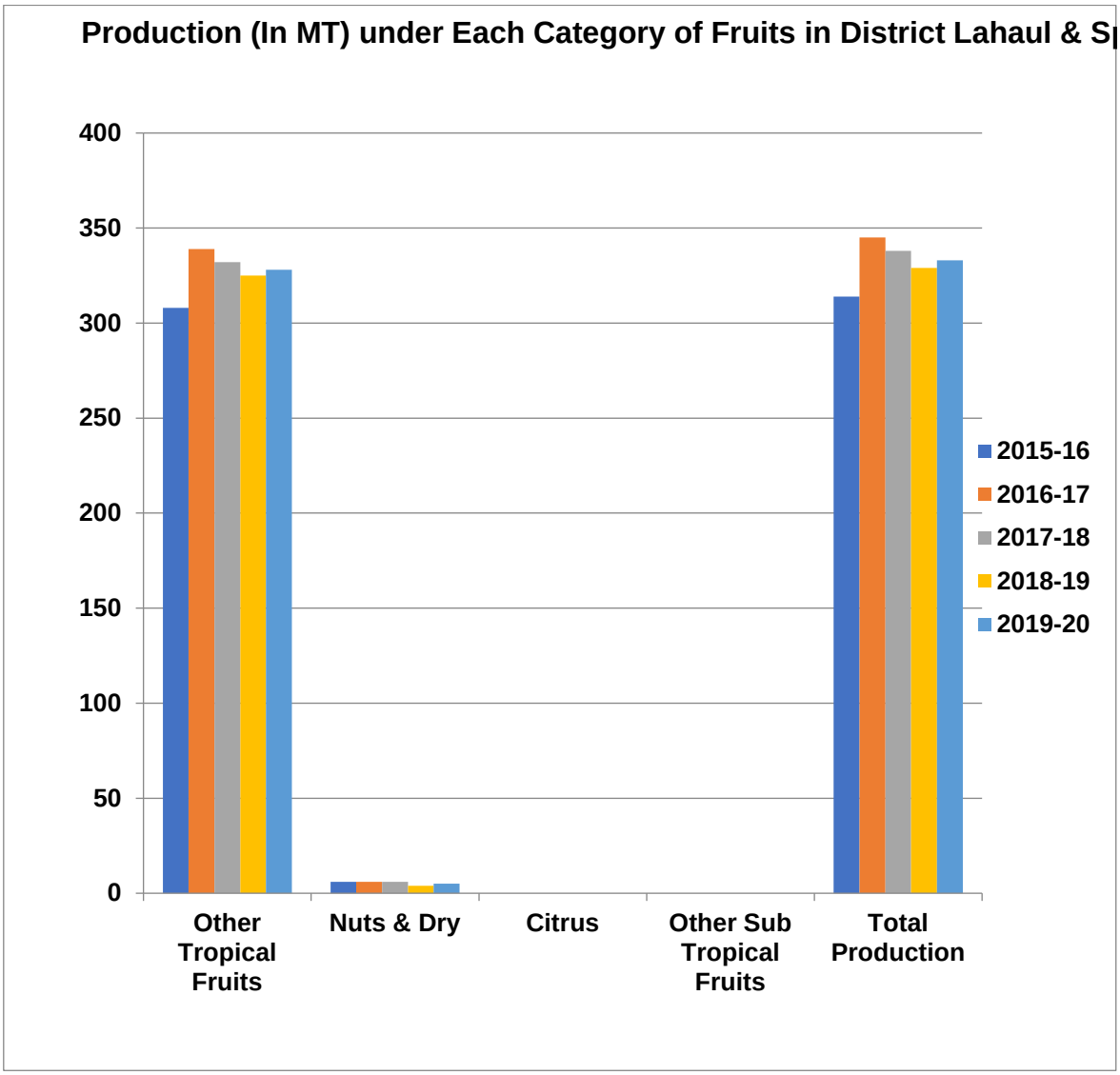


Graph Showing Area under Each Category of Fruits in District Lahaul & Spiti

Table showing Production under Each Category of Fruits in District Lahaul & Spiti

Table showing Production (In MT) under Each Category of Fruits in District Lahaul & Spiti					
Year	**Other Tropical Fruits**	**Nuts & Dry**	**Citrus**	**Other Sub Tropical Fruits**	**Total Production**
2015-16	308	6	...	...	314
2016-17	339	6	...	...	345
2017-18	332	6	...	...	338
2018-19	325	4	...	...	329
2019-20	328	5	…	…	333

***Source**: Directorate of Horticulture, HP*



Graph Showing Production under Each Category of Fruits in District Lahaul & Spiti

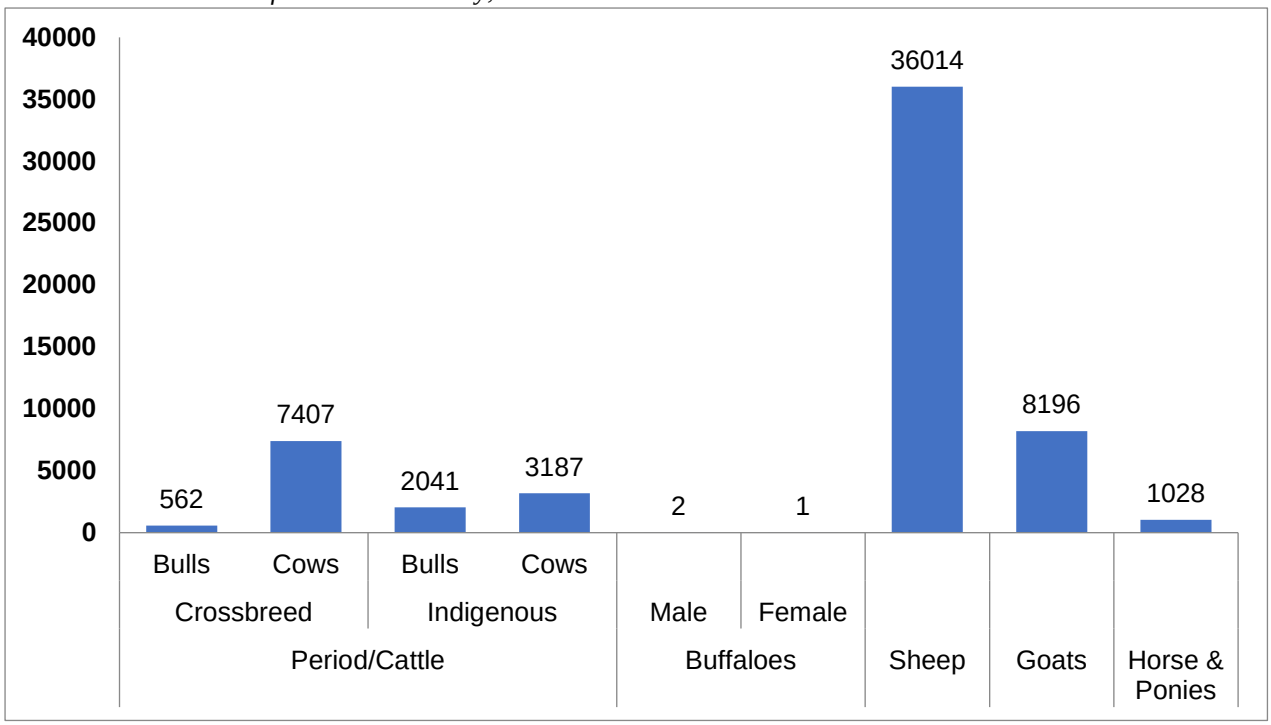
6.3 *Animal Husbandry*

Livestock rearing has remained an integral part of farming, particularly in hilly areas due to the vast area under forests and pastures and the important role it plays in human nutrition, draft farm power and transportation. The estimated livestock population in Lahaul and Spiti blocks shows the predominance of sheep and goats especially in Lahaul. During summer, shepherds from other areas (particularly Gaddi) migrate along with their flocks to graze sheep and goats on lush green alpine pastures in Lahaul & Spiti. The population of cross-bred cows is increasing over the years. Bullocks and equines also hold an important place as a means of draft power and transportation (beasts of burden Due to the cold climate, poultry is not so popular. The farmers generally keep a few birds to meet the domestic requirements. The population of poultry is higher in Lahaul as compared to Spiti. It has been found that improved breeds of poultry may not thrive well in this cold region but indigenous breeds have been found quite suitable. During the summer season, broilers can be taken up successfully for which there is a need to provide broiler chicks from poultry breeding farms from other districts.

Table showing Livestock census of District Lahaul & Spiti

Animal Husbandry Population in District Lahaul & Spiti										
Year	Status	Period/Cattle				Buffaloes		Sheep	Goats	Horse & Ponies
		Crossbreed		Indigenous		Male	Female			
		Bulls	Cows	Bulls	Cows					
2012	At L&S	562	7407	2041	3187	2	1	36014	8196	1028

***Source**: Directorate of Animal Husbandry, HP*

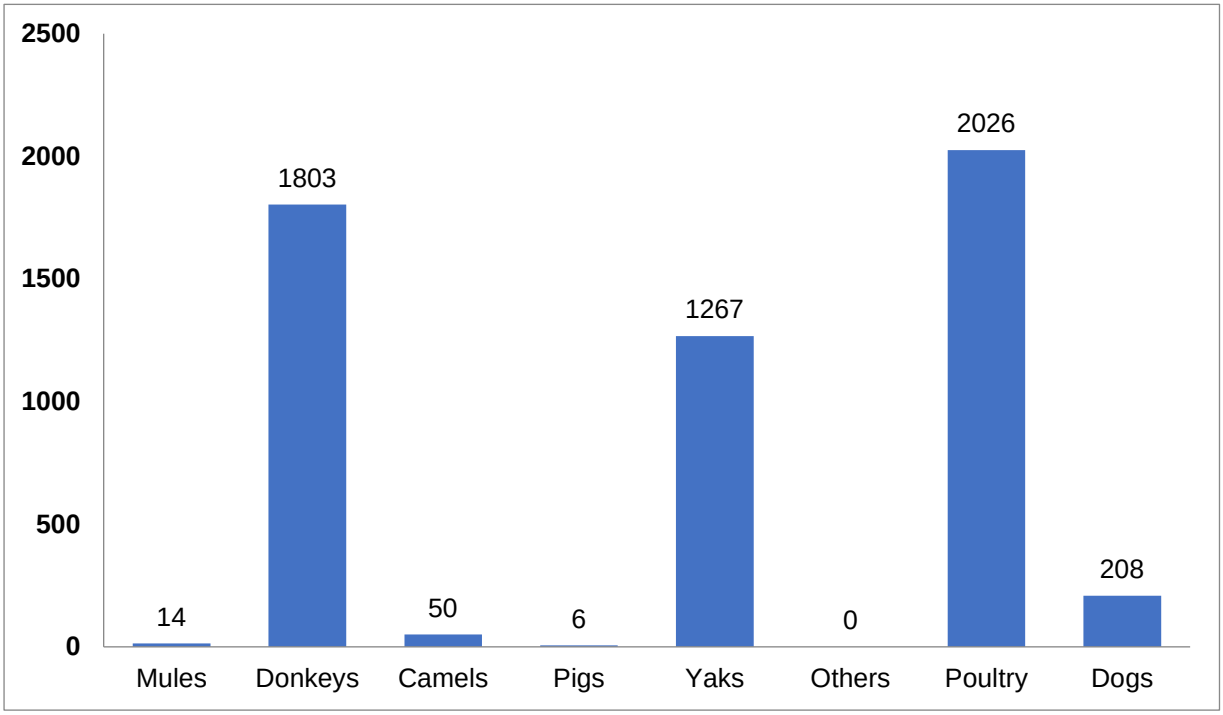


Graph Showing Livestock census of the Lahaul & Spiti

Table showing other Livestock census of District Lahaul & Spiti

Other Livestock							
Mules	**Donkeys**	**Camels**	**Pigs**	**Yaks**	**Others**	**Poultry**	**Dogs**
14	1803	50	6	1267	...	2026	208

***Source**: Directorate of Animal Husbandry, HP*



Graph Showing other Livestock censuses of the Lahaul & Spiti District

6.4 Fisheries

There is no special effort to take up fishery enterprise in the district. However, there is a scope to introduce cold-water fish culture at certain places where river flow is mild in the valley area. There is also scope for rearing trout that can be sold at a premium price. To harness this potential, the major interventions have been depicted

6.5 Forest, flora and fauna

The Forests of Himachal Pradesh known for their grandeur and majesty are like a green pearl in the Himalayan crown. These life-supporting systems are presently under great stress due to the impact of modern civilization, economic development and growth in the human and cattle population. According to National Forest Policy, 1988, at least two-thirds i.e. 66% of the geographical area should be under forest in hilly states like Himachal Pradesh. However, keeping in view that about 20 % of the area is inaccessible and beyond the tree limit, the State Government aims to bring 50% of the geographical area under forest cover.

FLORA

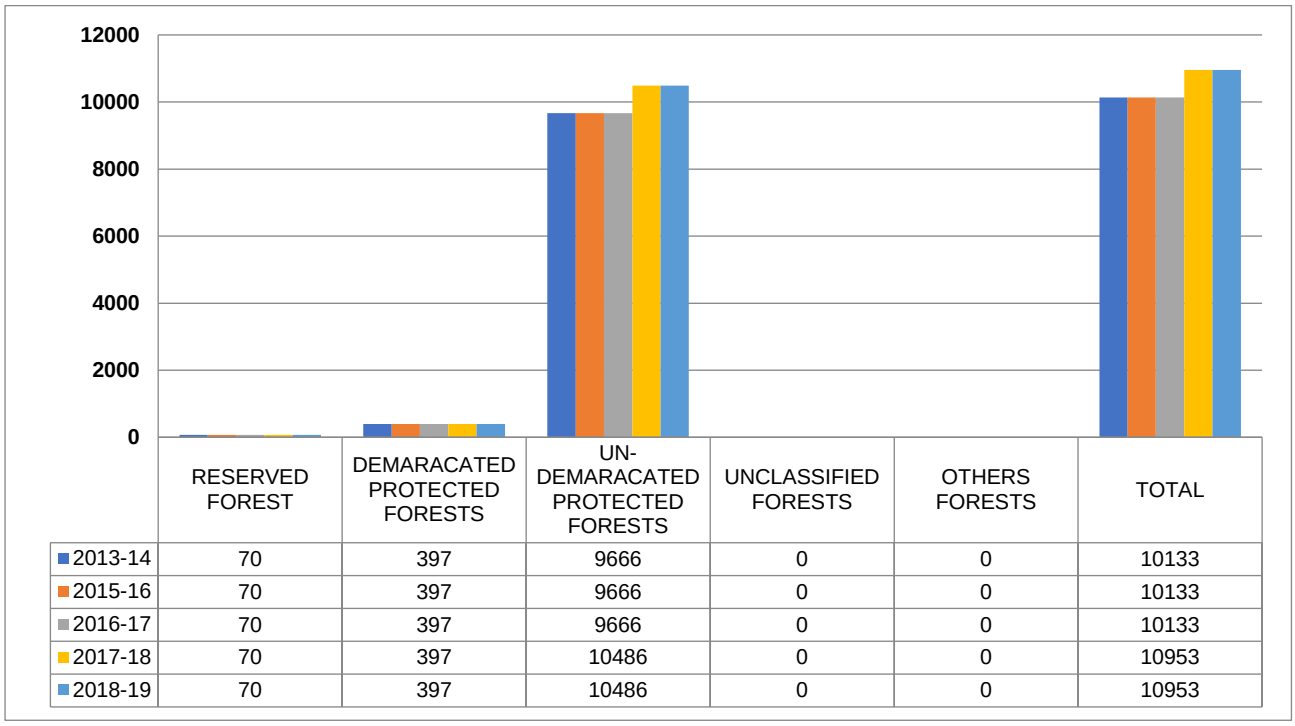
The flora of the two districts falls under the Himalayan dry temperate, dry alpine (cold deserts) in the Lahaul-Spiti and Pooh division of Kinnaur, whereas the forests in Nichar, Sangla and Kalpa areas fall under the moist alpine forests. Nichar, Sangla and Kalpa areas are dominated by tree species of Cedrus deodara, Pinus wallichiana, Picea, smithiana, Abies pindrow, Taxus wallichiana, Quercus floribunda, Q. semecarpifolia, Q. ballot (Peo and Kalpa region). The vegetation in the other parts of the area covering Pooh, Lahaul and Spiti is sparse, discontinuous and scattered, clearly showing the rugged landscape with brown sand and barren rocks, but at the same time is most varied and attractive owing to the dry alpine nature. Curiously shaped bushes, the majority of which form spinescent cushions, dominate vegetation stunted forms, twisted and bent nature of stems, succulency, cushiony and matted habits and strong root systems are the characteristic features of the vegetation. The only green patches, soothing to the eyes are available around the villages with activated fields and irrigated hay lands. Only a cluster of trees of Populus balsamifers, P. ciliata, Salix fragilis, S. elegans and dilapidated Juniperus macropoda are seen next to the villages and Gompas. Monumental trees of Poplars, Junipers, Salix and Betula can be seen at Rangrik, Lossar, Pomrang, Gue, Gulling, Tabo, Pooh, Mane, Kungri, Chud, Nako etc. Many of the trees survive because they are considered to be the abode of deities. Birth (Bhojpatra) patch exists opposite Pooh bridge near Saran in Spiti, Baspa valley in Kinnaur has plenty, while in Lahaul, small trees can be seen on the right side slopes beyond Gramphoo. A thick forest patch of Hippophae exists in Mane village, a tree size Myricaria can be seen at Gue and a dilapidated Juniper patch is in evidence near Gue and Kaa loops reminding us of the past forests and the present-day destruction by biotic interference. Lahaul and Kinnaur are greener than Spiti. Mini Manali at Udaipur has a thick forest patch of Deodar (Cedrus deodara). Vast tracts of hill slopes are covered by Juniperus macropoda; between Udaipur and Keylong. Whereas, in the Pooh area the Juniper trees are badly damaged. Faxinus xanthoxyloides grows as a medium-sized tree in both Pooh and Udaipur areas. The afforestation efforts by DDP projects in the Spiti and Pooh area have created green patches of Populus, Salix, Robinia and fruit trees. Most prominent shrubs include Rosa macrophylla (wild rose), species of Hippophae, Myricaria, Salix flabellaris, S. hastate, S. lindeleyana, Juniperus recurva, Ribes orientale, R. alpestre, Lonicera spinosa (Thapp), L. obovata, L. rupicola, Capparis spinosa, Caragana brevifolia (Trama). Rhododendron lepidotum, Colutea nepalensis, Ephedra gerardiana, Clematis vernayii, Cotoneaster microphylla etc. The scrub and spiny cushions are formed by the species of Caragana, Astragalus, Artemisia, Cousinia, Saussurea, Lonicera and Arnebia. Herbaceous element is dominated by the species of Astragalus, Chesneya, Oxtropis, Cicer, Lindelophia, Allium,

Rumex, Nepeta, Heracleum, Chenopodium, Artemisia, Lactuca, Gentiana, Gentianella, Hyssopus, Pedicularis, Rheum, Aquilaria, Caltha, Taraxacum, Plantagos, Aconitum, Thymus, Delphinium, Lepidium, Crepis, Mentha, Geranium, Bergenia, Senecio and Mertensia. Hyoscyamus niger (Tukhlang) is frequent near villages in Gulling and Kibber, Linum perenne (Linseed) in Pin Valley and Rangrik Hill slopes; Cicer microphyllum (Chirri, Wild gram) in Demul pastures Pin Valley; Eremurus himalaicus (Fox tail lily) in Sagnam glacier and Hyssopus officinalis (Tengu) in BurrGulling area and sparsely in Attargu and Kaa slopes.

Table Showing classification of forest area (in sq.km.) of District Lahaul & Spiti

CLASSIFICATION OF FOREST AREA (IN SQ.KM.) OF DISTRICT LAHAUL & SPITI						
YEAR	**RESERVED FOREST**	**DEMARCATED PROTECTED FORESTS**	**UN-DEMARCATED PROTECTED FORESTS**	**UNCLASSIFIED FORESTS**	**OTHERS FORESTS**	**TOTAL**
2013-14	70	397	9666	…	...	10133
2015-16	70	397	9666	…	...	10133
2016-17	70	397	9666	…	...	10133
2017-18	70	397	10486	...	...	10953
2018-19	70	397	10486	...	...	10953

***Source**: Forest Department, HP*

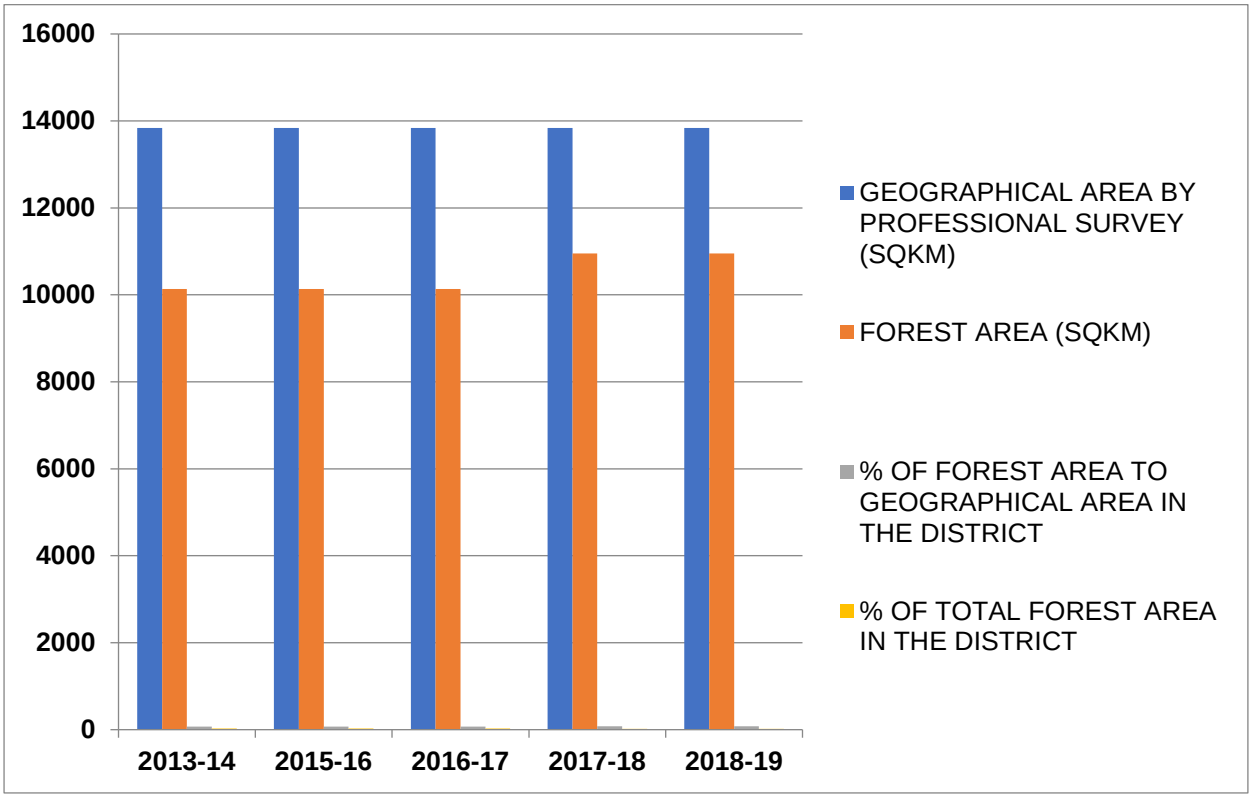


Graph showing the classification of forest area (in sq.km.) of District Lahaul & Spiti

Table showing forest area of District Lahaul & Spiti

FOREST AREA OF DISTRICT LAHAUL & SPITI				
YEAR	**GEOGRAPHICAL AREA BY PROFESSIONAL SURVEY (SQKM)**	**FOREST AREA (SQKM)**	**% OF FOREST AREA TO GEOGRAPHICAL AREA IN THE DISTRICT**	**% OF TOTAL FOREST AREA IN THE DISTRICT**
2013-14	13835	10133	73.2	26.8
2015-16	13835	10133	73.2	26.8
2016-17	13835	10133	73.2	26.8
2017-18	13841	10953	79.1	20.9
2018-19	13841	10953	79.1	20.9

***Source**: Forest Department, HP*



Graph showing forest area (in sq.km.) of District Lahaul & Spiti

FAUNA

The wild animals of Lahaul and Spiti are not numerous. The fauna is quite unique with Palaearctic affinities and Tibetan fauna like Ibex, Bharal, Brown bear, Tibetan wolf, Nayan, Marmot, Snow leopard, Ibex, Weasel, Vole, Snow cock, Snow partridge, Chukor, Chough, Raven etc. Two sanctuaries namely Pin Valley National Park in Spiti and the Sechu Tuan Nala in Chamba have been formed in the Cold Deserts of Himachal Pradesh. Lippa Asrang Sanctuary is located in a high latitude area and one of the few in India from where the Yak has

been reported, though it may well be feral. Musk Deer and Ibex are also present. The area is largely flat, like a huge plateau and a part of it is a barren cold desert. This sanctuary is among the few in Himachal Pradesh, which is not open to tourists.

Species, that are believed to be locally threatened, are Himalayan Black Bear, Brown Bear, Musk Deer, Ghoral, Ibex, Leopard, Blue Sheep and Yak. Rakchham Chittul Sanctuary is located at a high altitude and is a good habitat for the endangered Musk Deer. Rupi Bhaba Sanctuary. A remarkably wide variation in altitude supports a large diversity of habitats and wildlife in this catchment area of the Sutlej River. The Great Himalayan and Pin Valley National Parks are located on its Western and Northern boundaries, respectively.

7. SURFACE WATER AND GROUNDWATER SCENARIO OF THE DISTRICT

7.1 SURFACE WATER

The Lahaul area is drained by Chanderbhaga & Spiti district is drained by the Spiti River; In addition to this river, there are some other small areas of three other secondary rivers like Miayr Nala, Jhankar in Lahaul and Pin and Lingiti Nalas in Spiti Valley. The Chandrabaga and Spiti rivers form the major drainage system in the district. The river is formed by the confluence of two rivers, Chandra and Bhaga, at Tandi, 8 km (5.0 mi) southwest of Keylong, in the Lahaul and Spiti districts.

7.2.1 MAJOR RIVERS OF DISTRICT

Chandra River:

It originates from a huge snow field on the southeastern base of the Baralacha Pass around Chandra Tal. It flows in a south-westerly direction for the first 48 kms. Then, it takes a sharp northwesterly and western direction for a further 64 kms up to Tandi where it joins the Bhaga River. On its upper left bank is situated a beautiful glacial lake known as 'Chandra Tal' straddles between a low ridge and the Kunzum range. The lake is about a kilometre long and half a kilometre wide with an outlet into the river. Chandra River is fed by a number of glaciers. The biggest being the Shigri on its left bank and the Samundri, and Sonapani glaciers on the right bank. It registers an average fall of about 12.5 metres per kilometre up to its confluence with Bhaga at Tandi.

Bhaga River:

Bhaga River has its origin from the southwestern side of the Baralacha Pass at an altitude of about 4800 metres. It flows in a north-west direction for almost 13 kms and then takes a south-westerly course. It has a total length of about 65 km up to Tandi. The main

tributaries are Barsi, Milang nullah Billing nullah etc. Its valley is barren and rocky up to Darcha. It has an average fall of about 28 metres per kilometre.

Chenab River:

After their confluence at Tandi, Chandra and Bhaga rivers are called Chandra- Bhaga or Chenab. The River is entirely fed by a number of glacier tributaries from either side. The right bank tributaries include Shansha nullah, Thirot nullah, Chokang nullah, Miyar nullah etc. Lingar nullah, Rashil nullah, Naida nullah, Ghor nullah, and Galigorh are the left bank tributaries. Among these, Miyar nullah is the largest tributary with a length of about 32 kilometres. Chenab runs in a north-westerly direction for about 75 kilometres
until its exit to the Chamba district. It has an average fall of about 6 metres per kilometre from a height of 2800 metres.

Spiti River:

The Spiti River originates from far north on the eastern slopes of the mountain ranges between Lahaul and Spiti. It begins at the base of the Kunzum range with the confluence of 'Kunzum La Tagpo' and the streams Kabzina and Pinglung. Broad and flat valleys bordered by high vertical cliffs mark the Spiti River. The total length of the river is about 130 kilometres on the southeast of Spiti. It continues up to Khabo in the Kinnaur district where it joins the Satluj River. Several tributaries join the Spiti River on both sides. On its right bank are Chiomo, Gyundi, Rahtang, Pin and Sumra etc.

Thanar, Hanse, Tagling. Shila, Kaza, Lingti, Tabo, and Parechu streams join on the left bank. The Pin River is the most important right-bank tributary of the Spiti River. The length of the Pin River is about 50 kilometres. Lingti River is about 40 kilometres long and is an important left-bank tributary of the Spiti River

7.2 Groundwater

The district being hilly & mountainous, traditional sources of ground water mainly springs have played a major role in past in providing assured irrigation and water supply. These include the nallas and springs. In some of the areas, at present too these are the only sources for the water of the settlements. However modern means for tapping the ground water have been employed in recent years.

Snowfall/rainfall is the major source of groundwater recharge apart from the influent seepage from the rivers, irrigated fields and inflow from upland areas whereas discharge from groundwater mainly takes place from effluent seepages of groundwater in the form of springs and base flow in streams etc. The district has a hilly terrain having very high slopes. The valley areas are deep, narrow and isolated. The areas therefore not considered for the estimation of the groundwater resources due to their discontinuous aquifer systems.

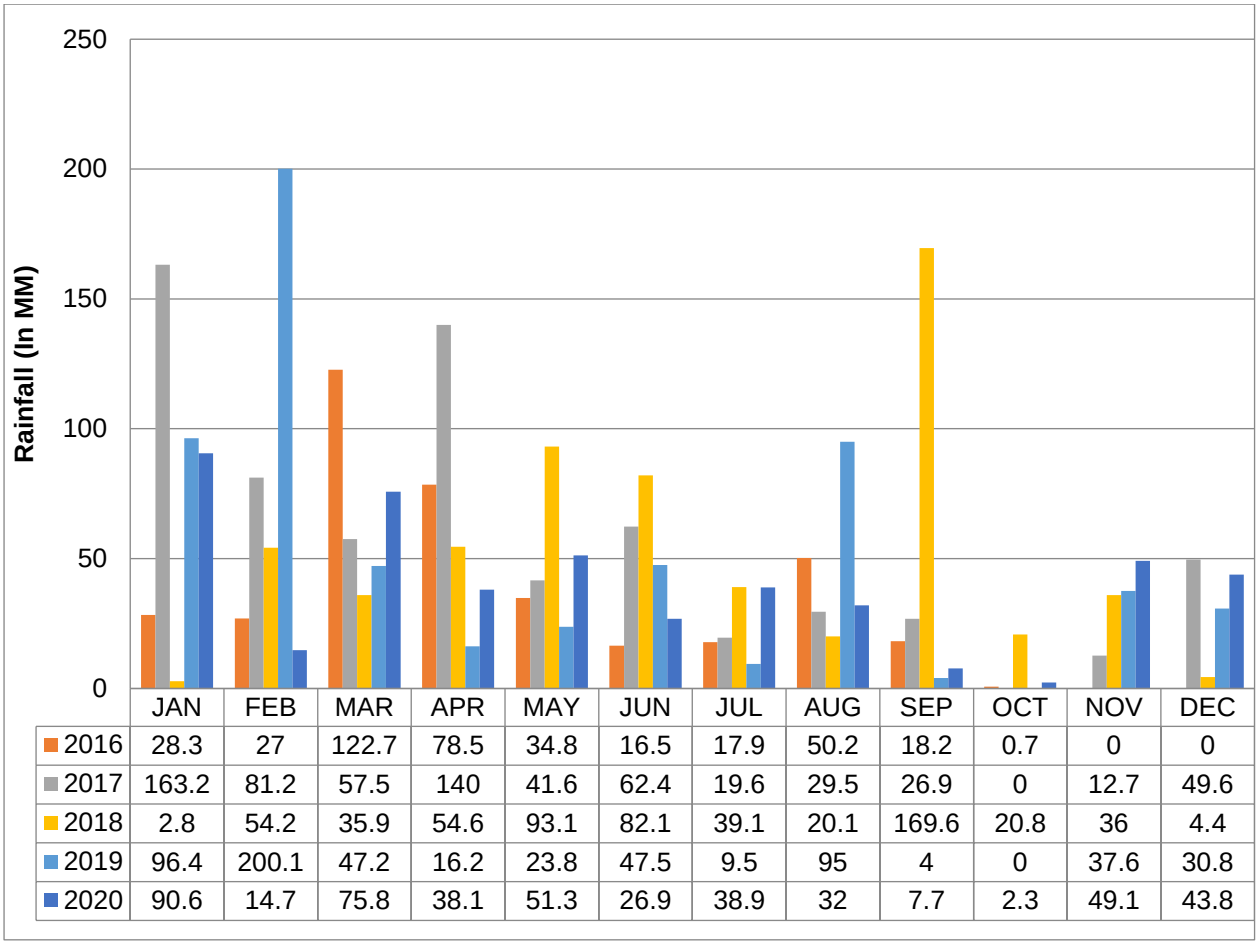
8. RAINFALL OF THE DISTRICT AND CLIMATIC CONDITION

This region is a low rainfall area as most of the precipitation in the region is in the form of snow. The rainfall takes place during the monsoon months only and the catchment experiences snowfall during the remaining period of the year. The Southwest monsoon is dominant during July to September, and most of the precipitation is in the form of rainfall. The following table shows the quantum of rainfall during the last 5 years from 2016 and 2020 in the district per IMD.

Table Showing monthly rainfall data of the district

LAHAUL & SPITI DISTRICT RAINFALL IN MILLIMETERS (R/F)												
YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	RAINFALL (IN mm)											
2016	28.3	27	122.7	78.5	34.8	16.5	17.9	50.2	18.2	0.7	0	0
2017	163.2	81.2	57.5	140	41.6	62.4	19.6	29.5	26.9	0	12.7	49.6
2018	2.8	54.2	35.9	54.6	93.1	82.1	39.1	20.1	169.6	20.8	36	4.4
2019	96.4	200.1	47.2	16.2	23.8	47.5	9.5	95	4	0	37.6	30.8
2020	90.6	14.7	75.8	38.1	51.3	26.9	38.9	32	7.7	2.3	49.1	43.8

Source: Meteorological Department, Govt. of India



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2016	28.3	27	122.7	78.5	34.8	16.5	17.9	50.2	18.2	0.7	0	0
2017	163.2	81.2	57.5	140	41.6	62.4	19.6	29.5	26.9	0	12.7	49.6
2018	2.8	54.2	35.9	54.6	93.1	82.1	39.1	20.1	169.6	20.8	36	4.4
2019	96.4	200.1	47.2	16.2	23.8	47.5	9.5	95	4	0	37.6	30.8
2020	90.6	14.7	75.8	38.1	51.3	26.9	38.9	32	7.7	2.3	49.1	43.8

Average monthly rainfall data of the district from the year 2016 to 2020

9. DETAILS OF THE MINING LEASES IN THE DISTRICT

At present, only 02 Nos of mining leases (Pvt./Govt. Land) have been granted/executed and are under operation and the demand for furnished material is still high. The details of the Mining lease are as follows:

Sr. No.	Name and Address of the Leases	Area of Mining Lease	Mohal/ Mauza	Tehsil	Date of execution of the lease	Hill slope/river bed	Status
1	Sh. Shiv Dass S/O Sh. Ram Dass VPO & Sub-Tehsil Udaipur, Distt. Lahaul and Spiti HP	18-11 Bighas	Chokhang, Udaipur, Distt. L & S H.P.	Udaipur	31-05-2023 to 30/05/2028	Hill slope	Working
2	Sh. Pratap Singh S/o Nihal Singh, Village Rapey, P.O. Jobrang, Tehsil Lahaul, Distt. L&S, H.P.	04-56 Hectare	Koksar	Lahaul	23/05/20218 to 22/05/2033	Hill slope	Non-working

10. DETAILS OF ROYALTY OR REVENUE RECEIVED IN LAST FOUR YEARS

Detail of Revenue Collected by Mining Office Lahaul-Spiti H.P. in Last 04 Years.				
Sr. No.	**Financial Year**	**Revenue collected Offline (In Rs)**	**Revenue Collected Online (In Rs)**	**Total Revenue Collected (In Rs)**
1	2020-21	56763981	24062120	**80826101/-**
2	2021-22	12879017	42970740	**55849757/-**
3	2022-23	51996827	49088240	**101085067/-**
4	2023-24	27860828	21814720	**49675548/-**

11. DETAILS OF PRODUCTION OF MINOR MINERAL IN LAST FOUR YEARS

Mineral	2019-20	2020-21	2021-22	2022-23
aggregate	321808	4259.5	46593	94242
Clay/ Muck	80255	634168.6	0	0
Bajri	82628	94820	199547	171623.155
Sand	26500	55278	56533	93448
Rough stone	81553.8	96036.3	340529	285298
Building stone	12608	12781	18872.66	15979
Slate	990	1060	526	1127

12. MINERAL MAP OF THE DISTRICT:

Himachal Pradesh is blessed with mineral wealth. As per an investigation by the Geological Survey of India, the minerals available in Himachal Pradesh include limestone, barytes, clays, mica, iron pyrites, salt, gypsum, slate, antimony and lead. The distribution of these minerals is scattered all over the State and includes limestone in Bilaspur, Sirmaur and Kangra districts; salt and slates in Mandi District; and gypsum in Rajban, and Bharli Sirmour districts.; Lahaul & Spiti and Sapatu in Solan distt.; byryte in Sirmour, iron ore in Mandi and Kangra; and Uranium in Kullu and Hamirpur districts.

There is no major mineral available in the district Lahaul and Spiti. The economy of the district is predominantly agriculture-based. About 80% of the population is engaged in agriculture and its allied activities. Potato, Peas, Hops and Seabakthorn fetch good prices to the inhabitants of the district. Besides agriculture, animal husbandry also plays an important role in the life of the people in Lahaul & Spiti. The entire area of Lahaul & Spiti remains under snow from November to April each year. The climate is dry temperate, which is suitable for the cultivation of apples, dry fruits and hops. Due to the geographical factors and the bulk of the workforce being engaged in agriculture and its allied activities, the district is industrially most backwards in the state.

There is no major Industrial Area in Lahaul &Spiti. Lahaul & Spiti district which is the tribal district of Himachal Pradesh is industrially underdeveloped. There are very few industrial enterprises in the district on account of topographical constraints and severe climatic conditions. Most of the industrial units as given in the subsequent sections are handloom-based units such as shawls, caps, patti and other woollen garments manufactured on handloom. There are 400 industrial enterprises registered in the district out of which 328 are working, providing employment to 640 persons.

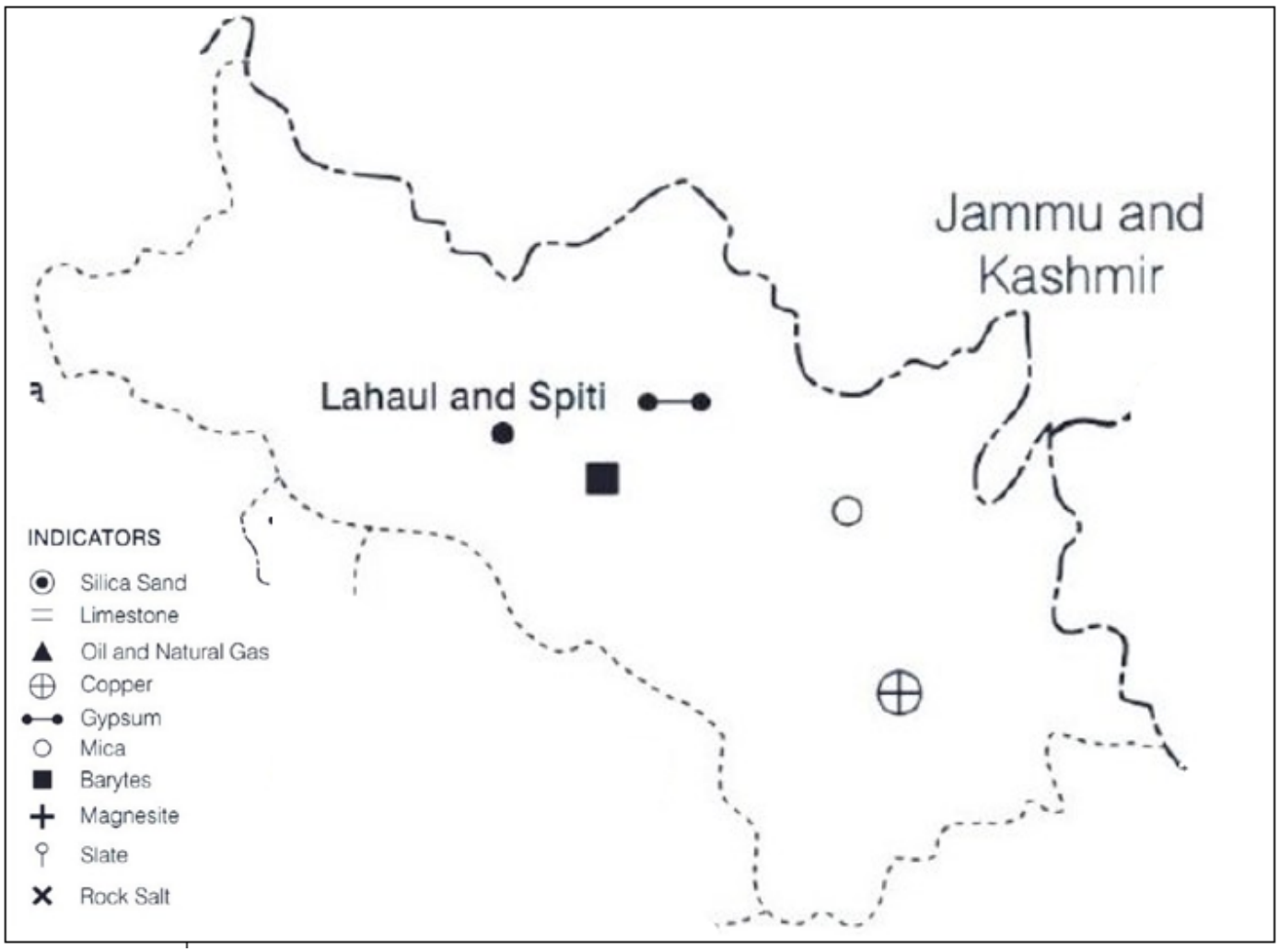


Image showing the Mineral map of District Lahaul Spiti

13. LIST OF LETTER OF INTENT (LOI) HOLDERS IN THE DISTRICT ALONG WITH ITS VALIDITY

It is submitted that the department grants mineral concessions in two modes, one through auction and another through mining leases. Further, letter of Intent (LoI) are issued to the applicants by the competent authorities only after recommendations of the Joint Inspection Committee which is a continuous process. for completion of other codal formalities, such as, obtaining the Forest Clearence, Environment Clearence and Mining plan etc. In such a manner, the letter of intent get matured for the grant of the mining lease only after the submission of clearances as mentioned in the conditions of letter of Intent (LoI. As such, it is an ongoing process and as soon as the clearances are obtained, the letters of intent are converted into a mining lease. Also, if the letter of intent holder is unable to obtain the required statutory clearances within the validity period of the letter of intent, the period is accordingly extended so as to enable the letter of intent holder to obtain the required clearances. Hence, as such it

shall not be possible to provide the exact details of the letter of intent in this survey document (DSR) as these keep on changing on a day-to-day basis.

Sr. No.	Name and Address of the Leases	Area of Mining Lease	Mohal/ Mauza	Date of execution of the lease	Hill slope/river bed	Status
1	Sh. Shiv Dass S/O Sh. Ram Dass VPO & Sub-Tehsil Udaipur, Distt. Lahaul and Spiti HP	18-11 Bighas	Chokhang, Udaipur, Distt. L & S H.P.	31-05-2023 to 30/05/2028	Hill slope	Working
2	Sh. Pratap Singh S/o Nihal Singh, Village Rapey, P.O. Jobrang, Tehsil Lahaul, Distt. L&S, H.P.	04-56 Hectare	Koksar	23/05/20218 to 22/05/2033	Hill slope	Non-working

14. TOTAL MINERAL RESERVE AVAILABLE IN DISTRICT: -

Mainly three types of Minor mineral constituents like Sand, Stone and Bajri are required for any type of construction apart from other materials like cement and steel.

In earlier times, mud houses/buildings were constructed with the use of mud. However, with the passage of time, new techniques of development activities were started. As such the demand of Minor minerals started on an increasing trend. In order to meet the requirement of raw material for construction, the local residents used to lift sand etc. from the river beds to meet out their bonafide requirement. However, after coming into being “The Himachal Pradesh Minor Mineral Rules 2015”, the mining is regulated in accordance with the rules. From the geological report, it appears that there are deposits of various minerals. The important minerals that are available in this district in a commercial scale are River borne Sand, Stone, Hill slope Stone mines (Leases), Slate etc.

At present, based on existing running mining leases of stone/slate (Hill slope) and available Mining plans (02 registered mining leases) mining operations is being carried out to produce stone/slate mining in the district. However, there is potential of stone and slate deposits have be identified in the District.

15. QUALITY /GRADE OF MINERAL AVAILABLE IN THE DISTRICT: -

The rock formations occupying the district range from the pre-Cambrian to the Quaternary period. Hard formations, form hilly and mountainous terrain and mainly comprise of igneous and metamorphic rocks, belonging to the Jutogh, Shali/ Largi and

Shimla groups and occupy the major parts of the area in the northern, central and eastern parts. Granites and gneisses are intruded in the meta-sediments of the Shali/Largi and Shimla groups. In the western and southern parts sediments comprising of sandstone, shale, siltstone, conglomerate etc of the Dharamshala/Sabathu group and Siwalik group of Tertiary age are observed. Alluvium, terrace deposits, and fluvial deposits of the Quaternary period occur in the intermontane valleys, viz., Balh Valley, Sarkaghat Valley etc., and constitute an important unit from a groundwater point of view.

The construction grade aggregate materials of good quality of Minor minerals are present in the District. The slate and building materials are also important minerals of the District. As we have assessed Mineral availability of the district is fair and acceptable quality and it has commercial value. The good quality thick bands of slates which is suitable for roofing, paving and fencing purposes occur in District. The Quartzitic rock and granitic gneiss, granite etc. are extensively quarried for the manufacturing of grit and are used in road metal, fencing blocks, building constructions etc. Granite & Granite Gneiss rocks are normally composed of mainly feldspar, quartz, mild amphibole, pyroxene, olivine, biotite etc. All these physical properties signify its good cementing properties and higher resistance which indicate its suitability for construction stone as the source areas have numerous fractures & joints.

16. USE OF MINERAL

A lot of construction activity in the private & Government sectors is going on. Stone, Bajri(Grit) and Sand are the basic requirements for construction materials and there is a necessity for such activity to flourish so that the requirement of the material can be met locally. Stone Aggregates represent about 80% to 98% of quarry output, most of which is used in road construction, maintenance and repair. Stones are derived from rocks, which form the earth's crust and have no definite shape or chemical combination but are mixtures of two or more minerals. They are strong, durable and decent in appearance. Much of this goes to the production of road metal, to provide a sturdy base for roads. Stone is an essential and more permanent building material in construction than other natural building materials. Based on the type, Stones can be used in buildings for flooring, roofing, masonry paving roads and also as aggregates for concrete.

Only the harder more resilient rocks can be employed for most road surfacing requirements. Apart from road usage, substantial amounts are mixed (coarse gravel-sized stone with finer stone particles or sand) with cement and water to make concrete.

Good deposits of Building stone occur in different parts of Lahaul-Spiti district. The slate is suitable for roofing, paving and fencing purposes and the Building stones are naturally occurring rocks of igneous, sedimentary or metamorphic origin which are sufficiently consolidated to enable them to be cut or shaped into blocks or slabs for use as walling, paving or roofing materials in the construction of buildings and other structures.

17. DEMAND AND SUPPLY OF THE MINERAL IN THE LAST THREE YEARS:

There is a huge demand for Stone Grit and M-Sand for the domestic and infrastructure sectors. Only a few Stone mines have environmental clearance for the extraction of Stone. There is a limited supply of Stone and there is a huge gap. There are no statistical data, regarding the demand and supply of minerals in the district. Due to the construction of upcoming National Highways, Tunnels, Hydro projects and public buildings for development works in the district, a large number of Stone chips & boulders are required. This will be met only by granting new leases in the district. As per the present data, a total 02 registered Mining leases have been granted/under process in the District.

Stone(Grit) and sand are the basic requirements for construction materials and have a good market in all regions of the State for the construction of buildings, roads, bridges, railway lines and other construction purposes. There are huge infrastructural activities such as roads, buildings, and railways are coming up by Govt. of India & PSUs. Out of the total production, approximately 70%-80% of the supply is utilized in government works, while the rest is consumed for private purposes. The certainty of the exact demand in the district depends upon various Govt projects & schemes etc, hence quite not impossible to quantify the exact demand. Certainly, there is an unavoidable gap between the demand and supply of road metal/stone in the district, hence to balance the demand-supply gap a few stone quarries have been proposed in certain areas. It is proposed to start the Stone production from larger areas to at least double the production of the district which will enhance the revenue of the State and also support the livelihood of the local people.

The mining project not only brought economic benefits to the State by the ways of royalty of Stone but also benefits to the local people and lessees. It will help in general employment in rural areas in the State where the people are starving due to unemployment. A single mining project shall provide employment to approximately 10 to 20 people of the poorest section of the society and benefit more than 50 to 60 people indirectly. Further, infrastructure development will help in the development of the nation. The socio-economic condition of the area will be improved as mining activity will create additional employment for the local inhabitants to raise their socio-economic status. A significant contribution will be made by the

lessee towards the societal development of the surrounding area in the form of DMFT/CSR fund.

18. MINING LEASES MARKED ON THE MAP OF THE DISTRICT

At present about 02 Nos of mining leases (Pvt./Govt. Land) have been granted/executed and are under operation and the demand for furnished material is still high. The details of the Mining lease are as follows:

Sr. No.	Name and Address of the Leases	Mohal/ Mauza	Type	Status	Location
1	Sh. Shiv Dass S/O Sh. Ram Dass VPO & Sub-Tehsil Udaipur,Distt. Lahaul and Spiti HP	Chokhang, Udaipur, Distt. L & S H.P.	Hill slope	Working	32°41'42.00"N 76°48'11.00"E
2	Sh. Pratap Singh S/o Nihal Singh, Village Rapey, P.O. Jobrang, Tehsil Lahaul, Distt. L&S, H.P.	Koksar	Hill slope	Non working	32°19'10.00"N 77°21'39.00"E

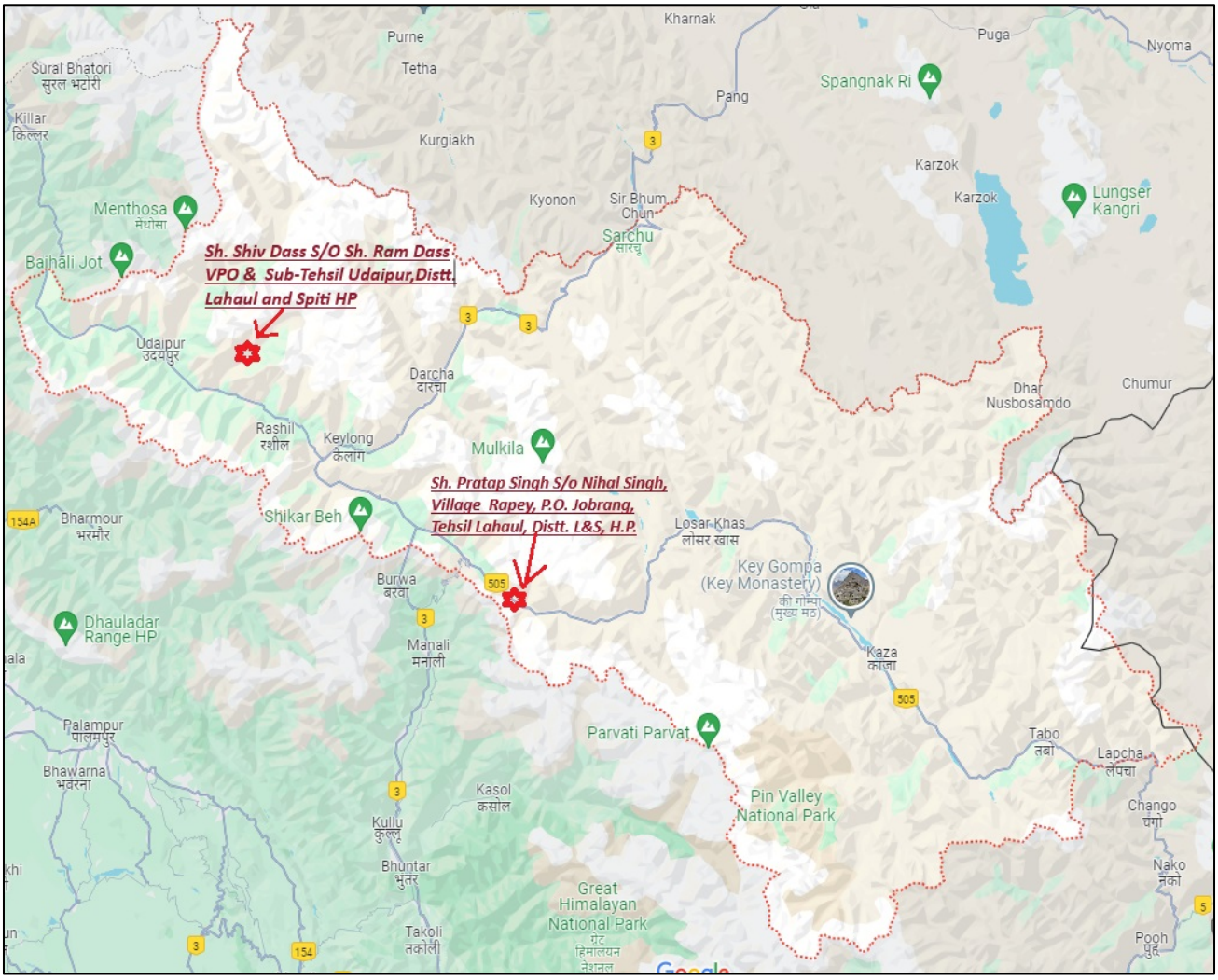


Image showing the location of the mining leases

19. DETAILS OF THE AREA OF WHERE THERE IS A CLUSTER OF MINING LEASES

The details of Quarries existing within a 500m radius are considered as clusters of Mining Leases as per the MoEF guidelines. However, there is no such zone in the district as all granted leases are scattered in the entire district.

20. DETAILS OF ECO-SENSITIVE AREA, IF ANY, IN THE DISTRICT;

There is no eco-sensitive area in Distt. Lahaul-Spiti

21. IMPACT ON THE ENVIRONMENT

Mining activities can have significant and diverse impacts on the environment across various domains, including air, water, noise, soil, flora and fauna, land use, agriculture, and forests. The specific impacts depend on factors such as the type of mining, mining methods, location, and scale of operations. Here are some common environmental impacts associated with mining:

Impact on the Air Environment

Mining operations can generate dust particles, leading to air pollution. This can affect respiratory health and contribute to soil and water pollution. In some lease surroundings, only a few households are living in the area and the population density of the village is very low. The area does not have any industrial activity in the core/buffer zone and hence, the ambient air quality of the area is good. Hence, the impact on air quality due to mining will not be significant.

Impact on Water Environment Surface

Runoff from mining sites can carry sediments, heavy metals, and pollutants into nearby rivers and streams, impacting aquatic ecosystems.

Groundwater: Improper disposal of mining waste can lead to the leaching of harmful substances into groundwater, affecting water quality.

Noise Pollution:

Blasting and Machinery Noise: Mining operations often involve heavy machinery and explosives, contributing to noise pollution. This can disturb wildlife, affect human health, and disrupt local ecosystems.

Soil Degradation:

Land Disturbance: The removal of vegetation and topsoil during mining can result in soil erosion, leading to reduced fertility and increased susceptibility to landslides.

Chemical Contamination: The deposition of mining waste on land can introduce harmful chemicals into the soil, affecting plant growth and soil quality.

Flora and Fauna Impact:

Habitat Destruction: Mining activities can lead to the destruction of natural habitats, displacing wildlife and disrupting ecosystems.

Land Use Changes:

Deforestation: Open-pit mining and large-scale extraction activities often require clearing extensive areas of forests, contributing to deforestation and loss of biodiversity.

Fragmentation: Mining can fragment landscapes, isolating populations of plants and animals and disrupting ecological connectivity.

Agricultural Impact:

Land Competition: Mining activities may compete with agriculture for land, leading to the displacement of farming communities and a loss of agricultural productivity.

Water Usage: Mining operations may compete with agriculture for water resources, affecting irrigation and water availability for crops.

Forest Impact:

Loss of Biodiversity: Mining-related deforestation can result in the loss of diverse plant and animal species, impacting overall biodiversity.

Carbon Sequestration: Forests act as carbon sinks, and their destruction during mining releases stored carbon into the atmosphere, contributing to climate change.

To mitigate these impacts, sustainable mining practices, strict regulations, proper waste management, and rehabilitation efforts are essential. Environmental impact assessments (EIAs) are often conducted before mining projects to identify potential risks and implement preventive measures

22. REMEDIAL MEASURES TO MITIGATE THE IMPACT OF MINING ON THE ENVIRONMENT

Mitigating the environmental impact of mining involves implementing various remedial measures to minimize negative effects on air, water, soil, flora and fauna, and overall ecosystems. Here are some common remedial measures to mitigate the impact of mining on the environment:

Remedial Measures for Air Pollution:

- All types of machinery and transport vehicles will be properly maintained and pollution checks will be done once in a year to keep the emissions from machinery and vehicles under control.
- Water sprinkling will be done on haul roads to control the emission of dust while

transporting minerals and waste. Provision for water spray by tankers on 'Kuccha' road shall be done.

- Water sprinkling at the loading area.
- Tree plantation along the haul roads & approach road will be done. Plantation along the mine boundary shall be done with a tree density of 2000 trees per Hectare as per the norms of MoEF & CC, to control dust & noise.
- Use of personal protective equipment like dust masks.
- Ambient air pollution monitoring will be carried out.

Remedial Measures for Water Pollution:

- Mining is proposed to plan above the groundwater table.
- Garland drain shall be made around the Waste dump and the rainwater shall be collected in the garland drain and allowed to settle in a small pit for settling suspended particles before allowing discharge to natural drainage system.
- For domestic wastewater Septic Tank with a Soak Pit shall be provided, and discharge from the Soak Pit, if any shall be used for plantation.

Remedial Measures for Noise Pollution:

- Diesel-powered machinery, which is a major source of noise in open-cast mining shall be properly maintained. Attention shall be paid towards rigorous maintenance of the silencer of the diesel engines.
- Protective devices shall be provided for use of persons employed in the vicinity of high-noise areas.
- With the adoption of controlled blasting techniques, the ground vibrations will be minimized.
- Plantation around the lease boundary will cut the noise levels.
- Remedial Measures for Land Environment:

Some of the measures followed to minimize the impacts are as follows:

- The mining activities will be restricted within the lease area only.
- The waste material will be utilized for the construction of roads and also will be used by the local people for construction work.
- The surface runoff from the lease area will be retained within the lease and used for plantation, dust suppression and block cutting. So, there will be no soil erosion from the lease area and its surroundings due to mining activity.

- The dump will have an inward slope with catch drains at the inward side of the terrace and the catch drain of the individual terrace will be connected to the garland drain outside the periphery of the dump. The retaining wall and garland drain will be constructed around the dumps and the surface runoff water pass through the garland drain and finally settle in a settling pit before being released outside.
- **Biodiversity Conservation:** Implement conservation strategies to protect biodiversity, including the preservation of critical habitats, reforestation, and the creation of wildlife corridors.
- **Community Engagement:** Involve local communities in decision-making processes and ensure they benefit from mining activities. This may include providing employment opportunities, supporting local infrastructure, and contributing to community development projects.
- **Closed-Loop Systems:** Design mining operations with closed-loop systems to minimize resource consumption and waste generation. This includes recycling and reusing water, materials, and energy within the mining process.
- **Monitoring and Compliance:** Establish regular monitoring programs to assess the environmental impact of mining activities. Ensure strict compliance with environmental regulations and standards.
- **Training and Awareness:** Provide training for mining personnel on environmentally friendly practices and the importance of conservation. Increase public awareness about the environmental impacts of mining and the efforts being made to mitigate them.
- **Post-Closure Planning:** Develop and implement plans for the post-closure phase of mining operations to ensure ongoing environmental monitoring, maintenance, and adaptive management.

By incorporating these remedial measures, mining operations can help minimize their environmental impact and contribute to sustainable resource extraction. It's important to recognize that effective mitigation requires collaboration among industry stakeholders, regulatory bodies, local communities, and environmental experts.

23. RECLAMATION OF MINED-OUT AREA

As per the Himachal Pradesh Minor Minerals Concession Rules, 2015, a reclamation plan is a mandatory part of the approval of the mining plan by the Geological Wing Department of Industries. In the case of hill slope or terrace mining the reclamation plan includes the

regressing or planation of area. It is necessary to reclaim the land affected by mining for to following reasons:

- To put the land into productive use like agriculture, forestry or recreational purposes.
- To check soil erosion from dumps leading to the destruction of watersheds and siltation of rivers.
- Accumulation of huge quantities of water in worked-out pits may pose a threat to life and property.
- To combat adverse visual impact.

The afforestation programme is the most important programme to improve the environment and ecological balance of the area. Grasses and bushes that have fibrous roots are at the first instance grown which gives the binding property to the soil. After growing grasses and bushes, other tree species in consultation with the experts will be raised, based on the characteristics of soil, topography and climatic conditions.

The main post-mine land use for the Project will be grazing based on a self-sustaining vegetation community using appropriate pasture grasses and scattered plantings of native tree and shrub species.

For successful reclamation following points are to be considered

- Listing inventory of pre-mining condition.
- Monitoring flexibility of mining programme in the light of efficient land reclamation.
- Evaluation of the post-mining requirements of the region and to decide on the needs and desires of the affected ground.
- To make reclamation planning suitable to the techno-economical and socio-political environment.
- To assess the physio-chemical characteristics of overburden.
- Extra cost of preservation, re-handling, spreading and levelling of subsoil and topsoil.
- Knowledge of hydrogeological/geomorphological conditions. Aesthetic and/or historic value of land.

The fast-growing plantation and re-grassing shall be done on the exhausted/excavated benches as well as in backfilled pits and will be done in consultation with local peoples or Govt. Authorities like the forest department etc. The mining lease shall be fenced properly in the entire periphery of the safety zone. The total mined-out area of the benches shall be dedicated to plantation and re-grassing. The average year-wise proposed bench area for the plantation is as under: -

a) The plantation/regressing and its maintenance cost will be borne by the leaseholders. Also, a green belt will be developed in consultation with the local panchayat and forest departments along approach roads in order to minimize pollution.
b) Based on the characteristics of soil, topography and climatic conditions of the area, plantation of grasses/bushes and other tree species will be done by the Leaseholders.
c) Plantation before the onset of the monsoon season will be done progressively until the final closure of the mine.
d) Green Belt shall be properly designed in consultation with the forest department. Plantation shall be carried out as per the periodical plantation programmer.
e) Fast-growing and evergreen trees, trees with broadleaf resistance to specific pollutants and those that would maintain the regional ecological balance, soil and hydrological conditions shall be favoured.
f) Green belt areas along the haul roads, buffer zone, dumping sites as well as excavated benches shall be developed.
g) Besides this, only local labourers shall be engaged for watch and ward and plantation activity with proper maintenance.
h) The plantation/regressing and its maintenance cost will be borne by the Leaseholders. Also, a green belt will be developed in consultation with the local panchayat and forest department along approach roads in order to minimize pollution.
i) The estimated survival rate proposed to be achieved shall be 80%

24. RISK ASSESSMENT & DISASTER MANAGEMENT PLAN;

Most of the mines in the district are in Hilly areas. Since the mining benches, trenches or pits are developed on hard compact and medium grain rocks hence, there may be a chance of possibilities of slope failure if mining activities are done in an unscientific manner. The Risk Assessment & Risk Management Plan will be prepared for the safety of man & machinery deployed in the mining activities as per Mining Act, Rules, and Regulations & DGMS circulars.

24.1 Risk Assessment:

- **Identify Hazards:**

  Conduct a thorough identification of potential hazards associated with mining activities, considering factors such as geology, equipment, processes, and external influences.

- **Risk Analysis:**

Assess the likelihood and potential consequences of identified hazards. This involves quantifying risks to prioritize them based on severity and probability.

- **Vulnerability Assessment:**
  Evaluate the vulnerability of critical infrastructure, surrounding communities, and the natural environment to potential risks and hazards.
- **Stakeholder Engagement:**
  Involve relevant stakeholders, including local communities, government agencies, and environmental experts, in the risk assessment process to gather diverse perspectives and local knowledge.
- **Emergency Response Planning:**
  Develop detailed emergency response plans for various scenarios, considering potential accidents, natural disasters, and other emergencies. Include evacuation routes, emergency shelters, and communication protocols.

24.2 Disaster Management Plan:

- **Risk Mitigation Strategies:**
  Implement risk mitigation strategies to minimize the likelihood and impact of identified hazards. This may involve engineering controls, process modifications, and the use of advanced technologies.
- **Safety Training and Awareness:**
  Conduct regular safety training for mining personnel, contractors, and local communities. Promote awareness of potential hazards and the importance of adhering to safety protocols. The required personal protective equipment should be provided and used in a manner that protects the individual from injury. A few minor injuries which can be prevented are slip, trip or fall hazards; hazards due to rock falls and collapse of unstable rocks, atmosphere containing toxic or combustible gases; protection from chemical or hazardous material etc.
- **Infrastructure Design:**
  Design mining infrastructure with safety in mind, incorporating features such as containment systems for hazardous materials, emergency exits, and protective barriers.
- **Contingency Planning:**

Develop contingency plans for various emergency scenarios, outlining specific actions to be taken in the event of accidents, spills, fires, or other critical incidents.

- **Collaboration with Emergency Services:**
  Coordinate with local emergency services, hospitals, and law enforcement agencies to ensure a seamless response to emergencies. Conduct joint training exercises and drills to improve preparedness.
- **Emergency Equipment and Resources:**
  Maintain an inventory of emergency equipment, such as first aid supplies, firefighting equipment, and evacuation vehicles. Ensure that resources are strategically located for quick access.

A disaster management plan should be prepared for taking care of any disaster. Other risks that are included in this category are noise, as it occurs and it can lead to permanent disability. There are problems related to road traffic in and out issuers; inappropriate exposure of moving machines; mechanical failure and because of the large number of moving trucks and dumpers there is a large quantity of dust present in roadways which affects the operators and can lead to accidents

By integrating comprehensive risk assessments and disaster management plans into mining projects, companies can enhance the safety of their operations, protect the environment, and contribute to the well-being of surrounding communities. It is essential to work closely with regulatory bodies and local stakeholders throughout the planning and implementation processes.

25. DETAILS OF THE OCCUPATIONAL HEALTH ISSUES IN THE DISTRICT

The persons employed in the mines are exposed to a number of hazards at work which adversely affect their health. Some of the important ones are dust, noise, heat, humidity, vibration etc. In recent times, there has been increasing awareness among the mining industry and workers about occupational diseases such as Coal Worker's Pneumoconiosis, Silicosis, Manganese Poisoning, Hearing Impairment etc. caused by exposure to health hazards at work. Almost all occupational diseases are known to cause permanent disablement and there is no effective treatment. However, most of occupational diseases can be prevented by adopting proper occupational health measures and engineering control of airborne dust at the workplace. Following diseases have been notified as the diseases connected with mining operations for the purpose of sub-section (1) of Section 25 of the Mines Act, 1952:

In order to detect occupational diseases, the health surveillance programme shall be adopted in mines which includes:

- Initial Medical Examination of persons to be employed in mines.
- Periodic Medical Examination once every five years. General physical examination, chest radiographs, lung function tests and audiometrics.
- Classification of chest radiographs of workers as per ILO Classification.
- Medical examination within one year of superannuation.
- Evaluation of all cases of suspected pneumoconiosis by Pneumoconiosis Medical Board.

Maintenance of medical records till the person is in service and 10 years thereafter. The cases of silicosis detected during health surveillance programmes are referred to as Pneumoconiosis

As per the available record of five-year data, no patients of Silicosis & Tuberculosis have been adversely affected or reported due to the mining activities in the District.

26. PLANTATION AND GREEN BELT DEVELOPMENT

Mining in the case of hill slope and terrace deposits is carried out by the formation of benches the height of the benches can vary from 2mX2m, 4mX4m, and 6mX6m, depending on the nature of the rock or deposits and the dimensions of the lease area. It is recommended to the lessee that a separate place has to be kept for dumping the topsoil which can be later on used for plantation purposes and re-grassing. As the mining operations are carried out from the top of the mining lease to the bottom, therefore, plantation and re-grassing have to be done every year on the excavated benches.

The fast-growing plantation and re-grassing shall be done on the exhausted/excavated benches as well as in backfilled pits and will be done in consultation with local peoples or Govt. Authorities like the forest department etc. The mining lease shall be fenced properly in the entire periphery of the safety. The green belt along the lease boundary and both sides of the transportation road shall be developed in almost all the existing leases in the district. Maximum numbers of plants shall be planted each year around the lease boundary and both sides of the transportation road as mentioned in the mining plan. Some mine owners also planted a large number of plants outside the lease area to develop a green belt in the district. Deodar, Sal, Khair Pine, Cheil, etc. are some important plants commonly planted Lahhul Spiti district.

In some cases where the nature of the rock is hard and there is no scope for plantation. lessee is asked to acquire a dedicated land from the private or local govt. bodies for plantation. Plantation is done in consultation with the forest department and local bodies.

A detailed record of the plantation is to be kept by the respective owner/agent/manager of the mine every year, which has been planted in the safety zone area and transport route, which is statutorily required. As per the norms of the Forest department, the plantation has to be carried out at the rate of 2500 local plants per hectare and along the roadside, at an interval of 2 meters in a zig-zag manner on both sides.

27. OTHER INFORMATION

The protection of mineral reserves as well as their sustainable exploitation for development use is one of the concerns of the State Government. As land and mineral reserves are the most important capital assets, protection of such capital assets would be a legitimate plan activity. Therefore, it is the responsibility of the state government to take an effective action plan to combat illegal mining and lifting which has led to huge revenue loss to state exchequer.

Provisions shall be made in the mining plans to protect the environment, though there are no trees in the mining area, even then intensive care will be taken to protect the nearby trees and to make the arrangements with the consultation of the Forest Department to make compensatory plantation & contribution to the Van Mahotsav events etc. Proper arrangements shall be made to dump the waste generated from the mining activities. The topsoil and silty clay will also be dumped at proper places as per suggestions made in the mining plan. So, that it can be used for plantation or agriculture purposes after the mining is over.

Also, it is accepted that effective resource management cannot be done in isolation. The proponent therefore vigorously pursues approaches towards coordination and integration where possible, so as to lead to coordinated regulatory systems.

28 MONITORING & EVALUATION

The Ministry of Environment, Forest & Climate Change has published "Enforcement & Monitoring Guidelines for Sand Mining" in the year 2020 wherein Monitoring Mechanism has been defined very specifically and recommended that a uniform monitoring mechanism is required to assess the regulatory provision in quantitative terms, with robust institutional and legal framework. Based on past experience and suggestions available, the following requirements are suggested for defining a mechanism for monitoring of mining activities which will help in identification of mining which is operating either illegally or are violating the regulatory provisions. Some suggestion will facilitate direct or indirect information to help in such an assessment.

1. All precaution shall be taken to ensure that the water stream flows unhindered and process of Natural river meandering doesn't get affected due to mining activity.
2. River mining from outside shall not affect rivers, no mining shall be permitted in an area up to a width of 100 meters from the active edge of embankments or distance prescribed by the Irrigation department.
3. The mining from the area outside river bed shall be permitted subject to the condition that a safety margin of two meters (2 m) shall be maintained above the groundwater table while undertaking mining and no mining operation shall be permissible below this level unless specific permission is obtained from the Competent Authority. Further, the mining should not exceed nine-meter (9 m) at any point in time.
4. Survey shall be carried out for identifying the stretches having habitation of freshwater turtles or turtle nesting zones. Similarly, stretches shall be identified for other species of significant importance to the river eco-system. Such stretch with adequate buffer distance shall be declared as no-mining zone and no mining shall be permitted. The regulatory authority as defined for granting Environmental Clearance, while considering the application of issuance of ToR and/or EC for the adjacent block (to non-mining zone) of mining shall take due precaution and impose requisite conditions to safeguard the interest of such species of importance.
5. District administration shall provide detailed information on its website about the sand mines in its district for public information, with an objective to extend all information in public domain so that the citizens are aware of the mining activities and can also report to the district administration on any deviation observed. Appropriate feedback and its redressal mechanism shall also be made operational. The details shall include, but not limited to, lease area, geo-coordinates of lease area and mineable area, transport routes, permitted capacity, regulatory conditions for operation including mining, environmental and social commitments etc.
6. A website needs to be maintain to track the movement of centralised sand mining and a Centralised server system should be made to manage the data related to sand mining across India.
7. The mineral concession holders shall maintain electronic weighbridges at the appropriate location identified by the district mining officer, in order to ensure that all mined minerals from that particular mine are accounted for before the material is dispatched from the mine. The weighing bridge shall have the provision of CCTV camera and all dispatch from the mine shall be accounted for.
8. The mineral movement shall be monitored and controlled through the use of transit permit with security features like printing on IBA approved MICR papers, Unique bar/QR, fugitive ink background, invisible ink mark, void pantographs and watermarks papers or through use of RFID tagged transit permits and IT /IT-enabled services. Such monitoring system shall be created and made operationalised by State Mining department and district level mining officer shall be responsible for ensuring that all legal and operational mines are connected and providing the requisite information on the system.
9. State Government shall constitute a District Level Task Force (DLTF) under the Chairmanship of Deputy Commissioner/District Magistrate/Collector with Superintendents of Police and other related senior functionaries (District Forest Officer, District transport officer, Regional officer- SPCBs, Senior Officer of Irrigation Department, District Mining Officer) with one/two independent member nominated by the Commissioner concerned. The independent member shall be retired government officials/teacher or ex-serviceman or ex-judiciary member. The

DLTF shall keep regular watch over the mining activities and movement of minerals in the district. The DLTF shall have its regular meeting, preferably every month to reconcile the information from the mining activity, and other observations made during the month and take appropriate corrective and remedial action, which may include a recommendation for revoking mining lease or environmental clearance. The DLTF may constitute an independent committee of the expert to assess the environmental or ecological damage caused due to illegal mining and recommend recovery of environmental compensation from the miner's concern. The recommendation may also include action under the provision of E(P) Act, 1986.

10. The area not identified for mining due to restriction or otherwise are also to be monitored on a regular basis by the DLTF. Any observations of mining activity from the restricted area shall be reported and corrective measures shall be initiated on an urgent basis by the DLTF.

11. The dispatch routes shall be defined in the Environmental Clearance and shall be avoided through densely habituated area and the increase in the number of vehicle movement on the road shall be in agreement with the IRC guidelines / carrying capacity of the road. The alternate and dedicated route shall be explored and preferred for movement of mining to avoid inconvenience to the local habitat. The mining production capacity, by volume/weight, shall be governed by total permissible dispatch calculated based on the carrying capacity of dispatch link roads and accordingly, the production should be regulated.

12. The movement of minerals shall be reconciled with the data collected from the mines and various Naka/check posts. Other measures may also include a general survey of the potential mineable area in the district which has not been leased/auctioned or permitted for mining due to regulatory or other reasons.

13. The location and number of check post requirement shall be reviewed by DLTF on a regular basis so that appropriate changes in location/number could be made as per the requirement. Such review shall be carried out on a regular basis for the district on inter-state boundary or district providing multiple passages between two districts of different states.

14. The district administration shall compile the information from their district of the permitted and legal mined out minerals and other details and share such information and intelligence with the officials of the adjoining district (Inter or/and Intra State) for reconciliation. The information shall include the area of operation, permissible quantity, mined out minerals (production) the permitted route etc., and other observations, especially where the mine lease boundary is congruent with the district boundary. Such coordination meeting shall be held on a quarterly basis, alternatively in two district headquarters or any other site in two districts decided mutually by the District Magistrate.

15. The in-situ and ex-situ environmental mitigative measures stipulated as EMP, CER, CSR and other environmental and safety conditions in mines including the welfare of labours shall properly reflect in the audit report.