LAND USE AND ENVIRONMENT

CHAPTER-9

9.0 District wise Land use-Land cover status of different districts of Himachal Pradesh.

9.1 Land use/ Land cover, Bilaspur district.

Different land use land covers categories were identified and mapped using temporal satellite images of the year 2015 and 2016 for district Bilaspur. The statistics demonstrates that 34.24 % of geographical area of the district falls under two-crop area that is Rabi and Kharif crops. In terms of percentage agriculture comprises the single largest category of land use in the district. Wheat is the dominant rabi crop while maize and paddy are predominantly grown as kharif crops. Area under two-crop are mostly in the north and central part of Jhanduta and Ghumarwin Tehsils. Forest area under dense, open and scrub forests comprises of 29.81% of the district area. In term of area, deciduous forests dominate over evergreen forests owing to hot and humid climatic conditions over major part of the year. Contiguous patches of dry deciduous forests are mapped on the elevated region along the Govind sagar reservoir. Wastelands were observed over 21.65% of district area, Gullied/Ravinous land-Gullied within the district are distributed mainly in the Sukkar khad and Sir khad in the western part of Jhanduta Tehsil. Industrial activities in district can be conspicuously observed at Associate Cement Corporation, Barmana cement factory besides Kol hydroelectric power station on Satluj river. Water bodies cover about 10.60% of the geographical area. Built up area and grassland covers about 2.64% and 1.06% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 1a and Figure1b.

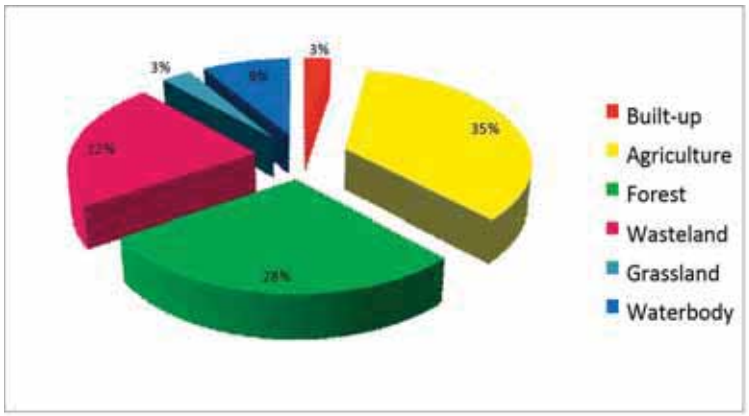


Fig. 1a. Percentage area under different major land use categories in Bilaspur district for the year 2005-06.

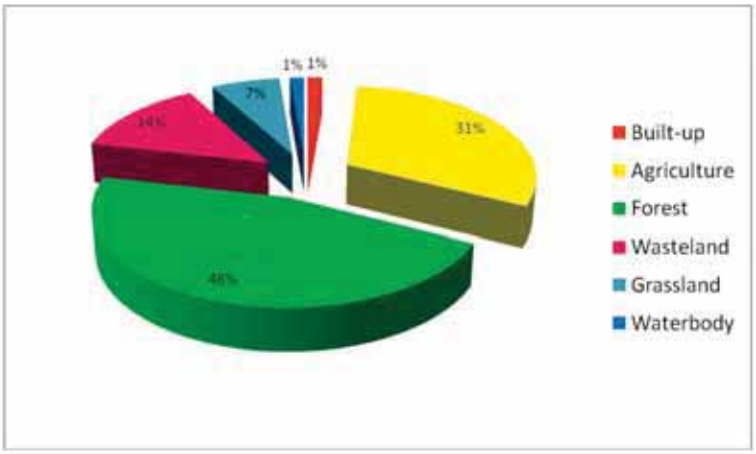


Fig. 1b. Percentage area under different major land use categories in Bilaspur district for the year 2015-16.

9.2 Land use/ Land cover, Chamba district

Different levels of land use - land covers categories were identified and mapped in Chamba district. Land use categories were classified as forest, grassland, wasteland, and agriculture land which covers the entire district lansdscape along with snow and water bodies. Forest is the major land use category in the district. The catchments areas of Ravi, Budhil, Saluni and Chandrabhaga rivers are densely forested, the main tree species being deodar *(Cedrus deodara)* and other pine species. The forest in the district covers an area of 46.18% of the district. Degraded patches of forests are found interspersed with agriculture and human settlement, mainly along river banks. Area under grassland and alpine pastures is 16.56%. Wasteland area in the district comprises of 13.46%. Extensive areas under alpine grazing lands are present in the Pangi, and Bharmour Tehsils. Two crop area shares the major agricultural area followed by single season kharif crop in higher reaches in the district. The aerial extents of agriculture area is 9.89%. Kharif crop is confined only to high altitude region of the district. Maize is the dominant kharif crop in high altitude. Kharif crops are dominant in Tissa, Pangi and Bharmour Tehsil. Areas under two-crop are predominantly mapped in the Bhattiyat, Chamba and Salooni Tehsils. Area under snow in the district comprises of 11.76%. Water bodies and built up area is 1.49% and 0.66% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 2a and Fig.2b.

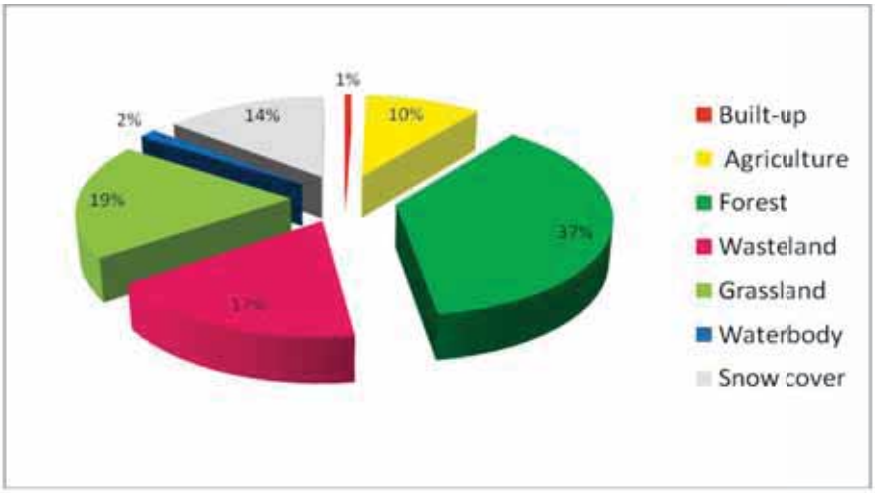


Fig. 2a. Percentage area under different major land use categories in Chamba district for the year 2005-06.

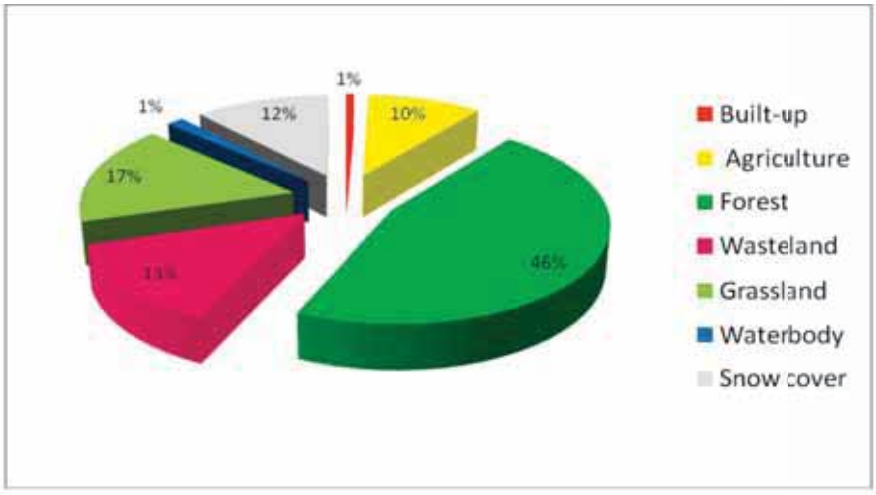


Fig. 2b. Percentage area under different major land use categories in Chamba district for the year 2015-16.

9.3 Land use/ Land cover, Hamirpur district

Different land use land covers categories were identified and mapped in the district. Agricultural land with two-crop area shares major part of land use category in the district with 36.37% of the district area. Wheat, rice and maize are the major crop combinations of the district. About 33.70% area has been identified and mapped under wastelands. Among the various wasteland categories scrub land is dominant one, followed by gullied land. Large chunk of wastelands-open scrub were mapped in the northern part of Dehra and southern part of Sujanpur Tehsil. Forest comprises the major land use category in the district and covers 21.83% of the district, forest patches are contiguous. A lot of agricultural activities were observed within the forest areas. Largest area under evergreen forests was mapped in the Nadaun Tehsil. The order of aerial extent of three dominant categories agriculture, wasteland and forest are agriculture > wasteland > forest. Industrial activities are also observed. Water bodies, Built up and grassland covers 3.66%, 3.41%and 1.13% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 3a and Figure3b.

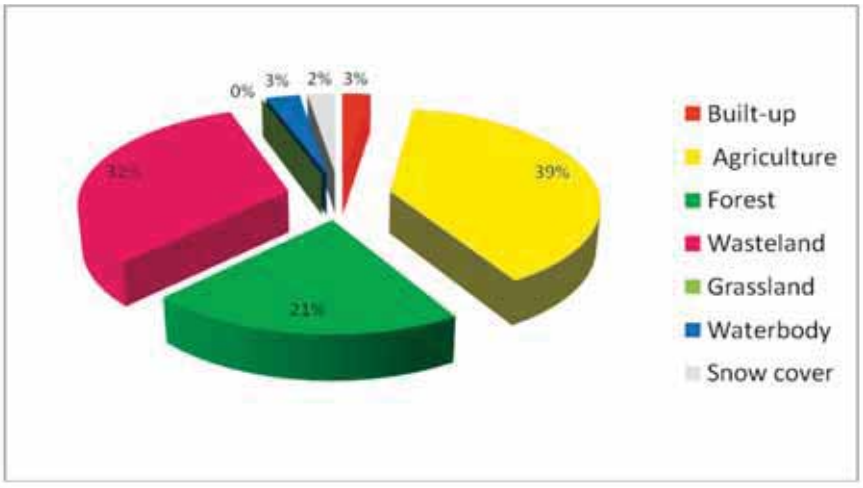


Fig. 3a. Percentage area under different major land use categories in Hamirpur district for the year 2005-06.

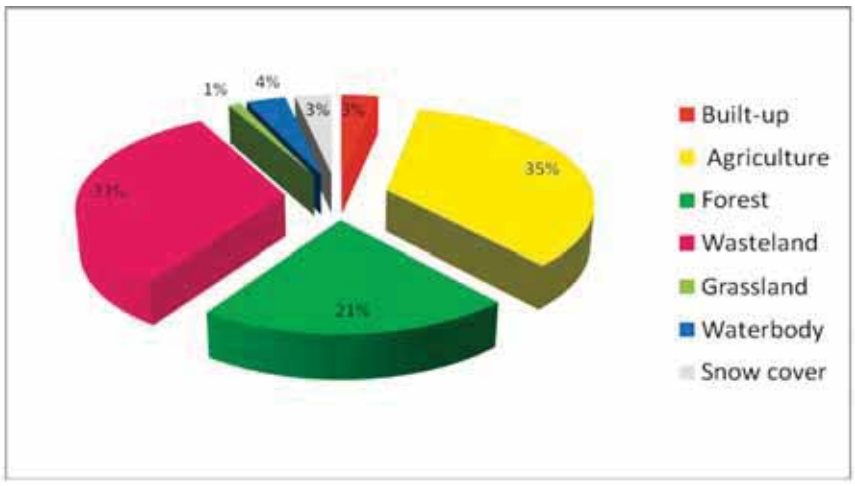


Fig.3b.Percentage area under different major land use categories in Hamirpur district for the year 2015-16.

9.4. Land use/ Land cover, Kangra district

River Beas and its tributaries are the main drainage system in Kangra district. Wheat rice-maize is major crop combination is the district. Due to very high rainfall (over 250 cm), Kangra valley is the most productive valley for rice cultivation in the state. Tea gardens are mainly confined in this district only. Deodar and other pine species are the dominant tree species in the evergreen forest of the district. Forest cover shares the major part (31.85%) of the district. Isolated patches of evergreen forests of pine forests were observed distributed in the middle part of Kangra district. Upper reaches of Baijnath have alpine grazing lands. Fragmented patches of dry deciduous open forests were mapped in the middle part of Fatehpur Tehsil. Patches of dense scrub were largely mapped in the Bodoh, Khundiyan, Jwali, Indora, Fatehpur and Nurpur Tehsil. Agricultural land with two-crop area comprises of 28.82%. The area under various categories of wastelands (gullied land, scrub, sand and snow/glacier) together covers 19.38% of the district. Waterlogged areas were mapped in downstream side of pong reservoir. Agro-horticultural activities of the district is less in comparison to the agricultural land and forest cover, number of tea gardens are mapped under agricultural plantation categories. Pong reservoir is the largest man made water body in the district along with other water bodies, the total area of the wetland covers 7.99% of the district. The snow cover area in the district is represented by the Dhauladhar mountain range covering about 5.04% area. Grassland and Built up area covers 4.19% and 2.72% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 4a and Figure 4b.

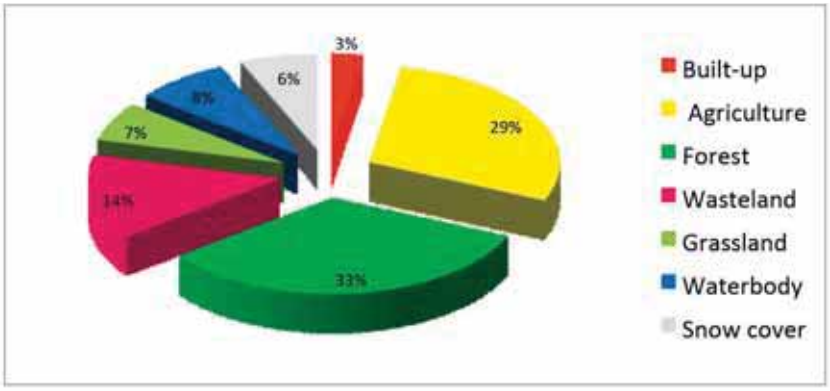


Fig. 4a. Percentage area under different major land use categories in Kangra district for the year 2005-06.

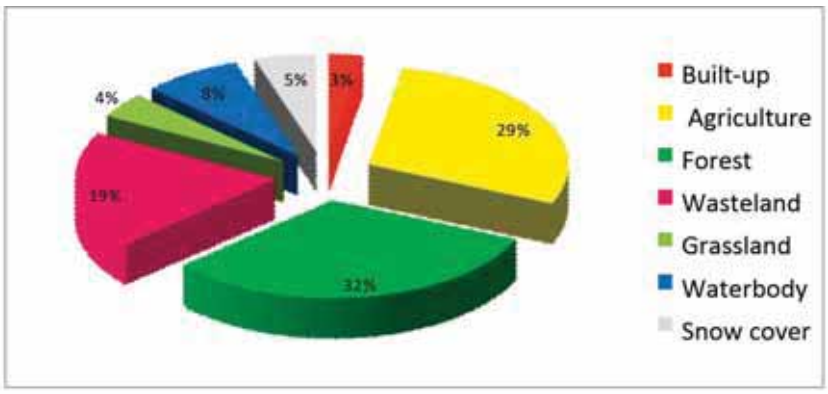


Fig. 4b. Percentage area under different major land use categories in Chamba district for the year 2015-16.

9.5. Land use/ Land cover, Kinnaur District

Waste land area is the largest land cover category of the district accounting 44.3 % area of the district, this category is especially delineated in Pooh Tehsil. Snow cover area is the second largest class accounting an area of 22.52%. The third largest category is the alpine/sub-alpine grassland land class accountings an area of 18.98 % area of the district. Forests area are mapped in the Nichar, Kalpa, Sangla and Morang Tehsils. Sub-alpine region have natural formations of Birch, Chilgoza, Sea Buck thorn, junipers etc. Significant forest cover area was observed and mapped. Forest cover area accounted 10.44 % of the district. Agriculture activities are largely confined to lower reaches of the major river valleys only. Major agricultural activities are reported in Nichar, Kalpa and Sangla Tehsil. Total of only 2.45% area of the district is under agricultural activities. Agro-horticultural practices are the main agricultural activity of the district. The region predominantly practice agro-horticulture besides the dry zone are famous for raising variety of millets crops. Other wasteland categories namely stony rocky land, scrub land accounted for 6.25 % and 3.97 % respectively. Water bodies and built up area comprises of 0.98% and 0.31% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 5a and Figure 5b.

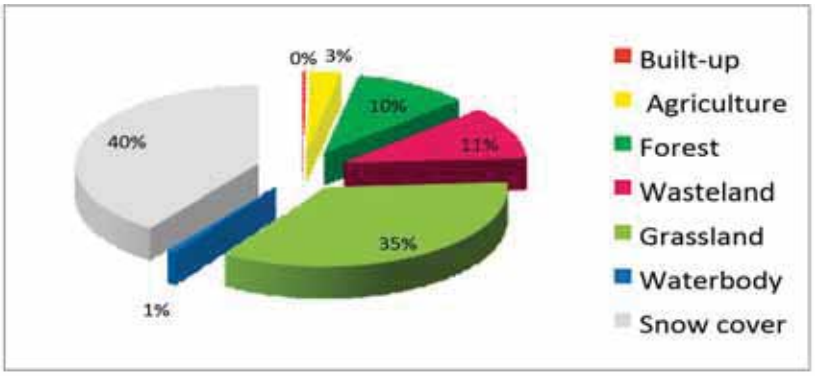


Fig. 5a. Percentage area under different major land use categories in Kinnaur district 2005-06.

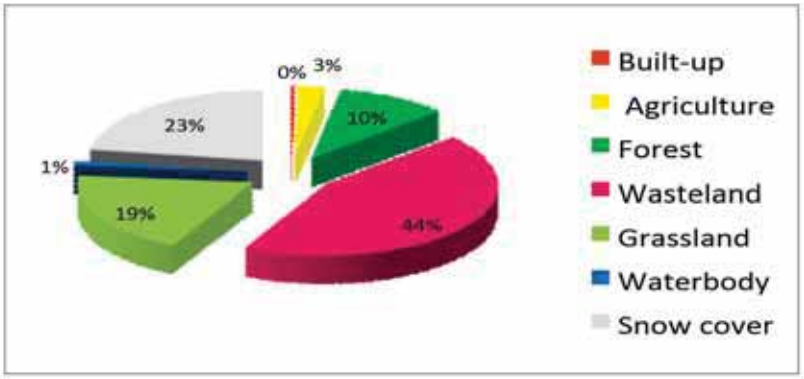


Fig. 5b. Percentage area under different major land use categories in Kinnaur district, 2015-16.

9.6 Land use/ Land cover, Kullu district

Different land use/ land cover categories of Kullu district were delineated on the basis of satellite imageries A considerable portion of the district is covered under forest. Forest Evergreen/Semi Evergreen is the dominant forest type. It together accounts for 35.03% of the district geographic area. A significant area is covered by closed forest area, followed by the open forest area, Forest scrub land is also very little. The wastelands of the district are Waste lands Scrubland- Dense scrub, Wastelands-Scrubland- Open scrub, Wastelands-Barren Rocky/Stony waste together accounts for 17.82%. The wastelands dominate over the grassland marginally and it accounted for 16.57% of the area of the district. Alpine grazing lands are largely mapped in KulluTehsil. Snow cover area occupies 17.20 % of the total area of the district. The entire higher fringe of the Kullu valley in the West, North and East direction is covered under snow cover except the southern fringe. The land under agricultural activities is 11.61%. Agro-horticulture is the dominant agricultural activity in the district. Significant area has been brought under under agro-horticulture crop. Main agro-horticulture growing areas are concentrated along the Beas river valley and associated valleys of its major tributaries like Parvati, Tirthan, Hurla, etc. Water bodies and built up area comprises of 1.02% and 0.64% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 6a and Figure 6b.

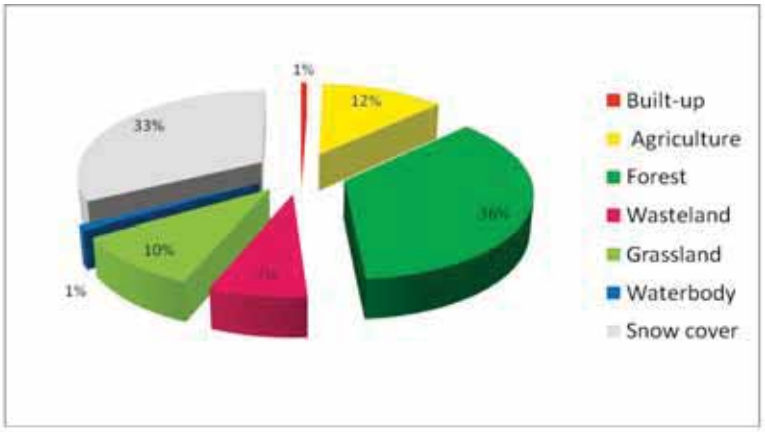
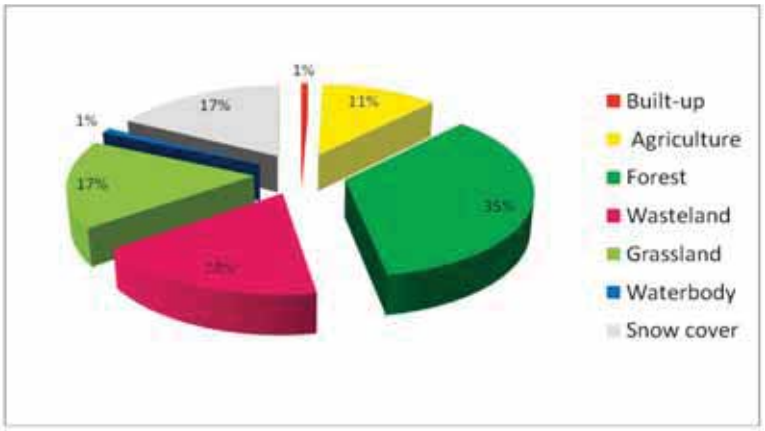


Fig. 6a. Percentage area under different major land use categories in Kullu district 2005-06.



.Fig. 6b. Percentage area under different major land use categories in Kullu district 2015-16

9.7 Land use/ Land cover, Lahul & Spiti district

Dominant land cover categories of the district mapped were snow/glacial area, 47.66% area of the district is under snow/ glacier. 38.39 % area is under rocky/stony waste area and 10.12 % is under grassland/alpine grazing lands. The district has limited area under agriculture covering only 0.65% area of the district owing to scanty rainfall as the entire district falls in the leeward side of the Pir Panjal mountain range and therefore, agriculture is practiced only during the short growing season between May to September. The harsh cold conditions of Lahul permit only scattered tufts of hardy grasses and shrubs to grow, that is up to 4,000 m msl. Glacier lines are usually found at 5,000 m. The riverbed of district harbors characteristic growth of a dominant shrub species - the sea buck thorn. In comparison to the Spiti Tehsil, forests covers are observed and mapped only in the Lahul Tehsil. Lahul valley is also having larger area under alpine grazing land as compared to Spiti valley. Inversely, Spiti region is having larger percentage of area under rock/stony waste slopes class as compare of Lahul region. Total forest cover of district is only 1.85%. Agricultural activities is confined to the lower valley region in scanty patches. Vegetables such as peas, potatoes, hoffs etc. are the major crops in the region. In recent years, seed potato cultivation is being promoted on large scale. Water bodies and built up categories comprises of 1.26% and 0.07% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Fig.7a & Fig.7b.

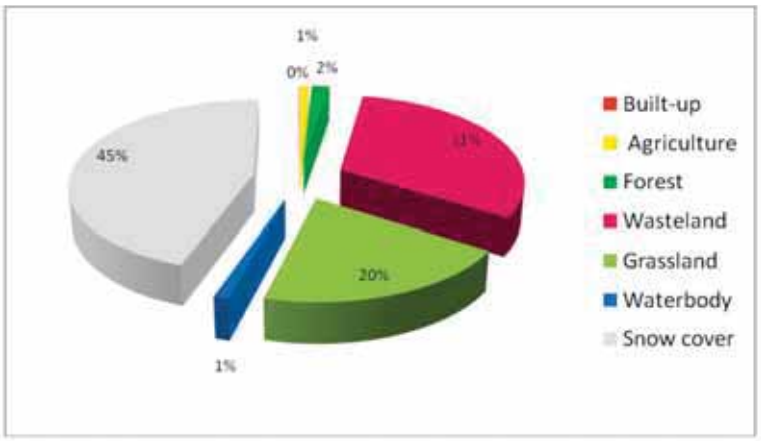


Fig. 7a. Percentage area under different major land use categories in Lahul-Spiti district 2005-06.

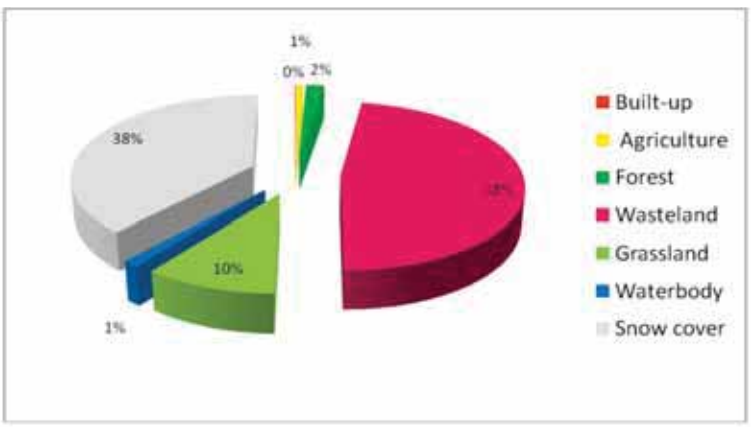


Fig. 7b. Percentage area under different major land use categories in Lahul-Spiti district 2015-16.

9.8. Land use/ Land cover, Mandi district

Forests and agricultural land are the dominant land cover/land use categories comprising 46.07% and 31.03% of the geographical area of the Mandi district. Agro-horticultural activities claims one third 10.07% of the agricultural area. Soil of the Mandi district is very fertile and productive. The two-crop area is dominant agricultural category observed in the district. Wheat Rice/ maize is the main crop rotation of the district. Area under double crops was mainly observed in the valleys of Chachyot, Sundernagar, Jogindernagar, Karsog and Paddhar Tehsil. The wasteland category all together is 13.47%. Of the wastelands, scrub land is dominant wasteland category in the district. Other wasteland categories are wastelands-gullied/ravinous land-gullied, Wastelands-barren rocky/stony waste, wastelands-sandy area-riverine. Dense and contiguous patches of Oak and Deodar are mapped in the Chachyot and Thunag Tehsil and in the western part of Dharampur Tehsil bordering Kangra district. Largest area under wasteland scrub was mapped in the Sarkaghat Tehsil. A considerable extent of grasslands was also observed and covers an area of 6.66 % of the district area. Built-up and Water bodies area comprises of 1.40% and 1.38% only. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 8a and Figure 8b.

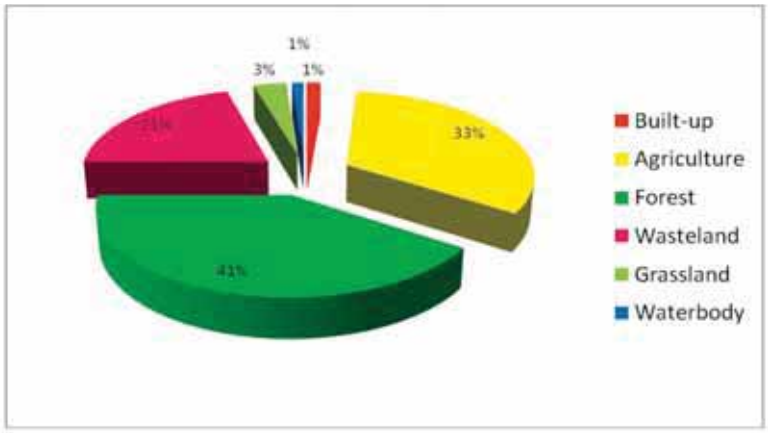


Fig. 8a. Percentage area under different major land use categories in Mandi district, 2005-06.

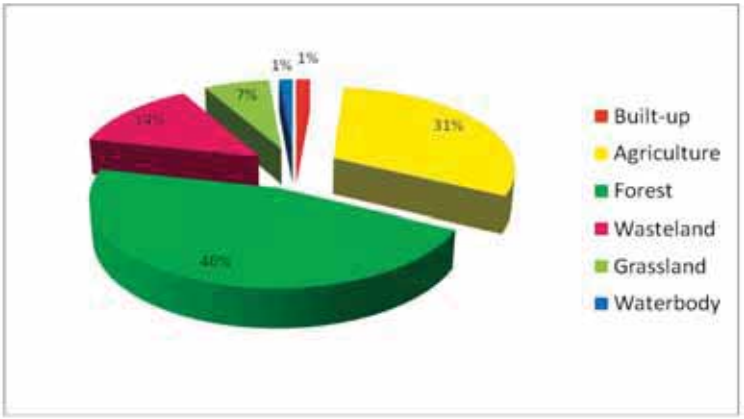


Fig. 8b. Percentage area under different major land use categories in Mandi district, 2005-06.

9.9 Land use/ Land cover, Shimla district

Three rivers viz., Sutlej, Giri and Pabbar are the main rivers that drains the district. Shimla is the biggest apple growing district in Himachal Pradesh and it is also not lagging behind in growing other fruits such as peach, plum apricot, walnut, almond cherry, citrus etc. Horticulture areas were mapped in Rampur, Jubbal, Rohru, Theog and Kotkhai and Chopal Kumarsain, Chidgaon Tehsil. The agricultural land with two-crops is the major agricultural land use of the district. The main cereal crops are wheat, maize and rice. In addition barley, millets, pulses, oilseeds and potato crops are also grown. 26.89% of the district area is under Agriculture and horticulture crops. Forest cover spread over 45.78% of the district with close, open and scrub forest. Shimla district represents luxuriant growth of deodar (Cedrus deodara) forests at many places besides other evergreen species. Evergreen dense forests are dominant forests cover. Sub-alpine areas of district have characteristics presence of birch species. Among the wastelands categories scrub land is the major category of the wastelands. It comprises of 15.34% of the district area. Grazing lands of the district is about 8.83% of the area of the district. Snow cover area is confined to the northern and eastern part of the districts adjoining Kinnaur district and Uttarakhand State in the east and it comprises of 1.20% of the district area. Built up and water bodies comprises of 1.35% and 0.61% respectively. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 9a & Figure 9b.

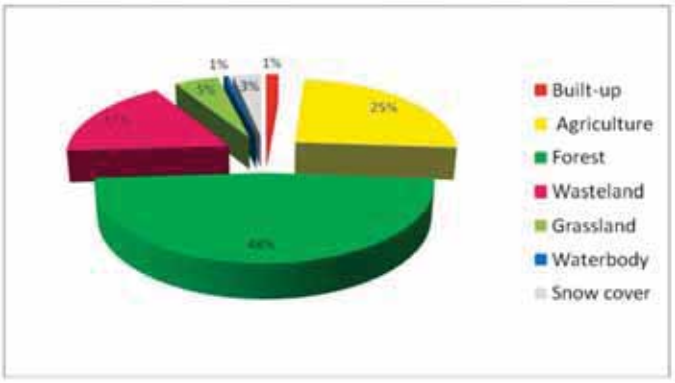


Fig. 9a. Percentage area under different major land use categories in Shimla district, 2005-06.

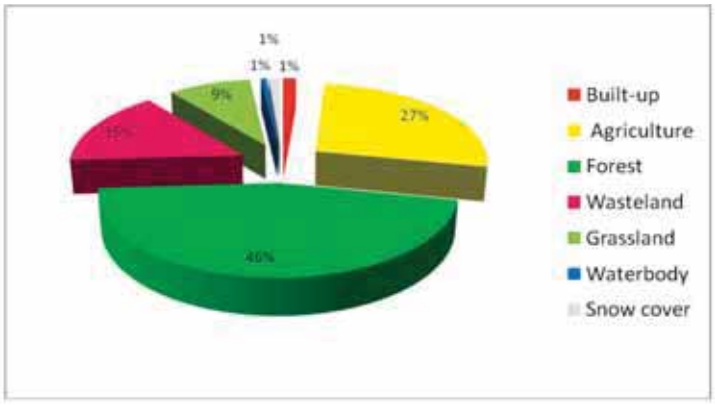


Fig. 9b. Percentage area under different major land use categories in Shimla district, 2005-06.

9.10 Land use/ Land cover, Sirmour district

A total of six broad categories of land use land cover classes were identified and delineated in the district. The broad land use classes are forest, agriculture, wasteland and grassland, built up and water bodies. Nearly half of the geographical area of district that is 52.90% is under forest cover. Different forest types and density observed are Forest-Evergreen/Semi Evergreen-Dense/Closed, Forest Evergreen/Semi Evergreen-Open, Forest Deciduous (Dry/Moist/Thorn)-Dense/Closed, Forest-Deciduous (Dry/Moist/Thorn) – Open and Forest- Scrub Forest. Evergreen dense/open forests of sal (Shorea robusta) are confined to Nahan and eastern part of Paonta Sahib Tehsil. Open forest of pine is the dominant class of the forest. Large dense patches of Oak and Deodar were mapped in the high altitude areas of Pachhad and Rajgarh Tehsil. Agricultural land with two-crop claims major share of cropped area and comprises of 28.78% of the district area. Agro-horticulture areas were mapped largely in the foothills. Wastelands are spread over an area of 9.60%. The area under grassland is 4.41%. Renula lake is a famous natural wetland site located in the district. Total area covered by wetlands is 2,35%. The total built up area comprises of Nahan town, Kala Amb industrial area, Paonta industrial belt and Bata valley industrial segments of, Paonta Sahib Tehsil comprising of 1.95% area of the district. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 10a & Figure10b.

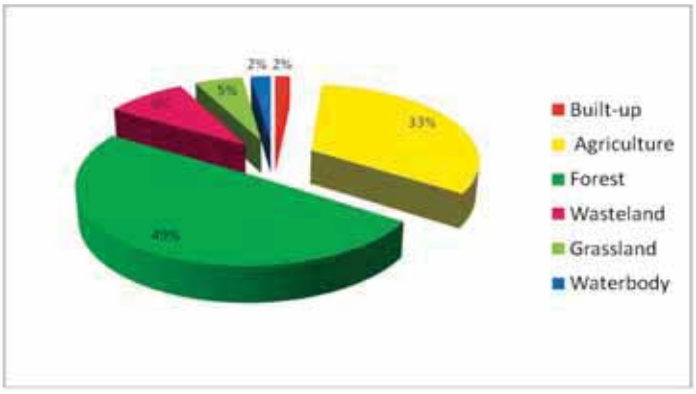


Fig.10a. Percentage area under different major land use categories in Sirmour district, 2005-06.

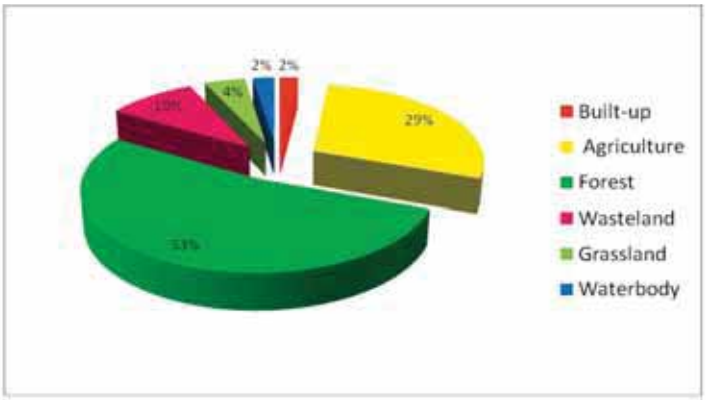


Fig.10b. Percentage area under different major land use categories in Sirmour district, 2015-16.

9.11. Land use/ Land cover, Solan district

In total six different levels of land use land covers categories were identified and mapped in the district. Forest is the dominant land cover of the district accounting 42.63% of the district. Pine trees grows as dominant evergreen forest species in the upper region of district, while lowers hills bear luxuriant growth of Khair (Acacia catechu) along with other deciduous species. The agricultural area of district is about 26.14 % of the district. Major wheat and rice cultivation areas are concentrated in the valleys. Most of the agricultural land is under double crop. Several varieties of sub-tropical fruits are cultivated in eastern part of district near to Solan district. The third largest land cover category is wastelands. It account for an area of 20.24%. The wasteland categories are Wastelands-Barren Rocky/Stony waste, Wastelands-Gullied/Ravinous land Gullied, Wastelands-Scrubland-Dense scrub, Wastelands-Scrub land-Open scrubland, and Wastelands-Sandy area-Riverine. Areas under gullied/ravenous land were mapped in Nalagarh Tehsil. Brick kilns and associated excavated dumps area are also observed and mapped. Built up area along with industrial activity in district can be observed at Darlaghat cement factory besides several other places in Chambaghat, Baddi, Solan, Dharampur and Parwaoo. These buit up area comprises of 6.18% of district area. The south facing slopes in the district exhibit dominant presence of sub-tropical grasslands. The grassland in the district comprises of 3% area. Water body in the district comprises of 1.58%. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 11a and Figure11b. .

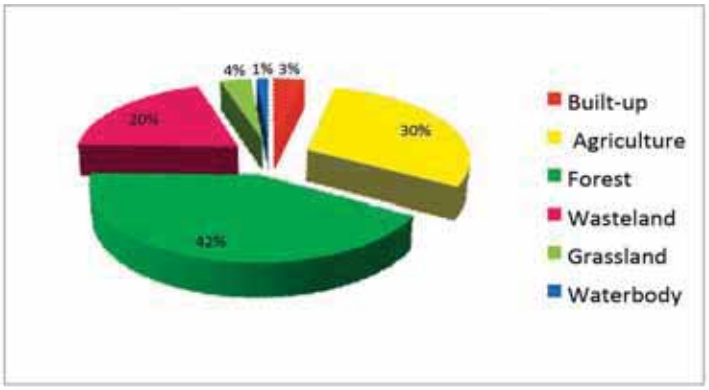


Fig.11a. Percentage area under different major land use categories in Solan district, 2005-06.

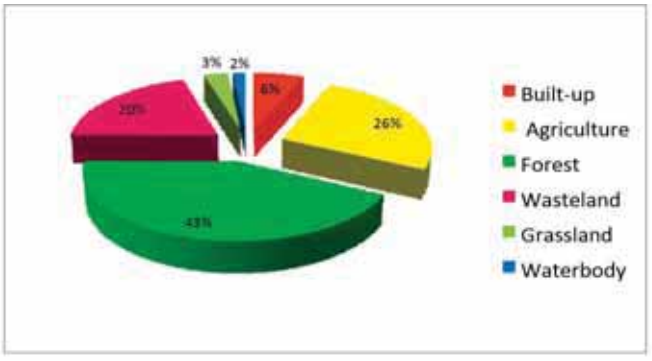


Fig. 11b. Percentage area under different major land use categories in Solan district, 2015-16.

9.12 Land use/ Land cover, Una district

Agriculture is the largest land use class accounting 37.59% of the district. Two-crop area is the dominant land use covering the entire district. The flat valleys of Una district are under intense agriculture activity. The inundated areas along the Soan river are being reclaimed for raising crops, there are also found remnant patches of permanently marshy and waterlogged area classed as inland wetland in the present study.

Due to very hot and dry climate in the surrounding hills, large area is observed under dense and open scrubland wasteland category. Among the scrubs, khair, acacia and ziziphus are the principal species. Areas under gullied/ ravenous land were also mapped in the north-eastern part of Una and Amb Tehsil. The total area under wasteland is 35.86%.The district has numerous dry seasonal streams running down from surrounding hills and contributing to the flood in the valley bed during the monsoon season.

Among the forests, deciduous forest is the dominant category. The largest area was observed under Forest-Deciduous (Dry/Moist/Thorn)-Open category, followed by Forest Deciduous (Dry/Moist/Thorn) - Dense/Closed and Forest- Scrub Forest. Total forest area in the district is 15.73%

Water body area in the district is that represented by the lower reaches of the Govind Sagar reservoir along the Siwalik ranges and comprises of 6.34 area of the district. Built up area comprising of the town of Una, Amb and other industrial area in the district and accounts for 4.17%. Grassland area in the district is only 0.30% of the total geographical area of the district. The percentage of area under different land use land cover categories for the year 2005-2006 and 2015-2016 are illustrated in Figure 12a & Figure12b.

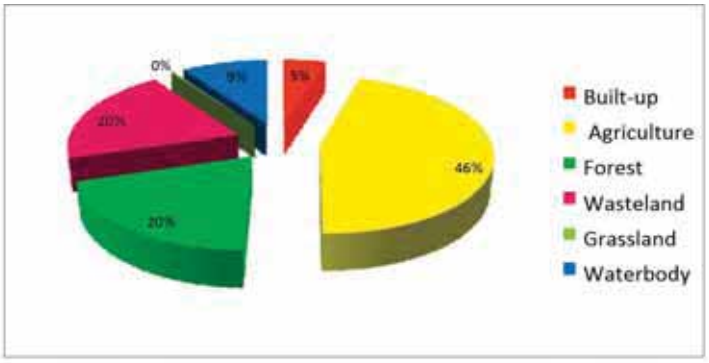


Fig. 12a. Percentage area under different major land use categories in Una district, 2005-06.

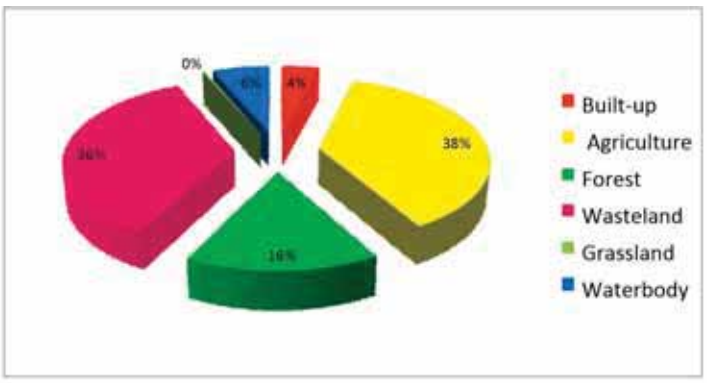


Fig. 12b. Percentage area under different major land use categories in Una district,2015-16.

9.13 Comparative evaluation of land use land cover change between the year 2005-06 and year 2015-16:-

9.14 AGRICULTURE

Based on the satellite data interpretation, the status of Land Use and Land Cover in the state of Himachal Pradesh between the year 2005-2006 and year 2015-2016 that is over a period of a decade the agriculture area has decreased by approximately 3%. District wise the trend shows that there is a decrease in agriculture area by 20% in Lahul and Spiti, 12% in Solan, 11% in Simour and Kinnaur, 10% in Hamirpur, 8% in Mandi, 6% in Kullu, 3% in Bilaspur, 1% in Chamba and Una, 0.5% in Kangra. The above state of the statistics indicate that agriculture area is under pressure for converting the agriculture area into built up area as it is evident from the built up statistics based on satellite data interpretation. Though agro- horticulture activities has increased in Shimla district by 9% from the wasteland area.

9.15 FOREST

Overall the Forest area in the State has increased by 5%. However district wise the statistics varies, there is increase in forest area of about 10% in Mandi, 2% in Solan and Chamba, 7% in Simour, Bilaspur, 5% in Lahul and Spiti, 0.9% in Hamirpur. The statistics indicates that the forest are in the state in not under stress, the increase in forest area is due to the ongoing forest developmental activities in the state by the state forest department. Though there is a marginal decrease in forest area by 1% in Una, 3% in Shimla, 2% in Kullu and Kinnaur, and 4% in Kangra district.

9.16 WASTELAND

Wasteland has decreased considerably by approximately 45% in the State. District wise there is a decrease of 35% wasteland area in Mandi, 22% in Chamba, 9% in Shimla, 3% in Bilaspur. This decrease could be contributed to the ongoing watershed developmental activities by various state departments organisation. There is increase in wasteland area by 53% in Lahul and Spiti, 36% in Kangra, However, large increase in wasteland along the slow line in Kullu and Kinnaur is because of the decrease in snow cover area as represented by the statistics on snow cover area as represented by satellite image interpretation. There is also increase in wasteland area by 9% in Sirmaur, 4% in Hamirpur and 3% in Solan and Una district along the Shiwalik hill ranges.

9.17 Grassland/Alpine Pastures

Grassland has decreased in the state by approximately 26%. Grassland has decreased by 65% in Bilaspur, 36% in Kangra, 16% in Simour,13% in Solan districts and Apline pasture has decreased by 48% in Kinnaur, Lahul and Spiti and by 13% in district Chamba. On the other hand grassland has increased by 79% in Shimla, 62% in Kullu, 49% in Una and 1% in Hamirpur districts a considerable area under this category in Mandi district is due to receeding of snowlines. This change may be attributed to the asymmetrical climate change scenario in the state.

9.18 Waterbody

Waterbody in the state has increased in the State by about 4%. It has increased by 18% in Bilaspur and Hamirpur, 17% in Mandi, 16% in Solan, 10% in Lahul and Spiti, 8% in Shimla and Sirmour, 6% in Kullu, 0.3 % in Chamba and 0.2 % in Kangra districts. The present status of the distribution of the water bodies in the state is the result of the creation of the water bodies due to the construction of hydro water projects along the major river valleys.

9.19 Built-up

Built-up area in the state has increased marginally by 1%. District wise there is an increase of 79% built up area in Solan, 37% in Lahul &Spiti, 34% in Hamirpur, 21 % in Chamba and Sirmour, 16% in Kullu, 13% in Kinnaur, 7% in Una, 1% in Kangra, Shimla and Mandi and 0.3% in Bilaspur districts. The above statistics reveals that the built up has been carved out of the existing agriculture area in the state, thereby indicating that there is a lot of pressure in the existing agriculture land.

NATURAL DISASTER

CHAPTER-10

NATURAL AND CLIMATE INDUCED HAZARDS

Himachal Pradesh a small hilly state forms a part of the Northwestern Himalaya are the youngest mountain chains in the world and are still active and are in the building phase. The environmentally fragile and ecologically vulnerable Himalayan part has rendered the state highly vulnerable and sensitive from the natural disaster point of view. Physiographically the state has been divided into three broad units viz. Lower or Outer Himalaya, Middle Himalaya and the Higher or Great Himalaya and each unit is susceptible to different types of hazards depending upon the lithological, soils and local climatic variations. Himachal Pradesh was formed as a Union Territory in 1948, after amalgamation of 31 erstwhile princely states and attained full statehood on 25th January 1971. Administratively the State comprises of 12 Districts, 75 Tehsils and 34 Sub-Tehsil with a total geographical area of 55,673 km^2. The State also shows considerable variations in the distribution of rainfall and temperature due to the varying aspects and altitudes. Precipitation declines from west to east and south to north. The average annual rainfall is about 1111mm, varying from about 450 mm in Lahaul & Spiti to over 3400 mm in Dharamshala, the district headquarter of Kangra. About 70% of precipitation is received from July to September. Winter precipitation in the form of snow is received at elevation above 1800 m.

10.1 Introduction

Natural hazards or the hazards are the events that take place in nature that cause harm. The word "natural" is used to note that the disaster is caused by nature. Some examples of natural hazards are: earthquakes, hurricanes, sinkholes, hail storms, wildfires, and the like. It might also be helpful to keep in mind that one natural hazard can lead to another. For example, an earthquake can cause a tsunami. Natural disasters are slightly different. They are the effects of natural hazards on humanity. For example, the tsunami in Indonesia caused a great amount of loss of property and more importantly lives. The earthquake and tsunami in Japan also caused loss of property and lives, as well as nuclear fallout. Vulnerability is a process which results in an understanding of the types and levels of exposure of persons, property, and the environment to the effects of identified hazards at a particular time.

10.2 OVERVIEW OF DISASTERS

Before Independence, droughts and famines were the biggest killers in India. The situation stand somewhat altered today, wherein it is combination of factors like increased irrigation development, improved water management and food security measures have reduced the deaths caused by droughts and famines considerably. Floods, cyclones, and earthquakes dominate (98%) the reported injuries, with ever increasing in the last ten years. The period from 1973 to 1997 has been associated with a large number of earthquakes in Asia that have a relatively high injury-to-death ratio. Floods droughts, cyclones, earthquakes, landslides and avalanches are some of the major natural disasters that repeatedly and increasingly affect India. The fast pace of growth and expansion without comprehensive understanding or preparedness has brought forth a range of issues that seek urgent attention at all levels. In the absence of such measures, the growing numbers in our population are at risk of prospective hazards such as air accidents, rail accidents, road accidents, boat capsizing, building collapse, electric fires, festival related disasters, oil spills, serial bomb blasts, and fires. The safeguards within the existing system are limited and the risk involved is high.

10.3 VULNERABILITY PROFILE

Vulnerability is defined as "the extent to which a community, structure, service or geographical area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster prone area." The concept of vulnerability therefore leads to calculation of risk. Risk management would therefore mean the level of social and economic ability to cope with resulting event in order to resist major disruption or loss. This susceptibility and vulnerability to each type of threat will depend on its respective differing characteristics. With such an understanding, vulnerability was examined by the High Powered Committee on physical as well as socio –economic parameters.

The HPC, which was constituted in August 1997 under the Chairmanship of Sh.J.C.Pant. HPC members were drawn from the Ministries, States, NGOs and experts from relevant fields. It was the first attempt in India towards evolving a systematic, comprehensive and holistic approach towards all disasters. The original mandate of the HPC was confined to the preparation of management plans for natural disasters only. However, it was expanded to include man-made disasters as well in order to develop an effective plan of action that would encompass disasters of all origins and shades. The Terms of Reference of the HPC were subsequently enlarged to include man- made disasters also with the approval of Prime Minister of India. Representation from concerned Ministries dealing with industrial, nuclear, biological, chemical disasters were ensured by way of inclusion of experts from these Ministries.

The HPC thus constituted five sub-groups to go into detailsof five major classifications as decided by the HPC.

SUB GROUP I - WATER AND CLIMATE RELATED HAZARDS

(a) Floods and drainage management
(b) Cyclones, tornadoes, Hurricanes
(c) Hailstorms, cloud bursts, Snow Avalanches, Heat and Clod Waves Thunder & Lightening
(d) Sea Erosion
(e) Droughts

SUB GROUP - II - GEOLOGICALLY RELATED HAZARDS

(a) Earthquakes
(b) Landslide, Mudflows
(c) Soil Erosion
(d) Dam Bursts and Dam Failures
(e) Mine Fires

SUB GROUP-III - CHEMICAL, INDUSTRIAL AND NUCLEAR RELATED DISASTERS

(a) Chemical and Industrial Disasters
(b) Nuclear Disasters

SUB GROUP -IV ACCIDENT RELATED DISASTERS

(a) Road, Rail and other transportation accidents including Waterways.
(b) Mine Flooding
(c) Major Building Collapse
(d) Serial Bomb Blasts
(e) Festival related Disasters
(f) Urban Fires
(g) Oil Spill
(h) Village Fires
(i) Boat Capsizing
(j) Forest Fires
(k) Electrical Disasters and Fires

SUB GROUP-V BIOLOGICALLY RELATED DISASTERS

(a) Biological Disasters
(b) Food Poisoning
(c) Cattle Epidemics/Pest Attacks

On the similar guidelines, the Government of Himachal Pradesh formulated a State Level Disaster Management Committee under the Chairmanship of Chief Secretary to take stock of the disaster situation in the state and monitor and administer the State Disaster Management Plan in Himachal Pradesh. Government also constituted five sub- groups as per the guidelines framed by the HPC of the Govt.of India. Sub-group –II was entrusted to deal with the Geologically Related Hazards in the state. F.C.-cum-Secretary (Science & Technology) was made the convenor of this sub-group. The other members of the group are as under:

1. Secretary (MPP)
2. Secretary (PWD)
3. Secretary (Planning)
4. State Geologist
5. Director General of Police
6. Commandant Deepak Project
7. Commandant ITBP
8. Representative BBMB
9. Member Secretary (S&T)

10.4 HAZARD PROFILE AT THE NATIONAL LEVEL

India has been vulnerable, in varying degrees, to a large number of natural, as well as man-made human-made disasters on account of its unique geo-climatic and socio-economic conditions. It is highly vulnerable to floods, droughts, cyclones, earthquakes, landslides, avalanches and forest fires. Out of 36states and union territories in the country, 27 of them are disaster prone. Almost 58.6 per cent of the landmass is prone to earthquakes of moderate to very high intensity; over 40 million hectares (12 per cent of land) are prone to floods and river erosion; of the 7,516 km long coastline, close to 5,700 km is prone to cyclones and tsunamis; 68 per cent of the cultivable area is vulnerable to drought and hilly areas are at risk from landslides and avalanches. A multi-hazard map of India is given in Map:1.4.

(a) India is one of the ten most disaster prone countries of the world. The country is prone to disasters due to a number of factors; both natural and human induced, including adverse Geo-climatic conditions, topographic features, environmental degradation, population growth, urbanization, industrialization, non-scientific development practices, etc. The factors, accelerating the intensity and frequency of disasters are responsible for heavy toll of human lives and disrupting the life support system in the country. As far as the vulnerability to

disaster is concerned, the five distinctive regions of the country i.e. Himalayan region, the alluvial plains, the hilly part of the peninsula, and the coastal zone have their own specific problems. While on one hand the Himalayan region is prone to disasters like earthquakes and landslides, the plain is affected by floods almost every year. The desert part of the country is affected by droughts and fa mine while the coastal zone susceptible to cyclones and storms.

(b) The natural geological setting of the country is the primary basic reason for its increased vulnerability. The geo-tectonic features of the Himalayan region and adjacent alluvial plains make the region susceptible to earthquakes, landslides, water erosion, etc. Though peninsular India is considered to be the most stable portions, but occasional earthquakes in the region shows that geo-tectonic movements are still going on within its depth.

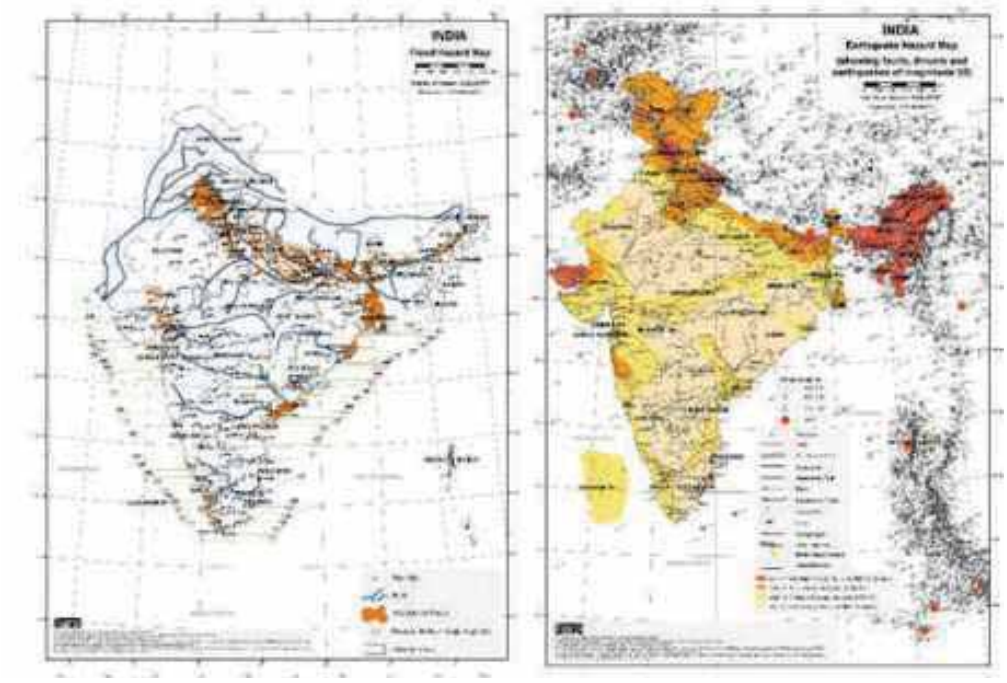
(c) The tectonic features, characteristics of the Himalaya are prevalent in the alluvial plains of Indus, Ganga and Brahmaputra too, as the rocks lying below the alluvial pains are just extension of the Himalayan ranges only. Thus this region is also quite prone to seismic activities. As a result of various major river systems flowing from Himalaya and huge quantity of sediment brought by them, the area is also suffering from river channel siltation, resulting into frequent floods, especially in the plains of Uttar Pradesh and Bihar.

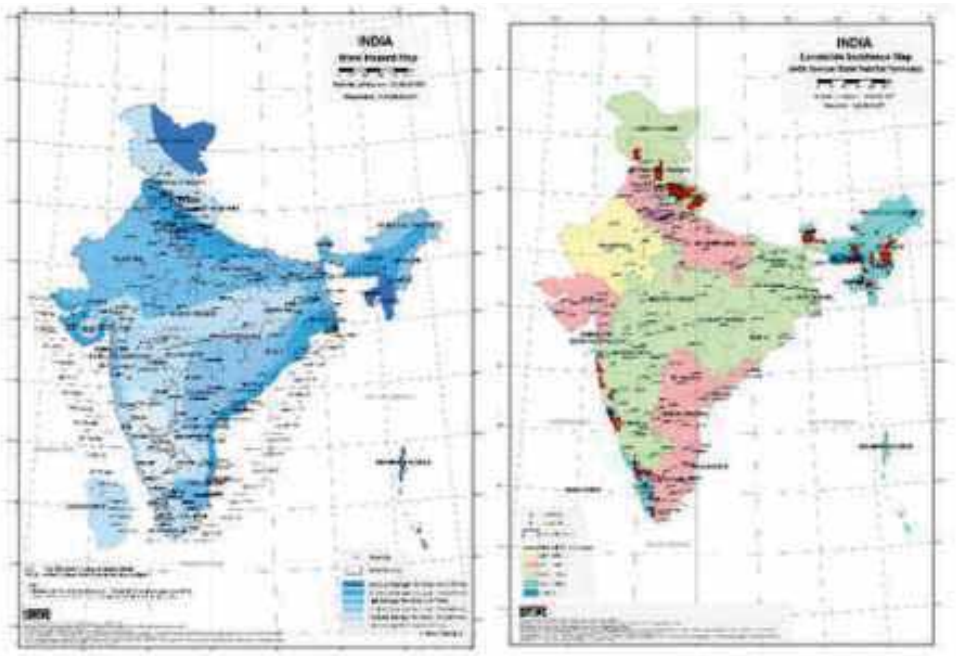
(d) The western part of the country, including Rajasthan, Gujarat and some parts of Maharashtra are hit veryfrequently by drought situation. If Monsoon worsens the situation spreads in other parts of the country too. The disturbance in the pressure conditions over oceans, results into cyclones in coastal regions. The Geo-tectonic movements going on in the ocean floor make the coastal region prone to tsunami disaster too.

(e) The extreme weather conditions, huge quantity of ice and snow stored in the glaciers, etc. are other natural factors which make the country prone to various forms of disasters.

(f) Along with the natural factors discussed in the preceding text, various human induced activities like increasing demographic pressure, deteriorating environmental conditions, deforestation, unscientific development, faulty agricultural practices and grazing, unplanned urbanisation, construction of large dams on river channels etc. are also responsible for accelerated impact and increase in frequency of disasters in the country.

MULTI-HAZARDMAPOFINDIA

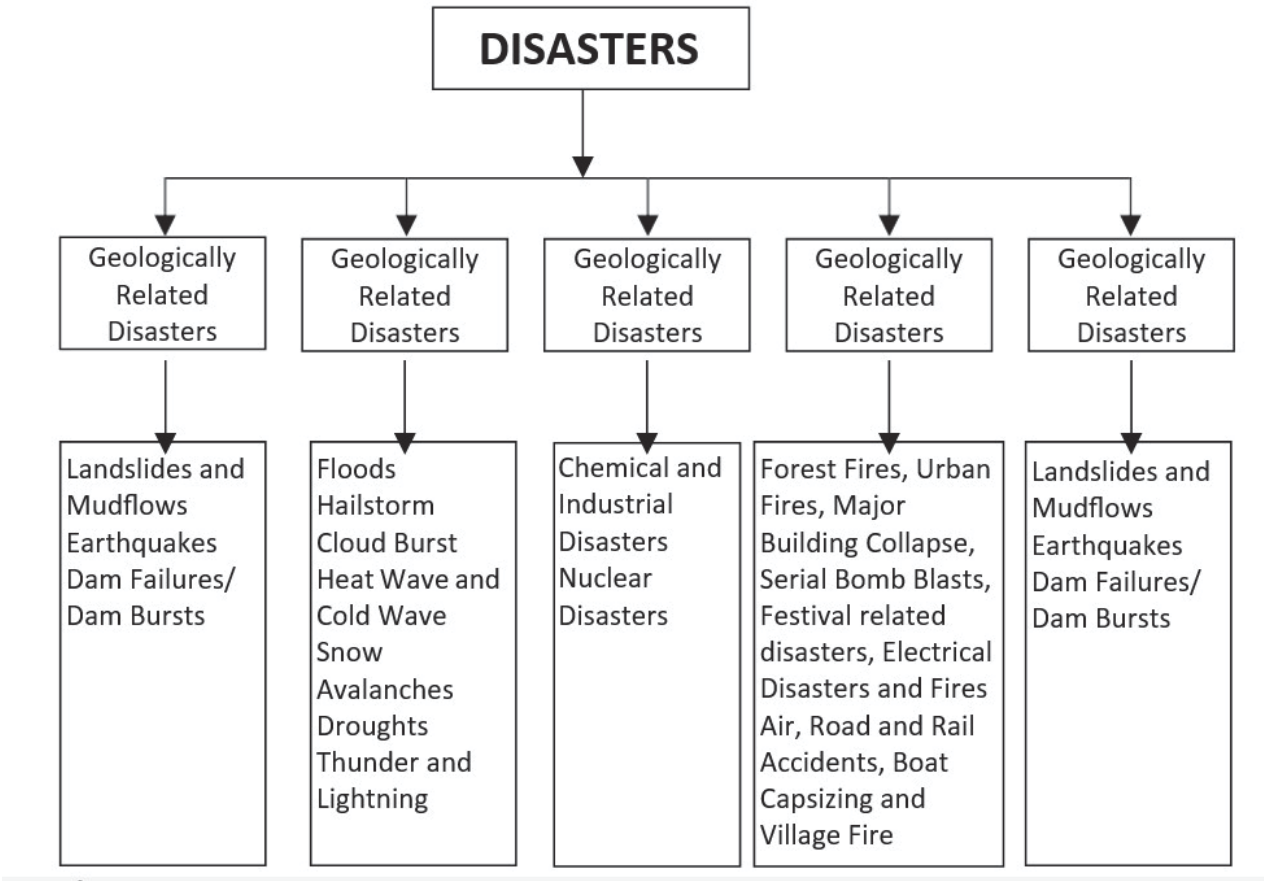




Source: Hazard Maps (BMTPC)

10.4 DISASTER PROFILE OF HIMACHAL PRADESH

Mountain areas are highly vulnerable to natural disasters where development over the years has compounded the problem by upsetting the natural balance of various physical processes. The increased pressure on the mountain environment has contributed in some measure to environmental problems such as landslides, land subsidence, removal of vegetation and soil erosion. According to one estimate, about 58.36% of the land is subjected to intense soil erosion, majority of which is located in the Himalaya. The State of Himachal Pradesh, which forms part of the Western Himalaya, is environmentally fragile and ecologically vulnerable. Geologically the Himalaya is considered to be the youngest mountain chains in the world and is still in the building phase. Natural hazards are matter of immediate concern to the State of Himachal Pradesh, as every year the State experiences the fury of nature in various forms like landslides, cloud bursts, flash floods, snow avalanches and droughts etc. The fragile ecology of the mountain state coupled with large variations in physio-climatic conditions has rendered it vulnerable to the vagaries of nature. The incidence of cloudbursts in the last few years has been unprecedented. Notwithstanding, the continuous efforts made by the Government to cope with natural hazards through relief and rehabilitation measures, landslides and snow avalanches continue to inflict widespread harm and damage to human life as well as property. The roads that Government to cope with natural hazards through relief and rehabilitation measures, landslides and snow avalanches continue to inflict widespread harm and damage to human life as well as property. The roads that are the State's lifeline are repeatedly damaged, blocked or washed away by one or other acts of nature. In the circumstances, the Government has to divert the already scarce resources of the state for relief and rehabilitation measures. Himachal Pradesh is vulnerable to 25 out of 33 types of hazards identified by the High Powered Committee (HPC) of Government of India and categorised into 5 sub-groups. Apart from identified hazards by HPC, the state is also confronting the emerging threats of climate change and man and animal conflict. Some of the identified hazards or prognostic hazards in Himachal Pradesh are as under:



10.6 Potential Hazard Threat to the State:-

10.6.1 District Wise Hazard Vulnerability Of The State:

An attempt was made to develop a vulnerability matrix for the state as a whole. Qualitative weightage was given in the scale of 0-5 for different hazards such as earthquakes, landslides, avalanches, industrial hazards, construction type and density of population. District wise matrix was prepared by evaluating the risk severity. The evaluation also gives weightage to the density of population likely to be affected. The matrix also includes the evaluation of hazards likely to be induced on account of development of projects such as hydel projects, roads, industries etc. In case of earthquake vulnerability, the districts Kangra, Hamirpur and Mandi fall in very high vulnerable category on the basis of the matrix devised. The districts which fall in high earthquake vulnerability are Chamba, Kullu Kinnaur and part of Kangra and Shimla districts, whereas the moderate and low vulnerable districts are Una, Bilaspur, Sirmour and Solan, Shimla and Lahaul & Spiti districts respectively. The landslide vulnerability in case of Chamba, Kullu, Kinnaur and part of Kangra and Shimla districts is high followed by Kangra, Mandi, Bilaspur, Shimla,Sirmour and Lahaul & Spiti districts fallin moderate vulnerable category. The areas falling in low vulnerable category are in the districts of Una, Hamirpur and Solan. The avalanche hazard vulnerability map suggest that the districts of Lahaul & Spiti and Kinnuar are very high vulnerable followed by Chamba, Kullu and part of Kangra and Shimla as moderate vulnerable areas where as the remaining districts fallin the category where avalanche hazard is nil. The flood hazard vulnerability map indicates that the areas fall in the districts of Chamba, Kullu ,Una and Kinnaur fall in high vulnerable districts where as the Lahaul & Spiti, Mandi, Shimla, Kangra,Hamirpur, Bilaspur, Solan and Sirmour fall in moderate and low vulnerability areas. The overall vulnerability of the State on the basis of the matrix clearly suggests that the district Chamba, Kinnuar Kullu and part of Kangra and Shimla fall in very high vulnerable risk. Similarly district

Kangra, Mandi, Una, Shimla and Lahaul and Spiti fall in high vulnerable risk status. The district Hamirpur, Bilaspur, Solan and Sirmour fall in moderate vulnerable risk status. The disaster management strategies and infrastructure required to be evolved by taking these factors into consideration.

DISTRICT WISE HAZARD THREAT IN HIMACHAL PRADESH

DISTRICT	EARTHQUAKE	LANDSLIDE	FLOODS	AVALANCHES	INDUSTRIAL	OVERALL VULNEABILITY
Kangra	VH	M	L	-----	M	H
Chamba	H	H	H	M	M	VH
Hamirpur	VH	L	L	-----	-----	M
Mandi	VH	M	M	-----	-----	H
Kullu	H	H	H	M	H	VH
Bilaspur	M	M	L	------	M	M
Una	M	L	H	------	H	H
Sirmaur	M	M	L	-------	H	M
Solan	L	L	L	-------	H	M
Kinnaur	H	H	H	VH	H	VH
L&Spiti	L	M	M	VH	-------	H
Shimla	L	M	M	--------	H	H

VH: Very High, H: High, M: Moderate, L: Low
Source : State Council for Science Technology & Environment

Fig.-----: Construction Vulnerability

Fig.----: Industrial Vulnerability

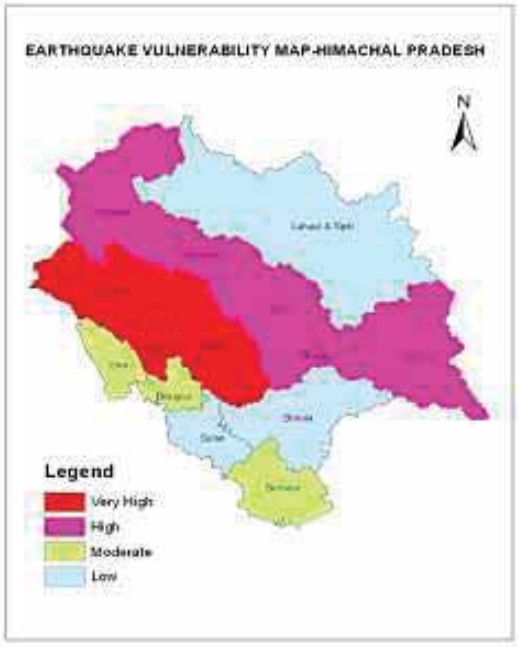


Fig.-----: Earthquake Vulnerability

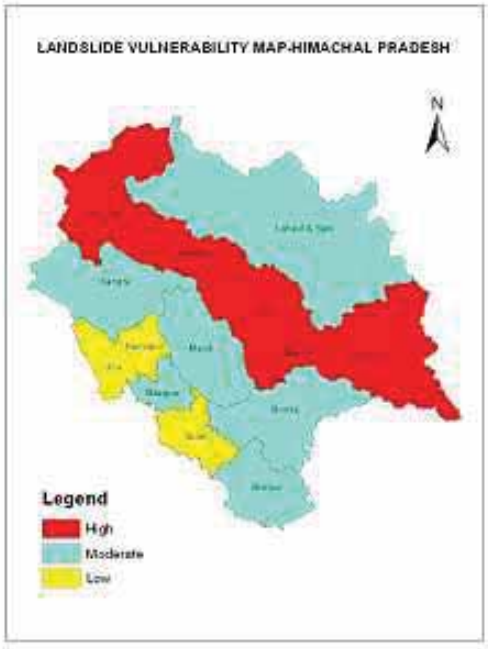
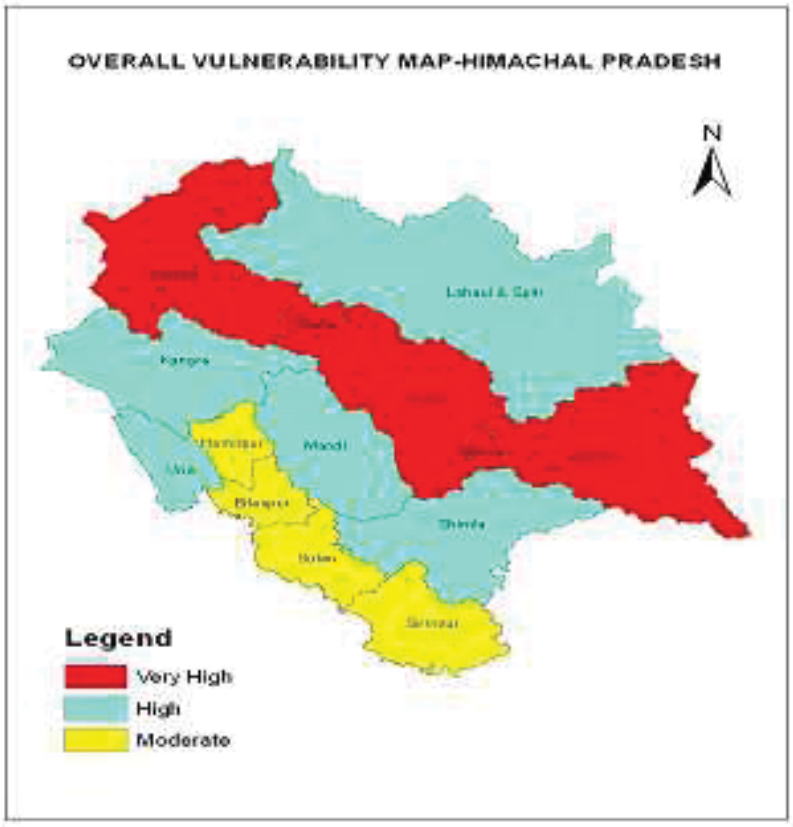


Fig.----: landslide Vulnerability

Fig.-----: Avalanche Vulnerability

Fig.----: Flood Vulnerability



10.7 PROMINENT NATURAL DISASTERS IN THE STATE

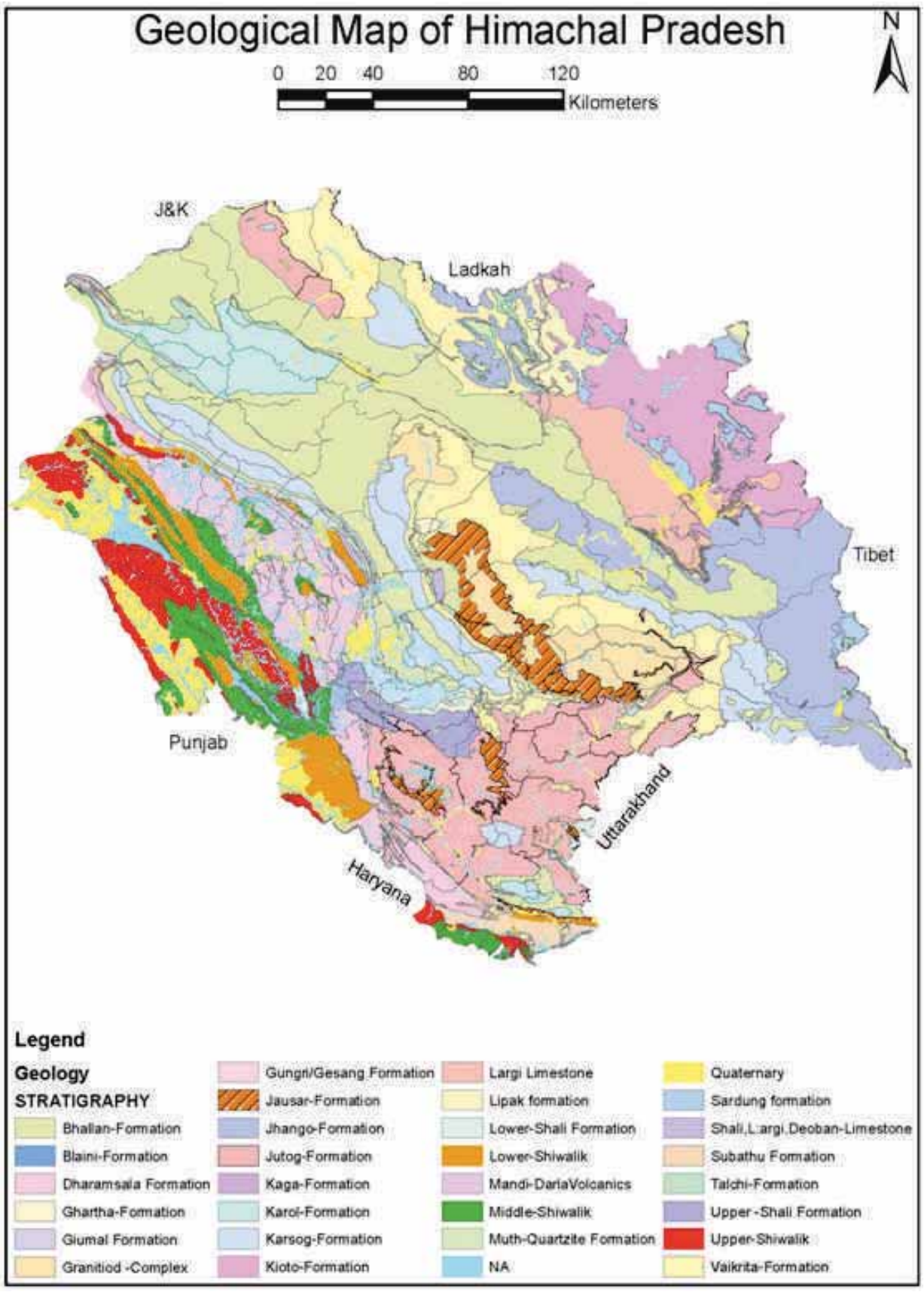
10.7.1 GEOLOGICAL DISASTERS:

Himachal Pradesh is characterised by diverse lithological variations ranging in age from Pre Cambrian to the Holocene-Recent (Map:1.6). The Himalayas are the youngest mountain chains in the world and are considered seismically very active. Thus the state from the seismicity point of view can be considered as most sensitive and its most of the area falls in the zone V and IV as per the seismic zoning map of India).Besides the hazards from earthquakes, the State is also vulnerable forthe other geological hazards like landslides and avalanches.

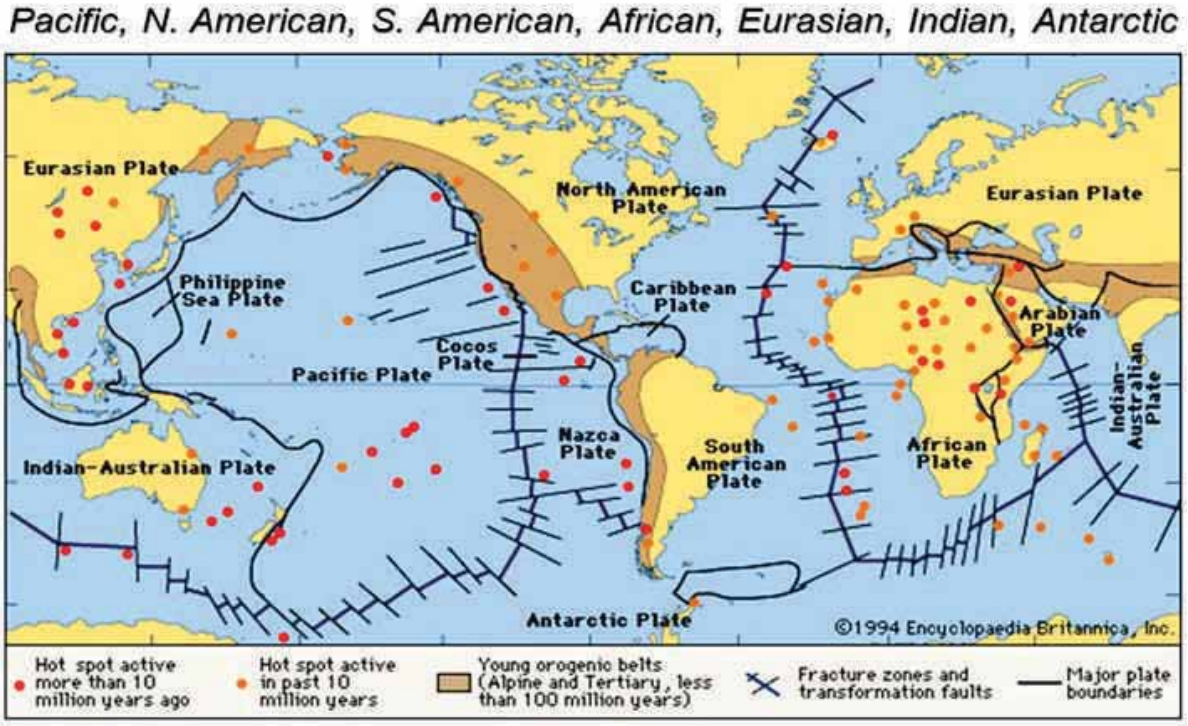
10.7.1.1 EARTHQUAKES

An earthquake (also known as a quake, tremor or temblor) is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's lithosphere that creates seismic waves. Most earthquakes occur along the edge of the oceanic and continental plates. The earth's crust (the outer layer of the planet) is made up of several pieces, called plates Map. The plates under the oceans are called oceanic plates and the rest are continental plates. Earthquakes are the greatest threat to the Himalayas. Almost all of the Himalayas are under great danger of the seismic activity or the earthquakes. The reverse fault is involved in this boundary because the plates are converging or coming toward each other. As the Indian Plate is pushing against the Eurasian Plate, the stress is building up and there have been many earthquakes in this region as a result of that and there are still more to come. Earthquakes are basically thought to have been caused by stress. The stress causes the crust to bend. Suddenly when the bond brakes, the crust that had been bends recovers or returns

to its original position. This is called the Elastic Rebound Theory. Elastic Rebound Theory is what has thought to cause most of the earthquakes that we experience today.



GeologicalMap of Himachal Pradesh (compiled based on published Literature by HIMCOSTE)



Major plates of Earth's Crust (Source: Plate Tectonics: Plate Boundaries by Kory Black)

The Indian subcontinent has a history of devastating earthquakes (Table). The major reason for the high frequency and intensity of the earthquakes is that the Indian plate is driving into Eurasian Plate at a rate of approximately 47 mm/year(Map:). Geographical statistics of India show that almost 54% of the land is vulnerable to earthquakes. A World Bank and United Nations report shows estimates that around 200 million city dwellers in India will be exposed to storms and earthquakes by 2050. The latest version of seismic zoning map of India given in the earthquake resistant design code of India [IS 1893 (Part 1) 2002] assigns four levels of seismicity for India in terms of zone factors. In other words, the earthquake zoning map of India divides India into 4 seismic zones (Zone 2, 3, 4 and 5) unlike its previous version, which consisted of five or six zones for the country (Map). According to the present zoning map, Zone 5 expects the highest level of seismicity whereas Zone 2 is associated with the lowest level of seismicity. The tectonic activity in India is mainly confined to Himalayan region, Indo-Gangetic plains, Andaman Nicobar Island, Western India, Kutch and Kathiawar regions which are geologically unstable parts of the country and some devastating earthquakes of the world have occurred there. A major part of the peninsular India has also been affected by strong earthquakes, but these relatively few in number and had considerably lesser intensity. Some of the major known damaging earthquakes in India are as under:

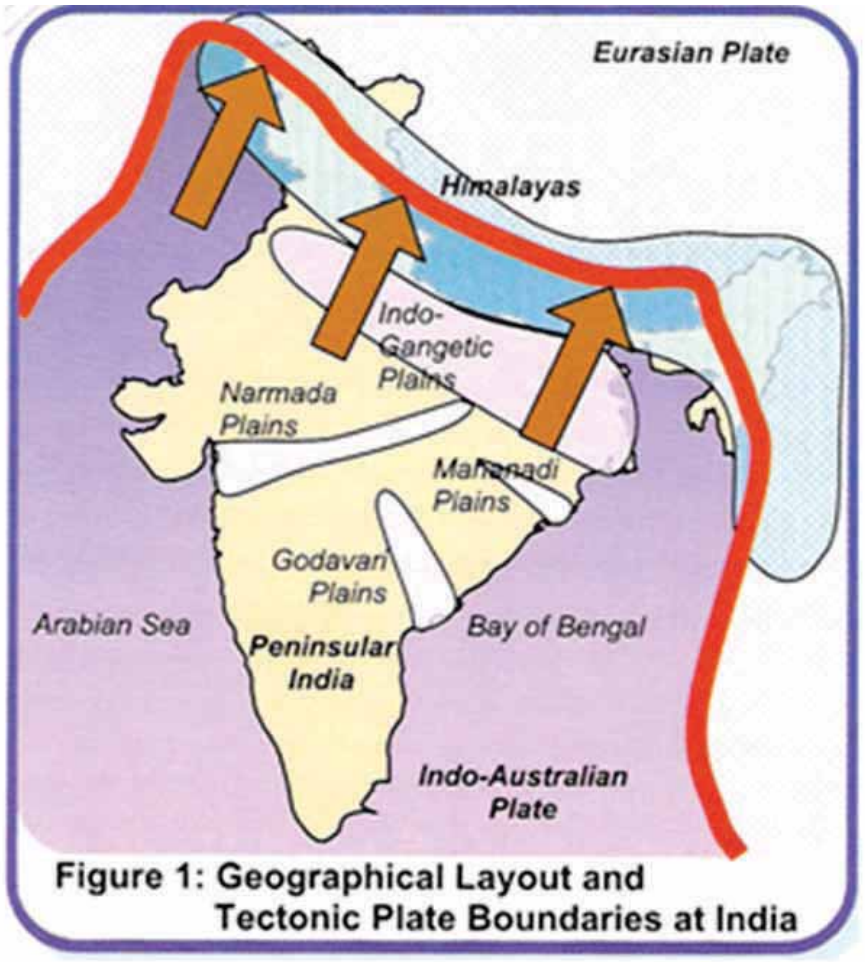


Figure 1: Geographical Layout and Tectonic Plate Boundaries at India

Geographical Layout and Tectonic Plate Boundaries at India

Known damaging Earthquakes in India

Year	Area	Date	(IST) Time hr:m:s	Latitude Degrees North	Longitude Degrees East	Magnitude M	Max MM Int.	Deaths
1819	Gujarat (Kutch)	Jan 16	Mid Night	-	-	8	XI	Many Thousands
1833	Bihar	Aug 26	-	27.5	86.5	7.7	XI	Hundreds
1897	Assam(Shillong)	June 12	16:36	25	92	8.7	XII	1600
1900	Kerala(Palghat)	Feb8	-	10.7	76.7	6	-	-
1905	Himachal Pradesh (Kangra)	Apr 4	6:20	32.5	76.5	8	XI	20,000

Year	Area	Date	(IST) Time hr:m:s	Latitude Degrees North	Longitude Degrees East	Magni tude M	Max MM Int.	Deaths
1819	Gujarat (Kutch)	Jan 16	Mid Night	-	-	8	XI	Many Thousands
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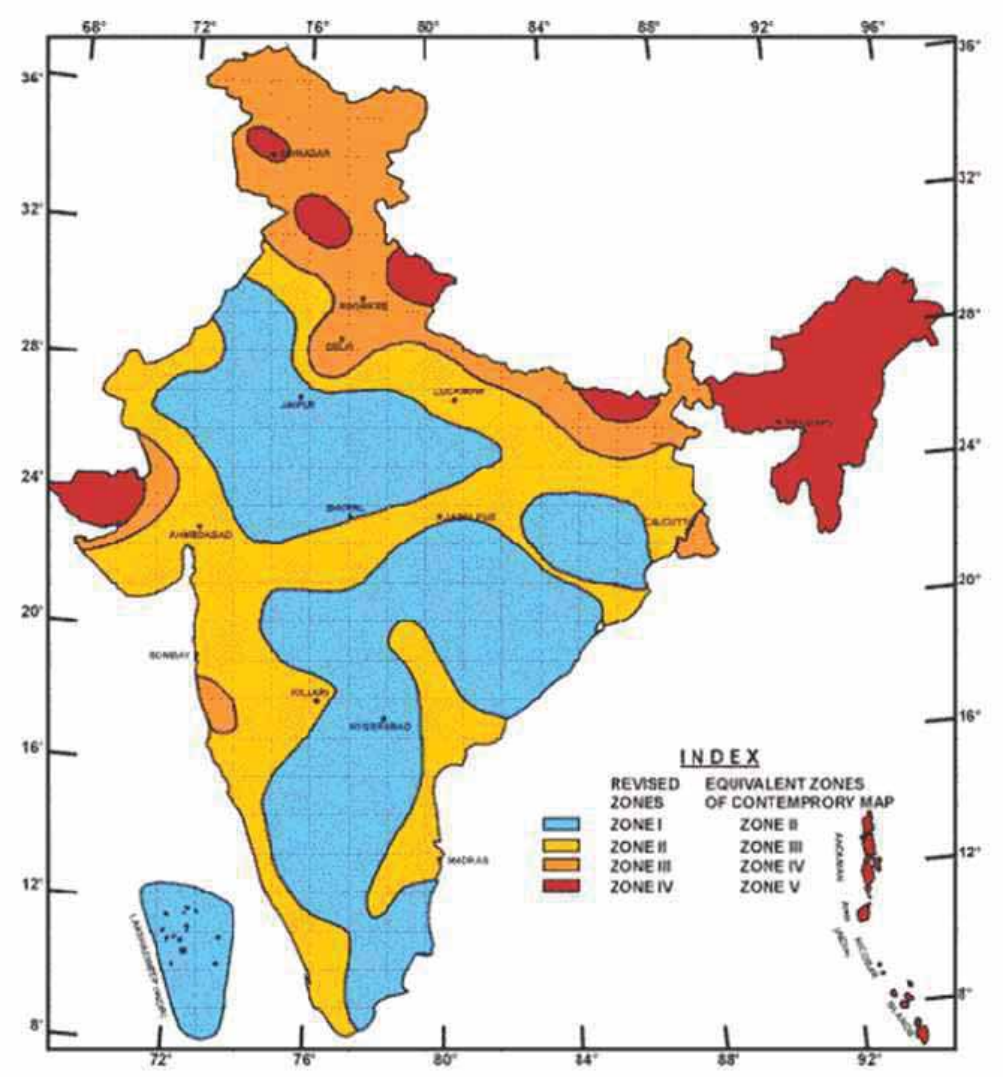
1897	Assam(Shillong)	June 12	16:36	25	92	8.7	XII	1600
1900	Kerala(Palghat)	Feb8	-	10.7	76.7	6	-	-
1905	Himachal Pradesh (Kangra)	Apr 4	6:20	32.5	76.5	8	XI	20,000
1930	Assam (Dugri)	July 3	2:33:34	25.8	90.2	7.1	IX	Many
1934	Bihar-Nepal	Jan 15	14:13:26	26.6	86.6	8.3	XI	14,000
1941	Andeman	June 26	-	12.4	92.5	8	X	Many
1943	Assam(NE)	Oct 23	22:53:17	26.8	94	7.2	X	-
1950	Assam (NE)	Aug 15	19:39:28	28.7	96.6	8.6	XII	1500
1956	Gujarat(Anjar)	July21	21:02:36	23.3	70	7	VIII	Hundreds
1956	Utter Pradesh (Bullendsehar)	Oct 10	-	28.1	77.7	6.7	VIII	Many
1958	UtterPradesh (Kapkote)	Dec28	-	30	80	6.3	VII	Many
1960	Delhi	Aug27	21:28:59	28.3	77.4	6	VII	-
1963	Kashmir(Baragaon)	Sept 2	07:04:32	33.9	74.7	5.5	VIII	Hundreds
1966	Western Nepal	June 27	-	29.5	81	6.3	VII	-
1966	Utter Pradesh (M.bad)	Aug 15	-	28	79	5.3	-	-
1967	Nicobar	July 2	-	9	93.4	6.2	VIII	-
1967	Maharastra (Koyana)	Dec 11	04:21:19	17.4	73.7	6.5	VII	200
1970	Andhra Pradesh(Bhadrache lam)	April13	-	17.6	80.6	6.5	VII	-

Year	Area	Date	(IST) Time hr:m:s	Latitude Degrees North	Longitude Degrees East	Magni tude M	Max MM Int.	Deaths
1970	Gujarat(Baroch)	Mar 23	07:23:03	21.7	72.9	5.7	VIII	-
1975	Himachal Pradesh	Jan19	-	32.5	78.4	6.5	VIII	-
1988	Bihar-Nepal	Aug 21	04:39:10	26.76	86.62	6.6	VIII	1003
1991	Utter Pradesh(Uttra kashi)	Oct 20	02:53	30.75	78.86	6.6	VIII	415
1993	Maharastra (Killari)	Sept 30	03:55:47	18.07	76.62	6.3	VIII	7928
1997	Jabalpur	May 22	04:22:31	23.1	80.1	6	VII+	38
2001	Gujarat(Bhuj)	Jan26	08:45			7.2		20,000



Seismic Zonation Map of India (As per Bureau of Indian Standards)

10.7.1.2 CHARACTERISTIC FEATURES OF DIFFERENT SEISMIC ZONES:

ZONE 5

Zone 5 covers the areas with the highest risks zone that suffers earthquakes of intensity —MSK IX or greater. The IS code assigns zone factor of 0.36 for Zone 5. Structural designers use this factor for earthquake resistant design of structures in Zone S. The zone factor of 0.36 is indicative of effective (zero period) level earthquake in this zone. It is referred to as the Very High Damage Risk Zone. The region of Kashmir, the Western and Central Himalayas, North and Middle Bihar, the North-East Indian region, the Rann of Kutch and the Andaman and Nicobar group of islands fall in this zone.

ZONE 4

This zone is called the High Damage RiskZone and covers areas liable to MSK VIII. The IS code assigns zone factor of 0.24 for Zone 4 Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, the parts of Indo-Gangetic plains (North Punjab, Chandigarh, Western Uttar Pradesh, Terai, North Bengal, Sundarbans) and the capital of the country Delhi fall in Zone 4. In Maharashtra, the Patan area (Koynanagar) is also in zone no-4. In Bihar the northern part of the state like Raxaul, Near the border of India and Nepal, is also in zone no-4.

ZONE 3

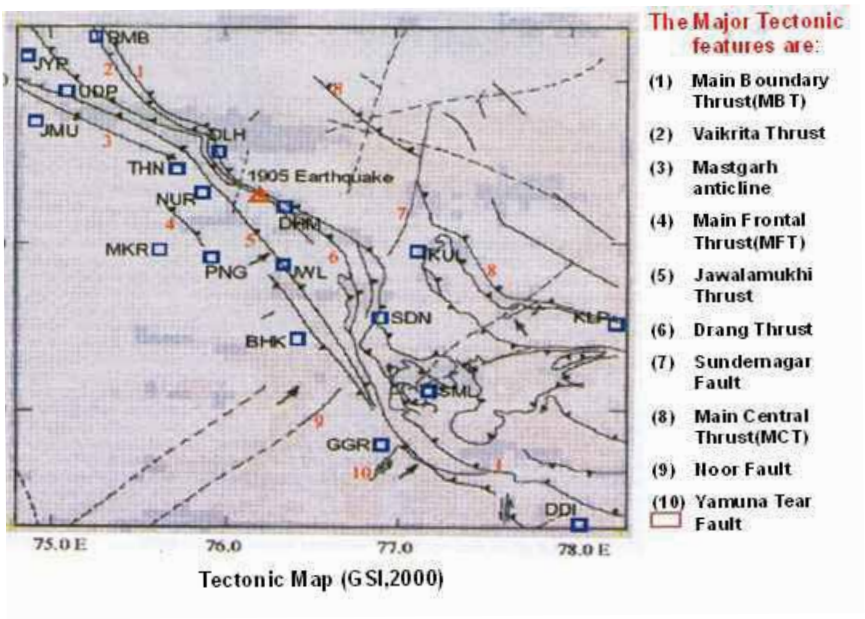
This zone is classified as Moderate Damage Risk Zone which is liable to MSK VII. and also 7.8 The IS code assigns zone factor of 0.16 for Zone 3. Several megacities like Chennai, Mumbai, Kolkata and Bhubaneshwar lie in this zone

ZONE 2

This region is liable to MSK VI or less and is classified as the Low Damage Risk Zone. The IS code assigns zone factor of 0.10 (maximum horizontal acceleration that can be experienced by a structure in this zone is 10% of gravitational acceleration) forgone 2.

10.7.1.3.SEISMICITY IN HIMACHAL HIMALAYA:

Earthquakes can be considered as one of the major natural hazards in Himachal Pradesh. The seismic activity in Himachal is closely associated with the active faults and folds that trend normal or oblique to the main Himalayan trend which leads tothe under thrusting of the blocks. The tectonic sensitivity of the State is very high, as over the years a large number of damaging earthquakes have struck the State and its adjoining areas. Due to its location, the state experiences dozens of mild earthquakes every year. Large earthquakes have occurred in all parts of Himachal Pradesh, the biggest being the Kangra earthquake of 1905. The major tectonic features exposed in the State are mainly the Himalayan Frontal Thrust (HFT), the Main Boundary Thrust (MBT), Main Central Thrust (MCT), the Krol, the Giri, Jutogh and Nahan thrusts are some of the tectonic features that are responsible for shaping the present geophysical deposition of the State (Figure). Besides these major tectonic lines, several transverse lineaments have also been observed which are responsible for causing major earthquakes of different magnitude in different parts of the State. The seismic vulnerability of Himachal Pradesh is primarily attributed to northward movement of Indian plate and to the major dislocation tectonic features such as MBF, MBT, Punjab thrust and MCT, etc. Besides the longitudinal tectonic feature trending parallel to the Himalayas there are a large number of transverse fractures, faults that have been responsible for the seismic activity in the Himalayan region ingeneral and Himachal Pradesh in particular.



Tectonic Map (GSI,2000)

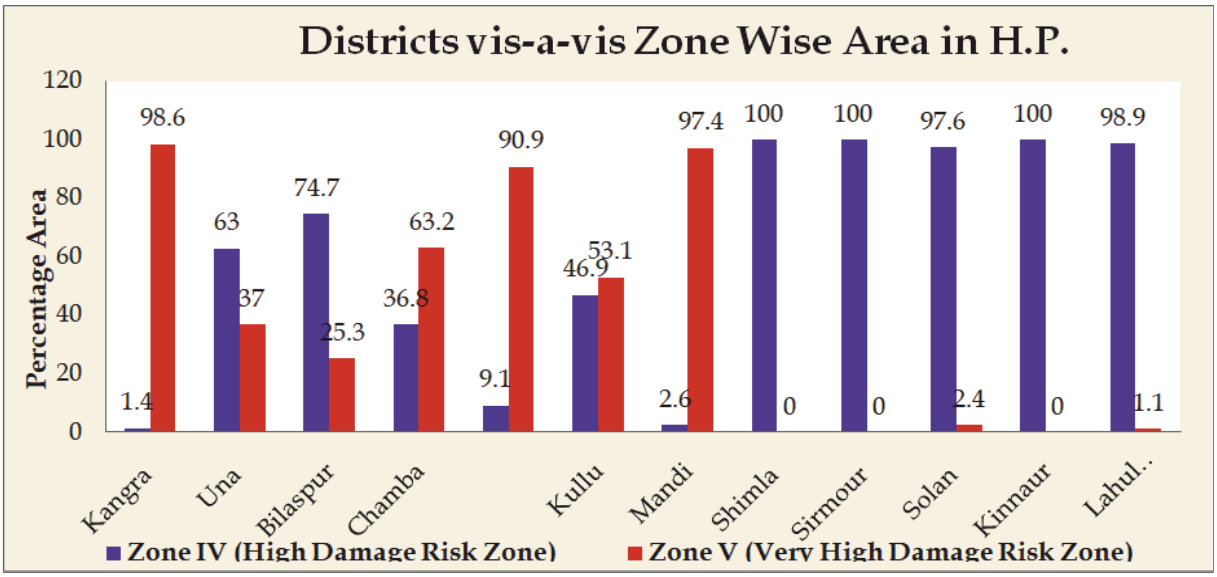
Considering the seismicity of the State, it falls in Zone V and IV as per the Seismic Map of India Zone V covers the areas which are liable to seismic intensity IX and above in Modified Mercalli Scale (MMS) and is most severe seismic zone referred to as the Very High Damage Risk Zone. Zone IV covers the areas which are liable to seismic intensity VIII and terms second in severity to zone V. It is also seen that according to the Seismic Map of India, five districts viz. Chamba (53.2%), Hamirpur(90.9%),Kangra (98.6%), Kullu (53.1%) and Mandi (97.4%) have 53 to 98.6 percent of the area liable to severest designed intensity of MSK IX or more, the remaining area of these districts being liable to the next severe intensity VIII. Two districts, Bilaspur (25.3%) and Una (37.0%) also have a substantial area in MSK IX and the rest in MSK VIII. The remaining districts Shimla, Lahaul & Spiti, Sirmour, Kinnuar, and Solan are liable to intensity VIII (Because of the large scale impact of earthquake it causes great damage to not only life but economic and social structure also. The impact of these shocking events can still be seen over the houses of these districts. The old construction practices and local material used for the buildings makes the houses here more vulnerable to earthquakes. Therefore the identification of the building types and their categorization on the basis of building type and material used is essential to mitigate the impact of such earthquakes over these areas. The housing pattern in the State and its vulnerability based on the housing census of 2011.

Districts with Seismic Intensities

Sr.No.	Name of District	Seismic Zones	Intensity MSK IX or more % Area	MSK VIII % area
1	Kangra	V/IV	98.6	1.4
2	Mandi	V/IV	97.4	2.6
3	Hamirpur	V/IV	90.9	9.1
4	Chamba	V/IV	63.2	36.8
5	Kullu	V/IV	53.1	46.9
6	Una	V/IV	37.0	63.0
7	Bilaspur	V/IV	25.3	74.7

Sr.No.	Name of District	Seismic Zones	Intensity MSK IX or more % Area	MSK VIII % area
8	Solan	V/IV	2.4	97.6
9	Lahaul & Spiti	V/IV	1.1	98.9
10	Kinnaur	V/IV	---	100
11	Shimla	V/IV	---	100
12	Sirmour	V/IV	----	100

Source : Vulnerability Atlas of Himachal Pradesh



Districts vis-à-vis zone wise area in Himachal Pradesh

Distribution of Houses by Predominant materials of Roof and Wall(Census 2011) andLevel of Damage of Risk

Wall/Roof		Census Houses		Level of Risk under								
		No. of Houses	%	EQ Zone				Wind Velocity m/s				
				V	IV	III	II	55& 50	47	44 & 39	33	Flood Prone Area in %
				Area in %				Area in %				
STATE – HIMACHAL PRADESH				**35.3**	**64.7**			**1.1**		**98.9**		
WALL												
A1 - Mud & Unburnt Brick Wall	Rural	518,775	20.1									
	Urban	12,709	0.5									
	Total	**531,484**	**20.6**	VH	H			VH		M		

A2 - Stone Wall not packed with mortar	Rural	275,229	10.7									
	Urban	5,362	0.2									
	Total	280,591	10.9	VH	H			H		L		
Total Category - A		812,075	31.5									
B – Burnt Bricks Wall & Stone wall packed with mortar	Rural	1,430,444	55.5									
	Urban	229,507	8.9									
	Total	1,659,951	64.4	H	M			H		L		
Total Category - B		1,659,951	64.4									
C1 – Concrete Wall	Rural	18,189	0.7									
	Urban	4,130	0.2									
	Total	22,319	0.9	M	L			L		VL		
C2 – Wood Wall	Rural	37,745	1.5									
	Urban	2,911	0.1									
	Total	40,656	1.6	M	L			VH		M		
Total Category - C		62,975	2.4									
X – Other Materials	Rural	34,780	1.4									
	Urban	6,166	0.2									
	Total	40,946	1.6	M	V L			VH		M		
Total Category - X		40,946	1.6									
TOTAL HOUSES		2,575,947										
ROOF												
R1 - Light Weight Sloping Roof	Rural	459,928	17.9									
	Urban	72,940	2.8									
	Total	532,868	20.7	M	M			VH		H		

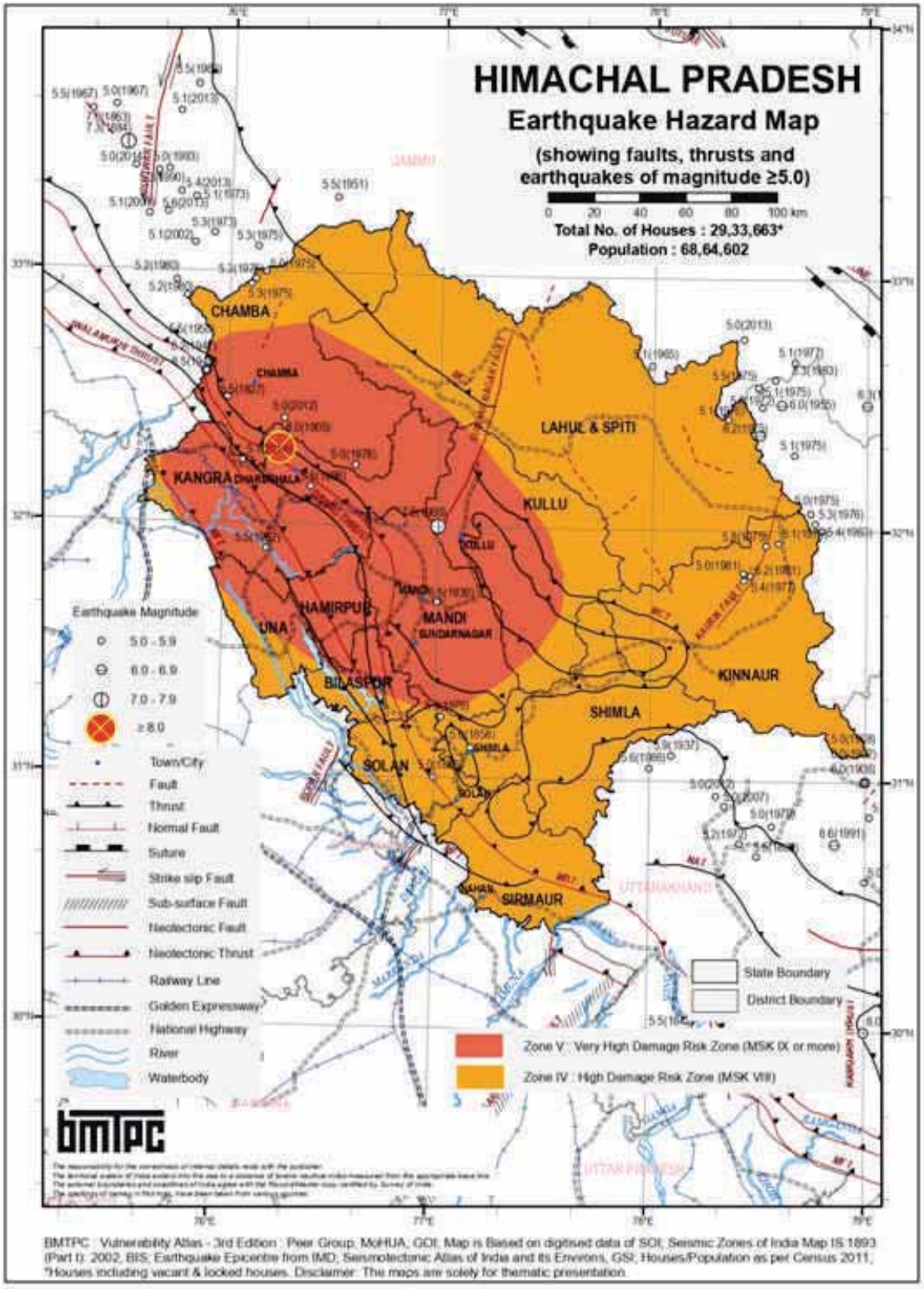
R2 - Heavy Weight Sloping Roof	Rural	1,032,745	40.1									
	Urban	19,199	0.7									
	Total	1,051,944	40.8	H	M			H		L		
R3 - Flat Roof	Rural	822,489	31.9									
	Urban	168,646	6.5									
	Total	991,135	38.4	Damage Risk as per that for the Wall supporting it								
TOTAL HOUSES		**2,575,947**										

Housing Category: Wall Types
Category - A: Buildings in field-stone, rural structures, Thatch, Bamboo, Wood, Mud, Plastic,
Category - B: Ordinary brick building; buildings of the large block & prefabricated type, half-timbered structures, building in natural hewn stone
Category-C: Reinforced building, well-built wooden Structures
Category - X: Other materials not covered in A,B,C. These are generally light.
Notes: 1. Flood prone area includes that protected area whichmay have more severe damage under failure of protection works.
In some other areas the local damage may be severe under heavyrains and chocked drainage.
2. Damage Risk for wall types is indicated assuming heavy flat roofin categories A, B and C (Reinforced Concrete) building.
3. Source of Housing Data: Census of Housing, GOI, 2011.

Housing Category: Roof Type
Category - R1 - Light Weight (Grass, unburnt brick houses, clay houses
GI Metal, Asbestos Sheets, Other Materials)
Category - R2 - Heavy Weight (Tiles, stone/Slate)
Category - R3 - Flat Roof (Brick, Concrete)
EQ Zone V: Very High Damage Risk(MSK >IX)
EQ Zone IV : High Damage Risk Zone(MSK VIII)
EQ Zone III: Moderate Damage Risk Zone (MSK VII)
EQ Zone II: Low Damage Risk Zone(MSK < VI)
Level of Risk: VH = Very High; H = High; M = Moderate; L = Low; VL = Very Low
* Total No. of Houses excluding Vacant/Locked Houses

Source: Vulnerability Atlas of India, 3rd Edition,2019(BMTPC, GOI, New Delhi)

From the perusal of Seismic Zoning Map of Himachal Pradesh, it is seen that about 32% of the total area is prone to the severest seismic risks as it falls in Very High Damage Risk Zone, Zone V (Map). The Statewas subjected in 1905 to one of the most severe earthquakes of the recorded seismic history of India having a magnitude of 8.0 on Richter Scale in which 20,000 people lost their lives. The towns of Kangra, Dharmshala, and the nearby areas were literally razed to the ground. The earthquake shock was felt over an area of more than 4,16,000 sq.km. in and around present Himachal Pradesh. A maximum intensity X on RossiforelMercalli Scale, was observed in the epicentral area, which, when interpreted on the new current Modified Mercalli Scale would be between X and XI. Besides, during the last century, the state has been jolted by a number of micro as well as macro earthquakes. A number of damaging earthquakes have struck the state and the adjoining parts of Punjab, Uttrakhand and J& K. Some of the prominent earthquakes that rocked the state are Kinnaur earthquake 1975 (M=6.7) in which 60 people lost their lives and Dharamshala earthquake 1986 (M5.7) (Table). Besides these major earthquakes, the state has been rocked by about 250 earthquakes with magnitude around 4.0 and 62 earthquakes with magnitude more than 5.0. Some of the major devastating earthquakes with magnitude more than 6.0 & 4.0 on Richter Scale that had rocked the state during the last century are listed in the Table.



Earthquake Hazard Map of Himachal Pradesh.

TABLE —–: EARTHQUAKES HAVING MAGNITUDE 6 OR MORE ON RICHTER SCALE IN HIMACHAL PRADESH DURING THE LAST 200 YEARS

1	1905	4	4	8.0	32°18'00" 76°15'00"	Karari Dal(Distt.Kangra)
3	1945	06	22	6.5	32°36'00" 75°54'00"	Minu (Chmaba Distt.)
4	1947	7	10	6.2	32°36'00" 75°54'00"	Minu (Chmaba Distt.)
5	1951	09	22	6.4	32 36 76 30	East of Dhan Kanda ,District Chamba
6	1975	1	19	6.7	31°56'24" 78°31'48"	Distt. Kinnaur

(Source: India Meteorological Department Statistics).

TABLE —–: EARTHQUAKES HAVING MAGNITUDE 4 OR MORE ON RICHTER SCALE IN HIMACHAL PRADESH DURING THE LAST 200 YEARS

Sr. No.	Year	Month	Day	Magnitude	Coordinates	Tentative Location
1.	1809			5.5	30°42'00" 78° 30'00"	Near Labrang (Distt.Kinnaur)
2.	1827	9		5.5	32°30'00" 76°00'00"	Near Dalhousie (Distt. Chamba)
3	1856	4	7	5.0	31°00'00" 77°00'00"	Near Ranhog (Distt. Solan)
4	1858	8	11	5.0	31°07'12" 77°10'12"	Shimla (Distt.Shimla)
5	1865	4	11	—		Shimla region
6	1905	4	4	8.0	32°18'00" 76°15'00"	Karari Dal (Distt. Kangra)
7	1906	2	28	7.0	32°00'00" 77°00'00"	Near Karshing (Distt.Kullu)
8	1930	5	11	5.5	31°42'00" 77°00'00"	Shila Kiepr (Distt. Mandi)
9	1940	4	07	—	31° 05' 77° 00'	Near Kali Hatti Distt. Shimla
10	1945	6	22	6.5	32°36'00" 75°54'00"	Minu (Distt. Chamba)
11	1947	7	10	6.2	32°36'00" 75°54'00"	Minu (Distt. Chamba)
12	1950	8	12	5.5	32°36'00" 75°54'00"	Minu (Distt. Chamba)
13	1951	9	22	6.4	32° 36' 76° 30'	East of Dhan Kanda (Distt. Chamba)
14	1962	9	15	5.5	31°54'00" 76°12'00"	Near Dehra Gopipur (Distt. Kangra)
15	1965	2	21	4.5	32° 14' 76° 54'	Near Bara Banghal (Distt. Kangra)
16	1967	9	20	—	32° 36' 76° 06'	Near Rajpura (Distt. Chamba)
17	1968	5	11	4.9	32° 22' 76° 22'	Near Atrori, (Distt. Chamba)
18	1969	1	23	4.0	32° 14' 76° 03'	Near Trilokpur (Distt. Kangra)
19	1970	3	05	4.9	32° 24' 76° 29'	Near Sani (Distt. Chamba)
20	1972	1	29	4.7	32° 51' 75° 54'	

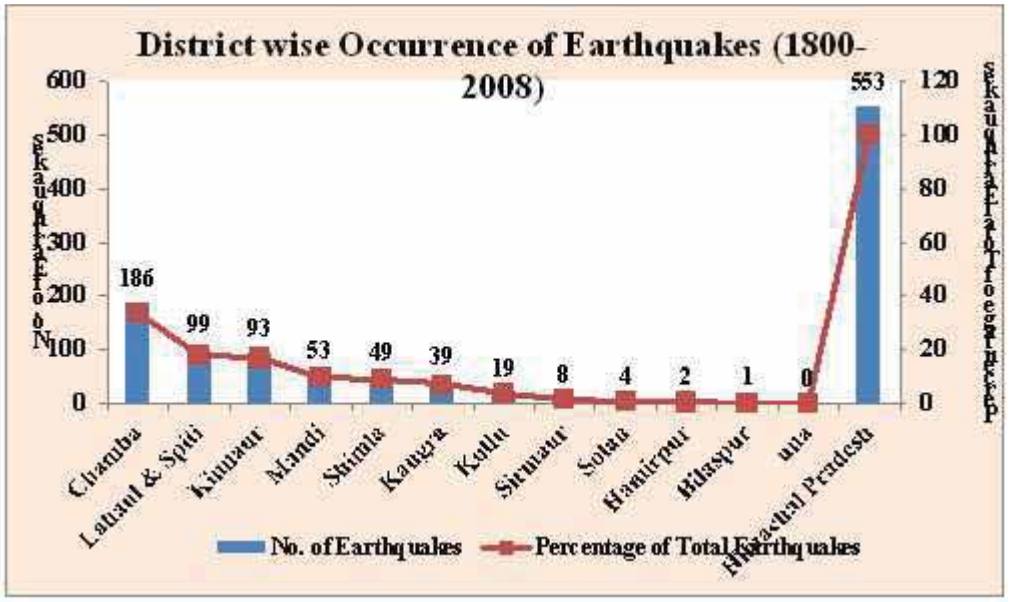
Sr. No.	Year	Month	Day	Magnitude	Coordinates	Tentative Location
21	1973	12	16	4.9	32° 17' 76° 00'	Near Mordhu (Distt. Chamba)
22	1974	11	16	4.8	32° 50' 76° 08'	Tissa (Distt. Chamba)
23	1975	10	30	5.2	32° 54' 76° 00'	Near Bhujara (Distt. Chamba)
24	1975	12	11	5.1	32° 50' 76° 58'	Near Jankar (Sumdo, Lahaul & Spiti)
25	1975	12	10	5.0	32° 49' 76° 11'	Near Chhajaut (Distt. Chamba)
26	1975	1	19	6.7	31°56'24" 78°31'48"	Distt. Kinnaur
27	1975	2	2	5.1	32°33'36" 78°53'00"	Indo China Border
28	1975	7	19	5.1	31°57'00" 78°35'24"	Near Chnago (Distt. Kinnaur)
29	1975	7	29	5.5	32°34'12" 78°29'24"	Near Kanum (Distt. Kinnaur)
30	1975	2	10	5.3	32°57'00" 76°06' 00"	Near Janu Pass (Distt. Chamba)
31	1975	2	11	5.0	33°00'00" 76°10'12"	Near Sathrundi (Distt. Chamba)
32	1976	1	7	5.3	32°58'12" 76°7'12"	Dunchili Gad (Distt. Chamba)
33	1976	1	09	4.7	32° 59' 76° 01'	Along J&K Border
34	1976	2	05	5.0	31°14'24" 77°01'48"	Near Chebri (Distt. Shimla)
35	1976	4	10	4.5	32° 43' 76° 30'	Near Balthal Got (Distt. Chamba)
36	1976	4	16	4.0	32° 52' 76° 00'	Near makkan, (Distt. Chamba)
37	1976	7	6	5.1	32°26'24" 78°21'00"	Near Raksham (Distt. Kinnaur)
38	1976	9	8	5.3	32°14'08" 78°45'36"	Near Baspa (Distt. Kinnaur)
39	1977	2	19	5.4	31°48'00" 78°25'48"	Near Rangbar Thachang (Distt. Kinnaur)
40	1977	3	27	5.1	32°40'12" 78°39'36"	Lenchichi (Distt. Kinnaur)
41	1978	6	14	5.0	32°14'24" 76°36'36"	Near Singhau Pass along Kangra Border (Distt. Chamba)
42	1979	1	19	4.1	32° 22' 76° 28'	Near Chandota Pass (Distt. Chamba)
43	1980	5	29	4.2	31° 33' 76° 33'	
44	1980	9	4	4.0	32° 00' 76° 54'	Near Pajaund (Distt. Mandi)
45	1980	11	26	4.0	32° 29' 76° 24'	Near Khaddar (Distt. Chamba)
46	1981	2	14	4.0	32° 35' 76° 37'	Near Bara Kanda (Distt. Chamba)
47	1981	6	19	4.5	32° 43' 76° 00'	Near Lohari (Distt. Chamba)
48	1981	6	13	5.0	31°49'12" 78°27'36"	Nalpaya Thach (Distt. Kinnaur)
49	1981	5	28	5.2	31°49'48" 78°25'48"	Barling (Distt. Kinnaur)
50	1982	5	18	4.0	32° 25' 76° 24'	Near Chagrauta (Distt. Chamba)
51	1983	2	27	5.3	32°36'00" 78°34'12"	Khadi Thach (Distt. Kinnaur)

Sr. No.	Year	Month	Day	Magnitude	Coordinates	Tentative Location
52	1983	4	13	4.0	32° 46' 76° 14'	Near Tikkri Khas (Distt. Chamba)
53	1985	3	11	4.8	31° 15' 77° 00'	Near Malaun (Distt. Shimla)
54	1985	12	29	4.9	32° 37' 76° 06'	Near Theru (Distt. Chamba)
55	1986	4	26	5.5	32°19'00" 76°24'00"	Near Nag Dal (Boundary of Chamba and Distt. Kangra)
56	1987	06	10	4.7	31° 55' 76° 26'	Near Daton (Distt. Chamba)
57	1987	12	26	4.3	32° 07' 76° 41'	Near Dewal Khas (Distt. Kangra)
58	1991	6	23	4.6	32° 18' 76° 42'	Near Gataunda (Distt. Shimla)
59	1992	1	26	4.5	32° 16' 76° 24'	Near Bhagsu Nath (Distt. Kangra)
60	1992	2	13	4.5	32° 37' 76° 30'	East of Dhan Kanda (Distt. Chamba)
61	1992	9	6	4.6	32° 25' 76° 20'	Near Darkund (Distt. Chamba)
62	1996	5	9	4.0	32° 50' 76° 19'	Near Kuntka Matha (Distt. Chamba)
63	1996	5	23	4.2	32° 42' 76° 29'	Near East of Kagal Dhar (Distt. Chamba)
64	1996	7	14	4.1	32° 37' 76° 31'	Near East of Dhan Kanda (Distt. Chamba)
65	1996	9	14	4.6	32° 49' 76° 22'	Near Kala Ka Bhandar (Distt. Chamba)
66	1997	7	29	4.7	31° 33' 76° 48'	Near Baldwara (Distt. Mandi)
67	1997	8	13	4.2	31° 12' 76° 41'	Near Jajjar (Distt. Solan)
68	1998	10	17	4.5	32° 12' 76° 32'	Near Kandha (Distt. Kangra)
69	1999	5	30	4.9	31° 48' 36'' 78° 54' 36''	Near Miyang Lung (Distt. Kinnaur)
70	1999	1	8	4.2	31° 26' 24'' 77° 18' 00''	Near Mehog (Distt. Mandi)
71	1999	5	30	4.9	31° 48' 36'' 78° 54' 36''	Near Miyang Lung (Distt. Kinnaur)
72	1999	1	8	4.1	31° 22' 48'' 77° 17' 24''	Near Karsog (Distt. Mandi)
72	2000	4	28	4.1	31° 30' 36'' 78° 15' 00''	Near Mehbar (Distt. Kinnaur)
73	2000	8	28	4.5	32° 01' 48'' 78° 18' 00''	
74	2000	9	26	4.0	30° 55' 12'' 75° 39' 00''	
75	2000	6	17	4.3	31° 48' 00'' 78° 27' 00''	Near Nalpaya, (Distt. Kinnaur)
76	2001	6	17	4.2	32° 42' 36'' 78° 26' 24''	
77	2001	1	22	4.0	31° 04' 12'' 77° 55' 48''	Along Uttranchal Border
78	2001	2	23	4.0	30° 55' 48'' 78° 00' 00''	Along Uttranchal Border
79	2001	9	18	5.1	33° 13' 12'' 75° 36' 36''	
80	2001		14	4.7	32° 31' 12'' 76° 06' 00''	Near Pundla (Distt. Chamba)
81	2001		23	4.6	33° 07' 12'' 75° 40' 12''	

Sr. No.	Year	Month	Day	Magnitude	Coordinates	Tentative Location
82	2002	1	27	5.1	33° 06' 36'' 75° 49' 48''	
83	2002	3	17	4.1	32° 46' 48'' 75° 55' 48''	
84	2002	2	17	4.1	33° 06' 00'' 75° 40' 48''	
85	2012	10	02	4.5	32° 24' 76° 24'	Chamba - Lahaul & spiti border, H.P.
86	2012	10	02	4.9	32° 24' 76° 18'	Chamba - Lahaul & spiti border, H.P.
87	2012	11	06	4.1	32° 18' 76° 12'	Chamba-Kangra border, H.P.
88	2012	11	11	4.0	32° 18' 76° 12'	Kangra H.P.
89	2013	04	30	4.1	32° 06' 76° 06'	J & k – H.P. border
90	2013	05	01	5.8	33° 06' 75° 48'	J & k – H.P. border
91	2013	05	01	4.6	33° 06' 75° 42'	J & k – H.P. border
92	2013	05	14	4.4	33° 12' 76° 06'	J & k – H.P. border
93	2013	06	04	4.8	33° 42' 76° 42'	Lahaul & Spiti, H.P.
94	2013	06	05	4.5	32° 48' 76° 18'	Chamba, H.P.
95	2013	07	09	5.1	32° 54' 78° 24'	J & k – H.P. border
96	2013	07	13	4.5	32° 12' 76° 18'	Kangra, H.P.
97	2013	07	15	4.4	32° 36' 76° 42'	Lahaul & Spiti, H.P.
98	2014	05	09	4.0	31° 54' 77° 06'	Kullu, H.P.
99	2014	06	17	4.1	32° 12' 76° 06'	Kangra, H.P.
100	2014	08	21	5.0	32° 18' 76° 30'	Chamba-Kangra border, H.P.
101	2015	08	19	4.0	31° 42' 77° 00'	H.P.
102	2016	02	04	4.1	32° 42' 75° 42'	Chamba-J & K border
103	2016	02	09	4.4	32° 48' 76° 24'	Lahaul & Spiti, H.P.
104	2016	08	27	4.6	31° 24' 77° 30'	Kullu, H.P.
105	2016	08	27	4.3	31° 24' 77° 30'	Kullu, H.P.
106	2016	08	27	4.2	31° 24' 77° 24'	Kullu, H.P.
107	2016	08	28	4.4	32° 48' 76° 00'	Chamba, H.P.
108	2017	05	19	4.5	32° 48' 76° 18'	H.P.
109	2017	05	20	4.1	32° 48' 76° 12'	H.P.
110	2017	08	16	4.1	32° 42' 76° 18'	Chamba, H.P.
111	2019	07	29	4.3		Distt. Lahaul Spiti (H.P.)
112	2019	07	28	4.0		Distt. Chamba (H.P.)

Sr. No.	Year	Month	Day	Magnitude	Coordinates	Tentative Location
113	2019	05	02	4.2		Distt. Mandi (H.P.)
114	2019	02	05	4.2		H.P.

(Source: IMD: India Meteorological Department, DLDH- Oldam (1883), ISS: International Seismological Summary, PDE: Preliminary Determination of Earthquakes).



Based on another study carried out using high resolution satellite data 9 morphotectonic zones of the Punjab Re-entrant part of Himachal Himalaya were delineated . Other inputs in the study area the lineament and drainage pattern, dissection pattern, morphology and geology of the area. The Northward convergence of the Indian Plate which resulted in the compressional stress regime has left indelinable mark in the form of regional tectonic discontinuities like MCT,MBT ,HFT and their splays. This Cenozoic mobile belt which forms an integral part of the Frontal Folded Belt of the Lesser Himalaya is termed as the Punjab Re-entrant in NW Himalaya and has assumed significance due to the presence of conspicuous seismicity.

Integrating the information on past seismicity in the form of past epicenters with magnitude more than 3 on Richter Scale and geological information together with morphotectonics divisions of the area, some interesting results on the seismic attributes have been observed.

1. Past seismicity has primarily been concentrated in the area North of MBT.
2. Towards the South in the Kangra valley, the patterns reveal scattered nature close to transverse lineaments.
3. Beyond Beas River, the seismicity is controlled by a major tectonic line known as Saon thrust.
4. In the Shiwalik Region, the pattern reveals a correlation with important tectonic plane traversing the area known as Jawalamukhi thrust and also in the Upper Shiwalik region along the Sir khad basin, trends parallel to the major tectonic plane have been noticed.

Based on the above study and analysis, the following observations were made:

1. The seismicity in the frontal region is mainly controlled by the Main Boundary Thrust (MBT) on the North of Kangra and the Himalayan Frontal Thrust (HFT) in the south separating the Punjab Plains from the Upper Shiwaliks.

2. From the perusal of the epicenter data plotted, it has been found that the State of Himachal Pradesh has been rocked by more than 1300 earthquakes during the last 100 years. Further distribution of these earthquakes based on their magnitude reveals that the State experienced 141 earthquakes with magnitude between 3 to 3.9 on Richter Scale, 22 earthquakes having magnitude 4 to 4.9, 43 earthquakes with magnitude 5 to 5.9, 7 earthquakes having magnitude between 6 to 6.9 and only 01 earthquake with magnitude of 8.0 on Richer Scale that was the Kangra Earthquake of 1905. Beside these earthquakes there were 1130 earthquake termed as small earthquakes with magnitude less than 3 on the Richter scale.

3. From the plotting of the past epicenters on the lineament map of Himachal Pradesh, it is found that there are two major clusters where majority of the earthquakes have happened. One of them is on the north of Dharamshala along the Dhauladhar Range in Kangra and Chamba District , where as the other is on the east of Sundernagar valley and along the right bank of Satluj River. These two locations also depict higher concentration of earthquakes in the form of micro earthquakes i.e the earthquakes with magnitude less than 3 on the Richter Scale.

4. The areas on the south of MBT up to the Punjab Plains show scattered nature of past epicenters but they follow a prominent trends of lineaments i.e. along the streams originating from Dhauladhar range i.e the Dehar, the Gaj, the Baner, and the Manuni khad. All these khads follow a linear trend and thus are structurally controlled which may have witnessed the epicenters of past earthquakes with magnitude more than 5 on Richter Scale along the Pong Dam area in the Kangra valley.

5. Further in the south eastern part of the State i.e in Sirmour district, although the major tectonic lines dominates the area, but the density of the past epicenters is not as much as it is in the other districts as discussed above.

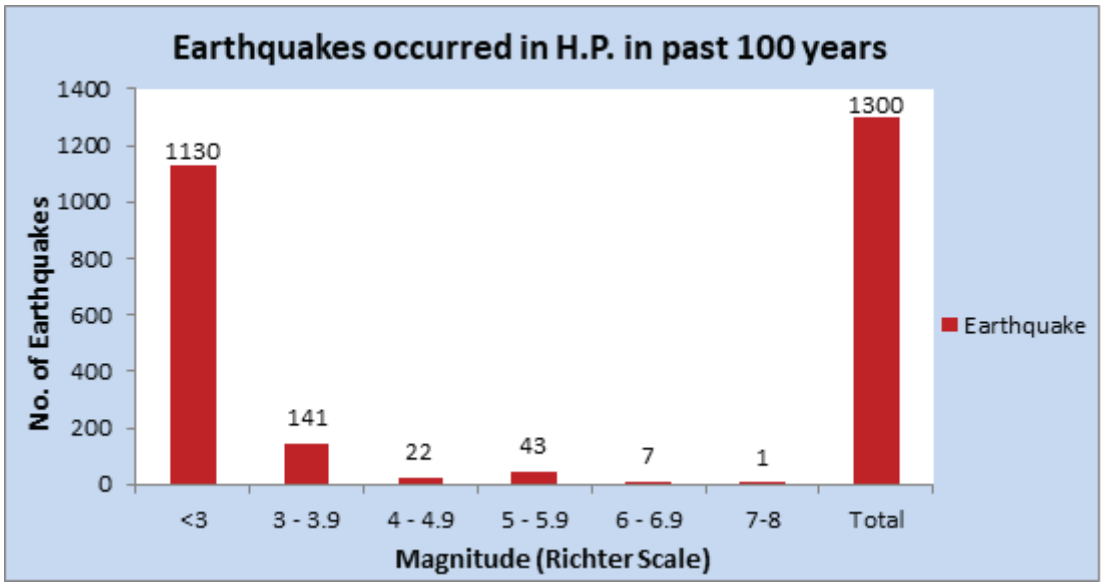
6. In the higher Himalayan region, the seismic activity is mainly confined to the northwest of Kalpa ie along the Spiti valley where majority of the earthquake with magnitude more than 5 on Richter Scale had happened in the past.

From the above observations, it is inferred that:

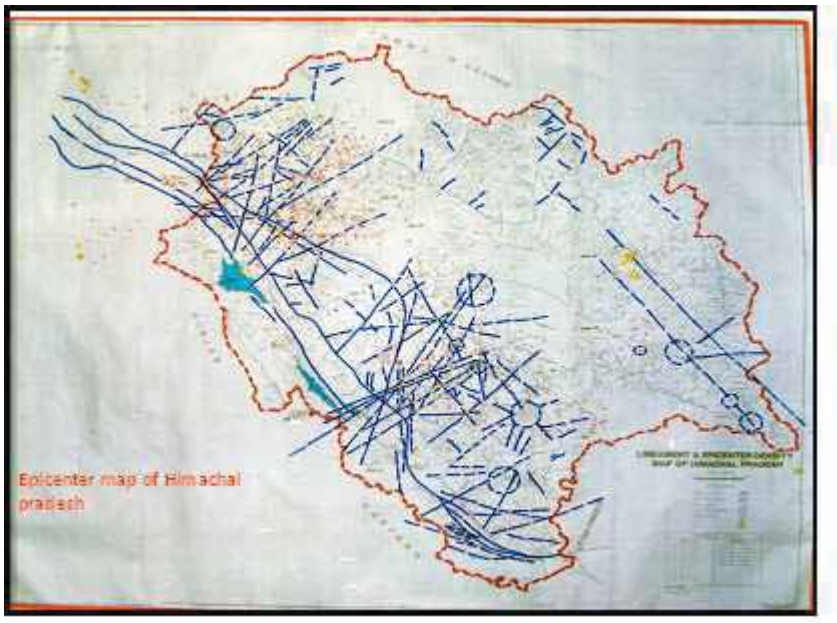
a) The areas on the north of MBT i.e. Dharamshala along the Dhauladhar Range in Kangra and Chamba district, and the areas on the east of Sundernagar valley shows very highly dense and orthogonal pattern of past epicenters which reflects that whatever stress /strain is being accumulated within the earth's crust is being released in the form of micro earthquakes and thus chances for having major earthquake in this part of the state are reduced to some extent but can't be overruled.

b) The areas on the south of MBT i.e. Dharamshala town, past epicenters are scattered in nature and some of the major earthquakes are along the transverse lineaments i.e. along the major khads originating from Dhauldahar Range. Thus this part of the State falling within the Kangra valley, Una valley and along the Sir khad in Hamirpur,Mandi and Bilaspur district along with the southeastern part i.e. Sirmour district may be termed as a seismic gap where although the major tectonic lines dominates but the energy is not being released in the manner as it is on the northern part of the state. Thus these areas can be termed as future locations for having earthquakes in the state.

c) Considering the overall broad vulnerability of the state from seismicity point of view, the preparedness level in terms of the structures and general mass awareness needs to be strengthened, so that the post disaster effects of earthquakes are minimized to some extent.



Graphical representation of earthquakes occurred in H.P. in past 100 year



Epicentre Map of HP

Severest Earthquakes in H.P. Some of the severest earthquakes in Himachal Pradesh which have history of damage in the State are:

Kangra Earthquake (1905)

Location - 32°15´ N, 76°15´ E
Date - 4th April, 1905
Time - 06 hrs 20 min., Indian StandardTime
Magnitude – 8.0 Richter Scale
Intensity (max.) – X on MM Intensity Scale
Causalities – 20000 persons
Kangra was then in Distt. Lahore. No government functionary was left alive even to report
Area Shaken – 416000 sq.km

Dharamsala Township suffered severe damage amounting to total destruction at many places and casualties reached very high figures. The military and civil staff was reduced to about one-half due to large number of deaths. At Forsythganj Bazar, buildings were constructed of sun-dried bricks especially in the lower storeys and partly of wood mostly in the upper storeys and verandahs. All shops to the east of the road were ruined while on the west many of them survived total collapse. Mcleodganj Bazar was leveled to the ground with no building standing even partially. Same was the situation at Kotwali Bazar. At Kangra, the devastation was total. Not a single house was standing. The horror of the actual calamity was beyond imagination. There was no one left alive for directing rescue operations. All the subordinate officials were killed.

Kinnaur Earthquake (1975)

Location - 31°90´ N, 78°50´ E
Date - 19th January, 1975
Time - 08 h 12 m 9 s, Indian StandardTime
Magnitude – 5.8 Richter Scale
Intensity (max.) – VIII on MM Intensity Scale
Casualities - 60 persons and several hundredinjured.

The epicentral distance was about 25 km from Reckong Peo town. Death of sixty people. Nearly 2000 dwellings are reported to have suffered heavy damage. Recent random rubble masonry and dressed stone masonry construction suffered extensive damage. Heavy flat roofs suffered greater damage. Buildings constructed in hollow concrete blocks or dressed stone masonry in cement-mortar developed small cracks in walls. Light structures made of corrugated iron sheets nailed to timber frames and arches did not suffer any damage. The temples (monasteries) and monuments also suffered badly.

Dharamshala Earthquake (1986)

Location - 32°10´ N, 76°30´ E
Date - 26th April, 1986
Time - 13 h 5 min. 17s, Indian StandardTime
Magnitude – 5.7 Richter Scale
Intensity (max.) – VII+ on MM Intensity Scale
Financial Loss – 65 crores

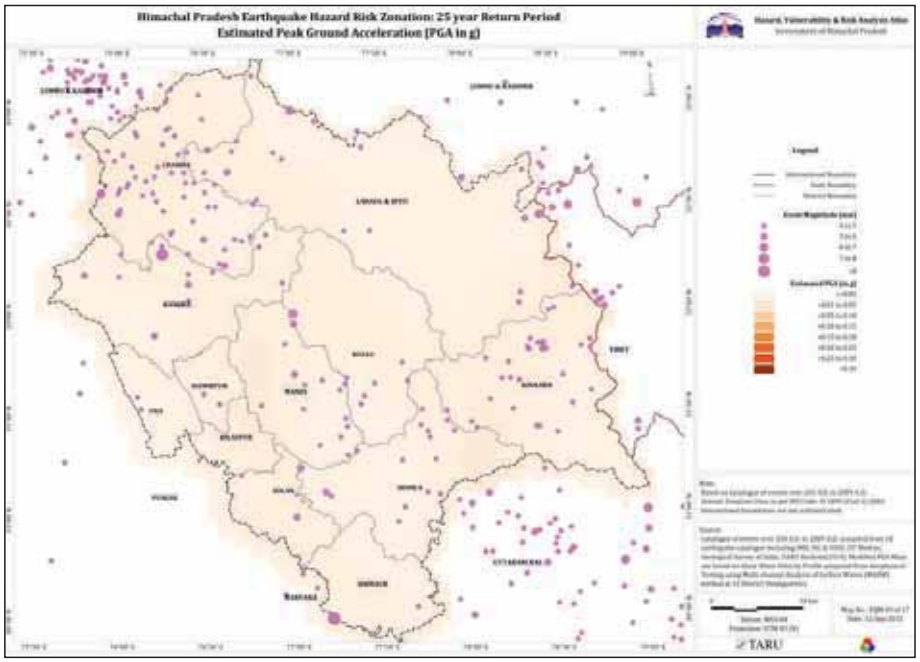
The epicentre of this earthquake was very close to that of 1905 earthquake. The focal depth was shallow, about 10km. Most significant damage, requiring reconstruction of houses, was to adobe and stone house in the villages near Dharmshala, such as Narghota, Naddi, Kaned, Sukar and Khanyara. The maximum Modified Mercalli intensities in this earthquake was VII^{+}

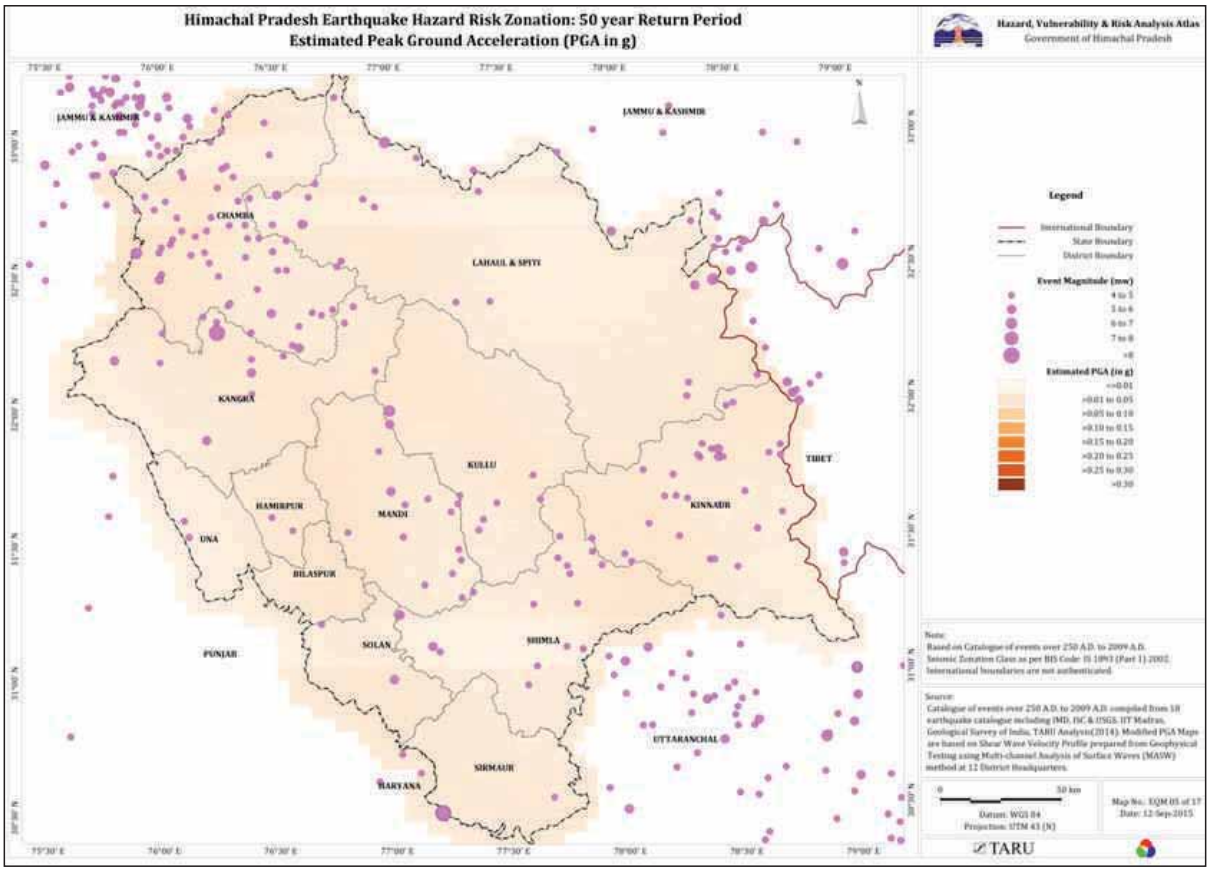
Source: Different Reports & Publications

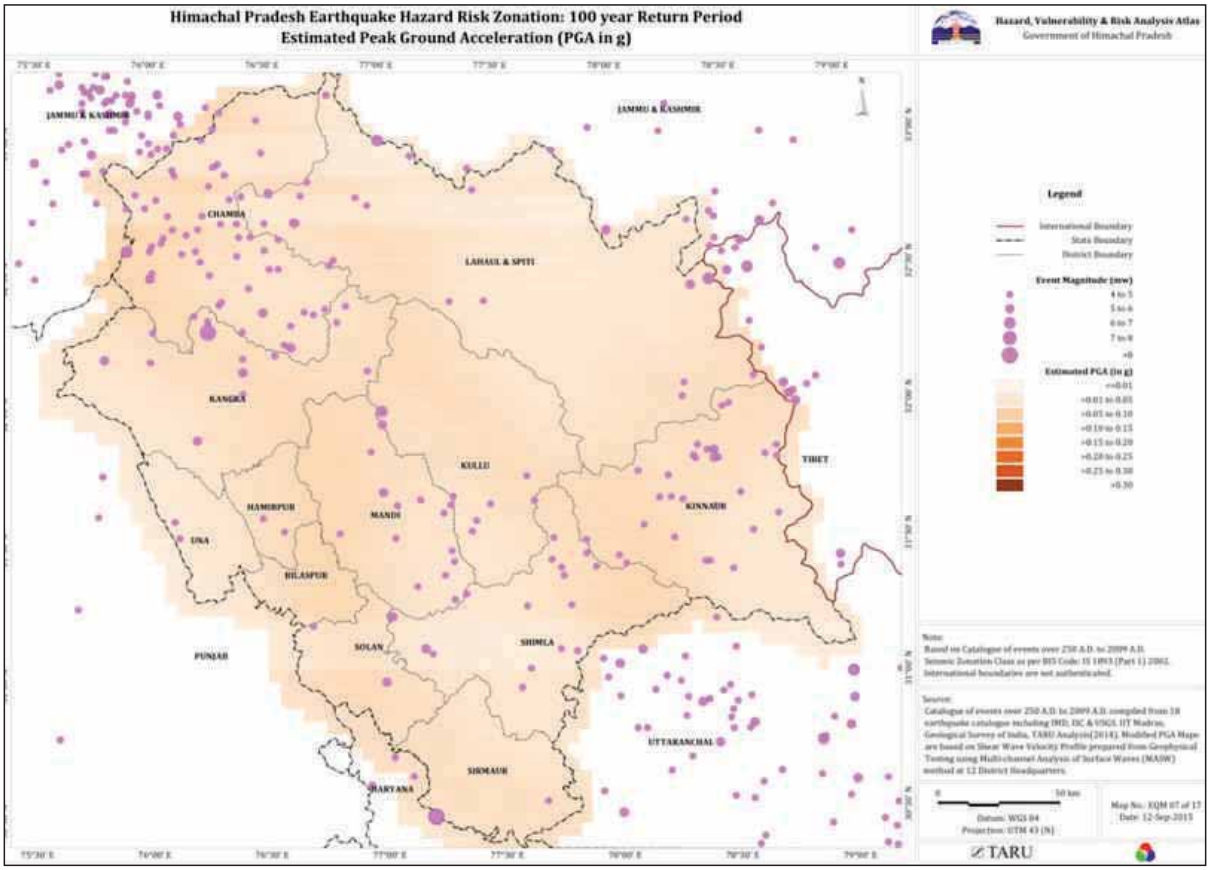
10.7.1.4 PGA BASED SEISMIC HAZARD ASSESSMENT IN H. P.

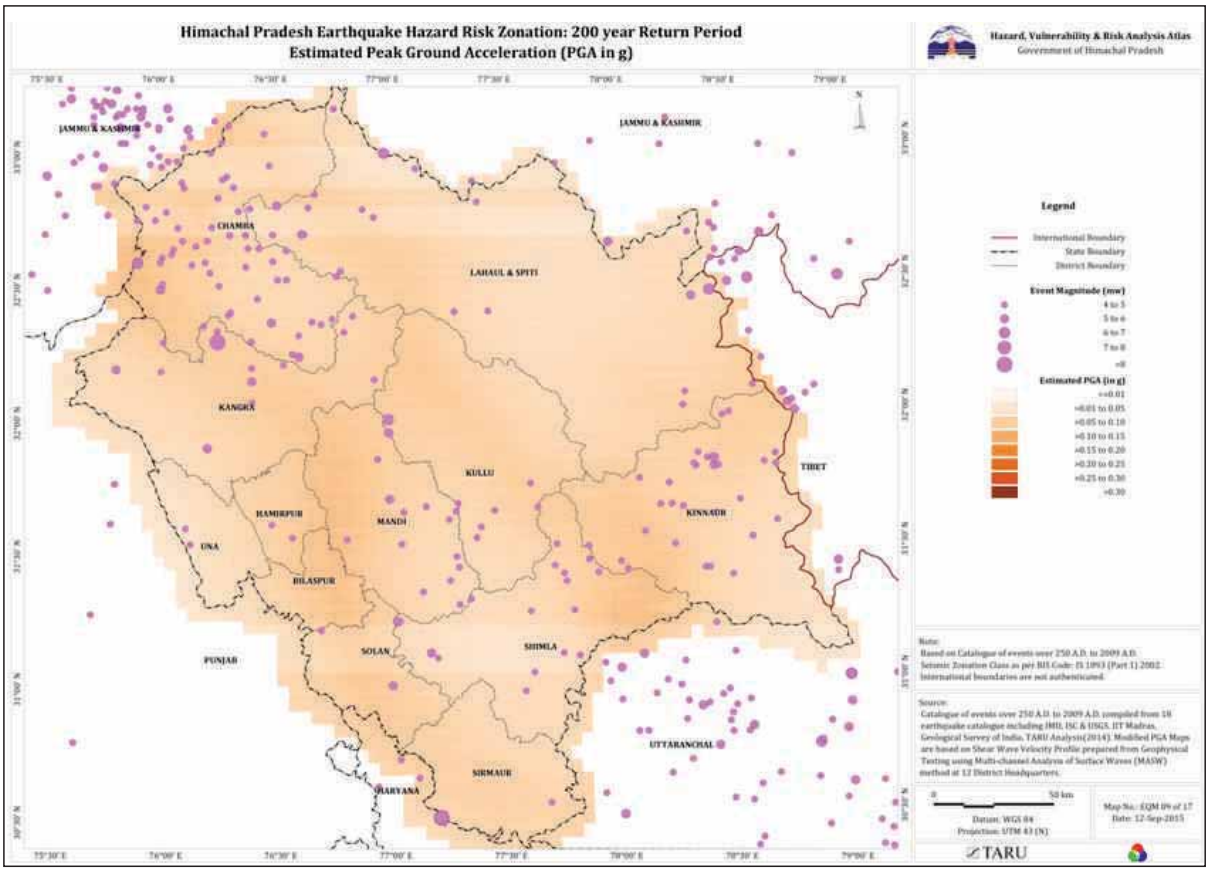
Peak Ground Acceleration (PGA) is a measure of earth-quake acceleration on the ground, also called design basis earthquake ground motion (DBEGM). During an earth-quake, the damage caused to buildings and infrastructure is related more closely to ground motion, rather than the magnitude of the earthquake. The values of PGA during an earthquake depends on number of factors such as, the length of the fault, magnitude, the depth of the earthquake, the distance from the epicentre, the duration (length of the shaking cycle), and the geology of the ground (subsurface). Shallow-focused earthquakes generate stronger shaking (acceleration) than intermediate and deep quakes, since the energy is released closer to the surface. Moreover, PGA values display extreme variability over distances of a few kilometers particularly with moderate to large earth-quakes.

Based on the study conducted for assessing hazard risk vulnerability assessment in terms of earthquakes, hazard maps for pga and spectral acceleration have been derived for hp by performing detailed psha. A circular region of radius 500 km around the target sites is taken and more than 195 faults have been considered in estimating the future seismic hazard. The seismic hazard for Himachal Pradesh is mainly controlled by the MCT and MBTfaults in the Himalayan region. The recurrence relation for the seismic zones is found from the maximum likelihood method of kijko and sellevoll (1989) including incompleteness and uncertainty of the database. New ground motion relations including local soil conditions are derived for himalayan and indo-gangetic regions. Detailed seismic hazard curves have been computed considering all the uncertainties. From these seismic hazard curves response spectra corresponding to 25-year, 50-year, 100-year, 200-year, 475-year, and 2475-year return periods have been found. Uniform hazard response spectra for twelve important cities have been obtained from psha. The maps generated for different return period are as per Map.




Himachal Pradesh Earthquake Hazard Risk Zonation: 50 year Return Period
Estimated Peak Ground Acceleration (PGA in g)
Hazard, Vulnerability & Risk Analysis Atlas
Government of Himachal Pradesh
JAMMU & KASHMIR
CHAMBA
LAHAUL & SPITI
KANGRA
KULLU
TIBET
HAMIRPUR
MANDI
KINNAUR
UNA
BILASPUR
SOLAN
SHIMLA
PUNJAB
UTTARANCHAL
SIRMAUR
HARYANA
Legend
International Boundary
State Boundary
District Boundary
Event Magnitude (mw)
4 to 5
5 to 6
6 to 7
7 to 8
>8
Estimated PGA (in g)
<=0.01
>0.01 to 0.05
>0.05 to 0.10
>0.10 to 0.15
>0.15 to 0.20
>0.20 to 0.25
>0.25 to 0.30
>0.30
Note:
Based on Catalogue of events over 250 A.D. to 2009 A.D.
Seismic Zonation Class as per BIS Code: IS 1893 (Part 1) 2002.
International boundaries are not authenticated.
Source:
Catalogue of events over 250 A.D. to 2009 A.D. compiled from 18 earthquake catalogue including IMD, ISC & USGS, IIT Madras, Geological Survey of India, TARU Analysis(2014). Modified PGA Maps are based on Shear Wave Velocity Profile prepared from Geophysical Testing using Multi-channel Analysis of Surface Waves (MASW) method at 12 District Headquarters.
0
50 km
Datum: WGS 84
Projection: UTM 43 (N)
Map No.: EQM 05 of 17
Date: 12-Sep-2015
TARU


Himachal Pradesh Earthquake Hazard Risk Zonation: 100 year Return Period
Estimated Peak Ground Acceleration (PGA in g)
Hazard, Vulnerability & Risk Analysis Atlas
Government of Himachal Pradesh
JAMMU & KASHMIR
CHAMBA
LAHAUL & SPITI
KANGRA
KULLU
TIBET
HAMIRPUR
MANDI
KINNAUR
UNA
BILASPUR
SOLAN
SHIMLA
PUNJAB
UTTARANCHAL
SIRMAUR
HARYANA
Legend
International Boundary
State Boundary
District Boundary
Event Magnitude (mw)
4 to 5
5 to 6
6 to 7
7 to 8
>8
Estimated PGA (in g)
<=0.01
>0.01 to 0.05
>0.05 to 0.10
>0.10 to 0.15
>0.15 to 0.20
>0.20 to 0.25
>0.25 to 0.30
>0.30
Note:
Based on Catalogue of events over 250 A.D. to 2009 A.D.
Seismic Zonation Class as per BIS Code: IS 1893 (Part 1) 2002.
International boundaries are not authenticated.
Source:
Catalogue of events over 250 A.D. to 2009 A.D. compiled from 18 earthquake catalogue including IMD, ISC & USGS, IIT Madras, Geological Survey of India, TARU Analysis(2014). Modified PGA Maps are based on Shear Wave Velocity Profile prepared from Geophysical Testing using Multi-channel Analysis of Surface Waves (MASW) method at 12 District Headquarters.
0
50 km
Datum: WGS 84
Projection: UTM 43 (N)
Map No.: EQM 07 of 17
Date: 12-Sep-2015
TARU

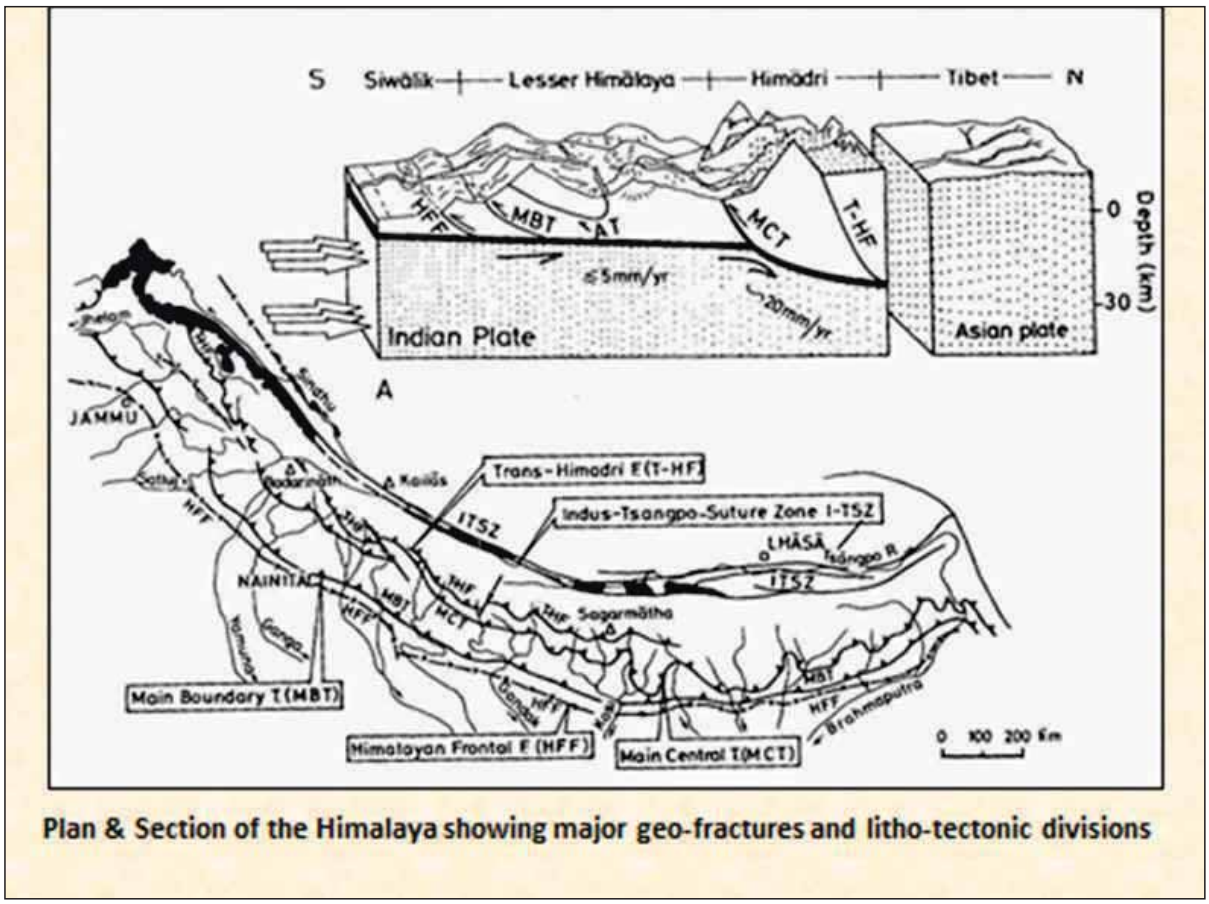


H. P. Earthquake Hazard Risk Zonation

10.7.1.5 LANDSLIDES HAZARDS

Landslides are generally mass movement of soil or rocks along the slopes of mountains. The 3000 km long and 300km wide Himalayas are young folded mountains or V-shaped valley, caused by the collision of Indo-Australian plate with the Eurasian plate. These are tectonically unstable terrains as Indian plate is still moving northwards and causing upliftment of the Himalayas and are highly fractured and sheared and thus prone to landslides which leads heavy loss of both life & property .

The hills and mountains of Himachal Pradesh are liable to suffer landslides during monsoons and also as a result of high intensity earthquakes. The vulnerability of the geologically young and not so stable steep slopes in various Himalayan ranges, has been increasing at a rapid rate in the recent decades due to inappropriate human activity like deforestation, road cutting, terracing and changes in agriculture crops requiring more intense watering etc. The fragile geology also renders the slopes prone to landslides (Map).



Plan & Section of the Himalaya showing major geo-fractures and litho-tectonic divisions

(Source: Regional Workshop DRR Oct 22-23,2019 at Shimla)

Map: Major Geo-fractures and litho -tectonic divisions along the Himalayan Belt.

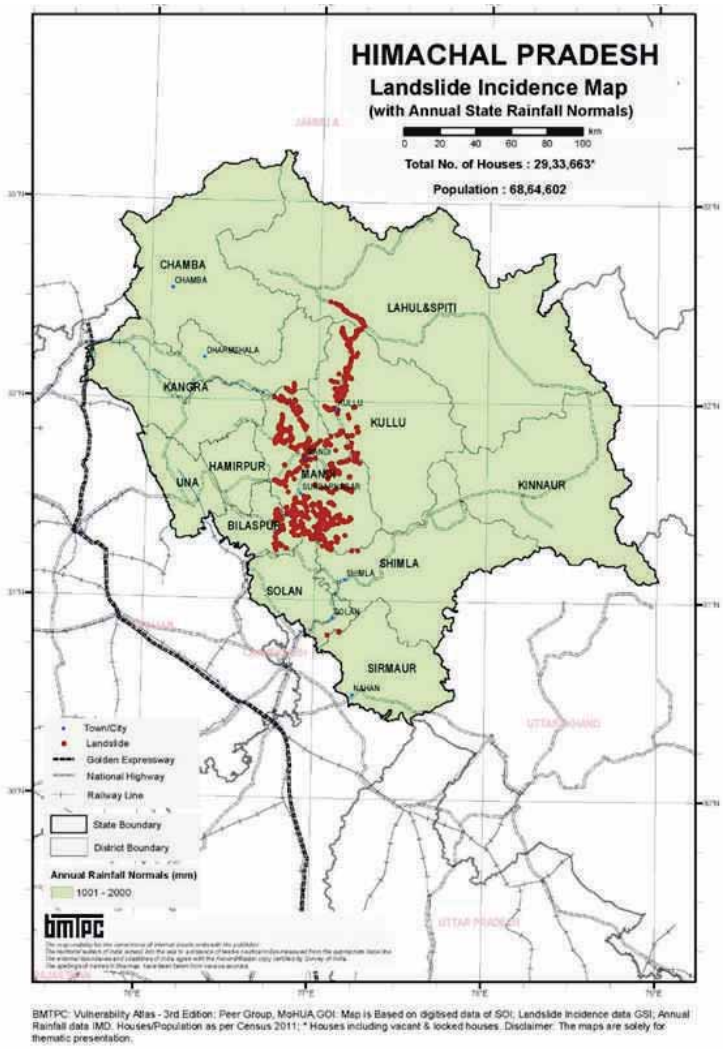
Hilly areas of Himachal Pradesh are vulnerable to landslides due to geological, meteorological and anthropogenic factors. Several devastating landslides have occurred in Himachal Pradesh over the past decade. The hydro-meteorological conditions and fragile structural fabric of geological strata of Himachal Pradesh increases the possibility of landslides. Anthropogenic factors, such as removal of vegetation cover, overloading of slopes by derbies also contribute to a great extent. Development activities like construction of roads, tunnels and excavation for hydro projects have further accentuated the problem. Loss of life, damage to buildings, soil erosion, and loss of tree cover, damage to bridges, communication lines and hydropower infrastructure are some of the impacts the landslide and slips tend to cause.

Landslide activity in Himachal Pradesh can also be grouped in three distinct zones based on their characteristics depending upon altitude, geology and topography is (Table). Some of the important landslides in Himachal Pradesh are given in Table.

Landslide Distribution in Himachal Himalaya

Himalayan Zone	Characteristics	Prone to
Higher Himalaya	High relief zone of glaciations characterized by typical alpine mountains steep slopes generally devoid of vegetation and valleys covered by glacial and periglacial deposits	Least inhabited part of the Himalaya so mass movement phenomena are not of common concern.
Lower and Mid Himalaya	Medium relief zone consists mainly of sedimentary rocks. This zone is covered by natural vegetation. High rate of fluvial erosion and weathering processes.	Most inhabited, facing the problem of ecological and environment imbalances due to anthropogenic factors.
Outer Himalaya	Low lying hill ranges of Shiwalik sediments of soft Tertiary rocks such as sandstone, siltstone, shale and clays.	Most inhabited part prone to large scale mass movement, cloud bursts and landslides.

Source : WIHG Reports



Landslide Incidence Map

Important slides in Himachal Pradesh

Sr.No.	Landslide Area	History of Damage
1	Maling (1968).	This slide damaged 1 Km of NH-22 and is still active.
2	Kinnaur (Dec.1982)	This occurred at Sholding nala collapsing 3 bridges and 1.5 of road vanished.
3	Jhakri (March 1989)	At Nathpa about 500 m of road was damaged due to this slide and is still active
4	Luggarbhati on 12 Sept.1995	39 people were buried alive during the slide
5	Prominent slides in Beas valley are at Marhi, Bhang, Chhyal, and Mandu in upper catchment of the Beas river	
6	Kotrupi Landslide, District Mandi	46 people lost their lives on the night of 13th August 2017
7	Landslide occurred at Kathalag, Kuthakar and Karyala villages of Ghumarwin Sub Division on 18 August 2019	13 ha land of 7 families was washed away and 23 people along with 21 livestock were rescued
8	Temporary lake was formed due to landslide near Khadelar near Danni village in Nurpur Sub Division on 18 August 2019	Four affected families were rehabilitated and about 25 kanal of agriculture land was damaged.

Source: WIHG Reports and Memorandum of Damages (SDMA, Govt of H.P)

The devastating landslides in H.P. need more intensive scientific studies and engineering measures focused on the problem of landslides. It is necessary to prepare zoning maps of landslides and rock fall prone areas through geological and geo technical studies. The landslide prone areas should be avoided while locating new settlement or buildings, and those, which are already occupied, should either be resettled or protective measures undertaken based on expert advice. Based on the BMTPCAtIas on Landslides, Lahaul & Spiti District occupies maximum area of 13591 sq.km. which is prone to landslides, where as Kinnaur (6322 sq.km) and Chamba (6370 sq.km.) has the total area which is prone for landslides in the district. Una being in Shiwalik system occupies about 1500 sq.km. of area prone to landslides.

Landslide Prone Areas Of Himachal Pradesh

District	Severe to Very High	High	Moderate to Low	Unlikely	Total Area (Sq.Km.)
Bilaspur	216	842	83	1	1142
Chamba	2120	3829	351	70	6370
Hamirpur	0	851	204	45	1100
Kangra	123	3698	1233	557	5611
Kinnaur	868	4956	498	0	6322
Kullu	1820	3512	65	3	5401
Lahaul & Spiti	127	11637	1825	2	13591

District	Severe to Very High	High	Moderate to Low	Unlikely	Total Area (Sq.Km.)
Mandi	968	1978	826	98	3870
Shimla	893	3345	767	14	5019
Sirmaur	95	1805	614	228	2742
Solan	556	1118	157	79	1910
Una	2	678	517	311	1508

Source: Landslide Hazard Zonation Atlas of India, BMTPC

10.7.1.5.1 Causes of Landslide

Every natural slope has its own strength (cohesion, friction, shear strength etc). Whenever this is reduced/ overcome by external forces, the slope fails. There are many causes which add to the stress acting on the slopeBedding and joint plane dip slopes, high joint and joint set frequencies, low vegetation cover, high monsoonal rainfall, thin soil cover and anthropogenic activities were found to be the main causative factors of the landslides. Anthropogenic activities include local path, canal and road construction, mining and quarrying, overgrazing, deforestation and unscientific agricultural practices, such as tilling steeper slopes (>30) without contour benches and without provision of drainage ditches, and over cropping without giving rest to the overtaxed soils. Where slope conditions are critical human activities should be controlled so as to minimise the slope failure processes. Some of the prominent causes of landslides over Himalayan region area as under:

Natural causes:
- Pore pressure.
- Geology.
- Decrease in shear strength due to weathering and/or saturation.
- Toe erosion.
- Seismic vibrations.

Anthropogenic causes:
- Deforestation
- Interference or changes to natural drainage.
- Leaking pipes such as water and sewer reticulation.
- Modification of slopes during construction of roads, railways, buildings etc.
- Overloading of slopes.
- Mining and quarrying activities.
- Vibrations from heavy traffic, blasting etc.

10.7.1.5.2 Types of Landslides

Landslides are generally classified into four types. These are mainly Fall & Toppling, Rotational and Translation slides and Flows & Creep.

Fall and Toppling

A rock-fall is the abrupt free fall or downslope movement, (rolling or sliding) of loosened blocks or boulders of solid rock. It differs from a slide in that free fall is the main type of movement and no marked slide surface develops. This type of slope failure occurs along steep gorges, cliffs and steep road cuts through unstable bedrock. The bedding, jointing and fracturing of the bedrock are the important factors affecting slope stability. The effects of weathering, such as the freezing of water in joints (in cold regions), the pressure of water in fissures, and root pressures may initiate failure in the weak rocks.

Slides

A slide, in the strictest sense, is characterized by failure of material at depth and then movement by sliding along a rupture or slip surface. If sliding is on a predominantly planar slip surface, then the slide is called a block slide. If movement is on a curved slip surface, then the slide is called a rotational slide. A lot of rotational slide end up as a mudflow leaving a gaping hole in the ground where the slide began. Debris from the slide is strewn down a torrent track along which the mudflow travelled to the base of the slope or where the flow path widens and dissipates. A rotational slide with one or more curved slip surfaces where the movement of material is incomplete, leaving individual slumped blocks, is referred to as a slump. Slides are probably the most common and overall possibly the most destructive type of landslide to hillside developments. Wherever steep mountains or hillside slopes occur or are altered, the possibility of large landslides and consequent disasters exist. The rupture or slip surface can occur within the bedrock, at the contact between the bedrock and the overburden or soil (in which case all the surface materials move) or within the overburden which in some cases may be of artificial fill.

Flows

Flows involve the deformation of an entire soil mass that then flows downslope as a viscous or sticky fluid. Deformation may be due to a high soil water content or seismic shaking that leads to liquefaction and thus generates such a fluid flow. The slopes need not be very steep. Two types of flow can be recognized; if the downslope movement is very slow then is an ea rthflow, if it is very rapid it is a debris flow or as it is sometimes known, a mud-flow.

Earth flow

Earth flow occur in moderate to steep slopes where the topsoil or overburden seasonally becomes saturated by heavy rains. The material slumps away from the upper part of the slope leaving a scarp, and flows down to form a bulge at the toe. Earthflows range from very small to the very big, involving hundreds of tons of material blocking or destroying roads, damming rivers and destroying houses.

Debris flow

Debris flow or Mud flow are the two terms used interchangeably and refer to the rapid but viscous flow of mud and other surficial materials. Rotational slides usually end up as mud flows after travelling a few metres because the soil is saturated and vibrations caused by the movement induces the soil to liquefy and behave as a viscous fluid. The flow can travel along channels or flow paths for considerable distances until the slope decreases or the channel widens, at which point the flow fans out and its momentum abates. Mud or debris flows commonly originate in steep terrain where vegetation and organic litter that help to stabilize the soil and retain rainfall and runoff have been removed by fire, grazing, logging or other processes. Intense and prolonged rainfall may then trigger the downslope movement of soil and other surface materials. This type of landslide is potentially more dangerous than other types because it can form very quickly and more velocities up to 80km per hour.

Creep

Creep occurs mainly in the soil mantle, that part of the soil from the surface to a few centimeters or metres below the surface. It involves the slow downslope movement or the gradual plastic deformation of the soil mantle and/or the fracturing of bedrock at imperceptible rates. There is no single surface along which slippage occurs. The rate of downhill movement or creep can vary from a few millimeters per year for slopes less than 10% to about 10mm per year in steeper terrains. The downward movement involves minute displacement of individual particles that are moving at different rates. It is commonly caused by the expansion of the surface layer due to heating followed by contraction due to cooling. Creep may also be caused be the swelling of certain clays after seasonal rainfalls when their moisture content increases, followed by contraction when their moisture content drops during the dry period.

10.7.1.5.3 Examples of different types of Landslides observed in Himachal Pradesh

CREEP:

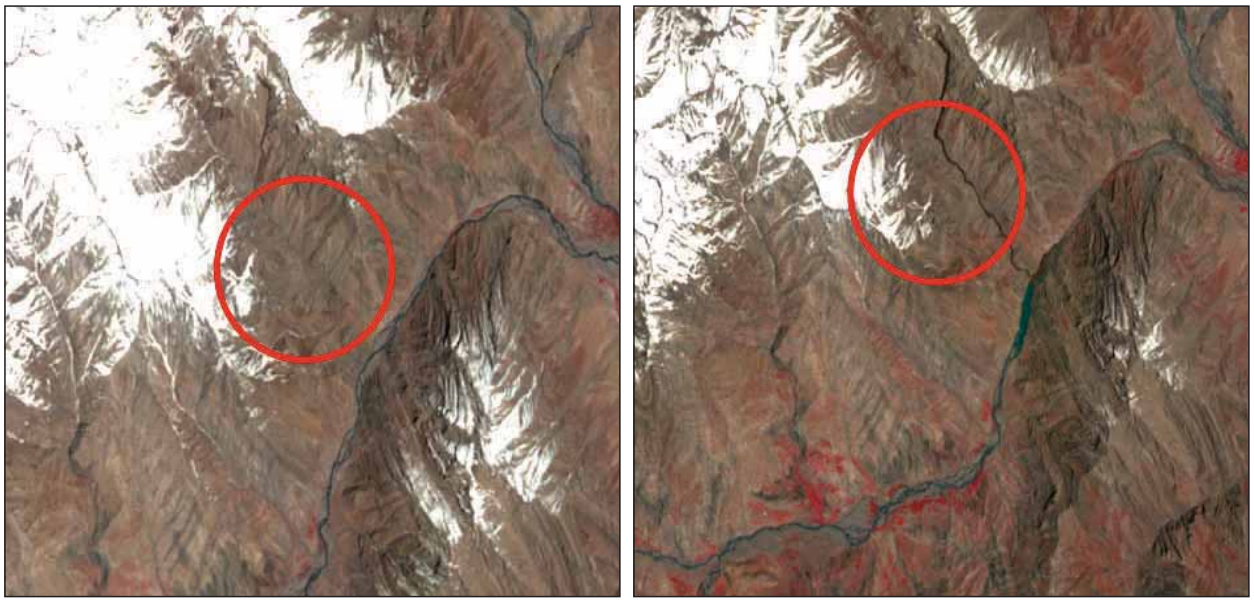
- Very slow rate of movement and defines major sinking zones (few cm per year) eg leori area.
- Identified by hockey stick bend of trees, tilting of building, poles, trees etc. • Absence of vegetation on a debris covered slope
- Most affected zone is Lesser Himalayan Zone
- Slopes with sufficient thickness of debris
- Slopes with highly fractured and weathered rock
- Palaeo creeps material are also present and can be seen on right bank of Satluj at Rampur and Jeori; right bank of Chenab River nearly 2 km d/s of Udaipur. (u/s of SeliFIEP); Barauni khad bridge also affected due to this.

MUD/DEBRIS FLOW:

- Kirgang Nala experiences mud flow/debris flow slide in the month of July — August for the past three consecutive years due to melting of Yula glacier located u/s of Kirgrang Nala at El ±5000ms1.1n the year 2014, heavy discharge of slide debris consisting of rubbles & soil with water gushed out through the kirgrang nala and breached the connectivity bridge along with Attargoo— Mudh— Bhawa road, as a result two gram panchayats namely Sagnam and Kungri was cut off from the rest of the town.

- Barauni Khad Bridge breach along NH22 near Jhakri
- Pagal nala near Manali. Debris material moves down along nala course during monsoon.

Ceep Flow



Debris Flow due to snowmelt along stream in Pin River Basin

ROCK FALLS

Occurs mostly in high altitude areas and in steep slopes where there are structural disturbances to the rocks like joints, faults etc. The rockfall near Dwada village at change 231.400Km in NH-22 initiated on 5/12/2015 by minor movement in upslope and triggered on 7/12/2015. Geologically the area represents rock sequence ranging from Paleo-Proterozoic to Neo-Proterozoic. The area comprise of carbonaceous phyllitic slate, quartz arenite with thin bands of biotite chlorite schist belonging to Vaikirta Group. The negative slope due to road cut without proper scaling and highly jointed rock mass creates wedge failures.

Rockfall along Billing Nala in Lahaul & Spiti District

PLANAR FAILURES

- If the slip surface of the slide is straight it is called planar failure.
- Usually happens when the beds/joints slope towards the hill/road cut.
- Lubrication in the interface due to water results in slide.
- Very common all over Himachal Pradesh.

Planar failure observed near Joginder Nagar, Mandi district

DEBRIS SLIDE:

• Involves huge amount of debris of either fluvial, glacial or paleoslidematerials. tg: Reckong pro, Will, Dadahu landslides • Urni landslide in Kinnaur is an example where the NH 22 and the Sutlej River was blocked.

Debris cone over road and river

View of Urni landslide

RECKONG PEO LANDSLIDE

Causative factors for the subsidence are thick unconsolidated, non-cohesive glacio.fluvial material, very poor shear strength of slope forming material, high infiltration during rains through a highly permeable medium, infiltration of the domestic drainage discharge from the human settlements, besides dead load imposed by many building complexes, located around the slide.

Reckong Peo Landslide

Landslide at Shimla:

• Road 40m in length on the ridge in front of Gaiety theatre caved in by about 6 feet on Sth September 2010 during heavy monsoon showers. • The portion had developed cracks in August 2010.

Causes:-

• Presence of unconsolidated overburden material • Improper drainage arrangements • Inadequate slope protection measures • Triggering event- heavy downpour on Sth September, 2010.

A VIEW OF THE CROWN PORTION OF SLIDE (VIEW FROM EASTERN SIDE)

Debris slide near Dadahu, Sirmur

Debris slide near Harabagh, NH-20, Mandi

Debris slide near Chirang, NH-20, Mandi

Debris slide near Mandi town (Due to quarrying)

SINKING ZONES

DADAHU SLIDE-SINKING ZONE

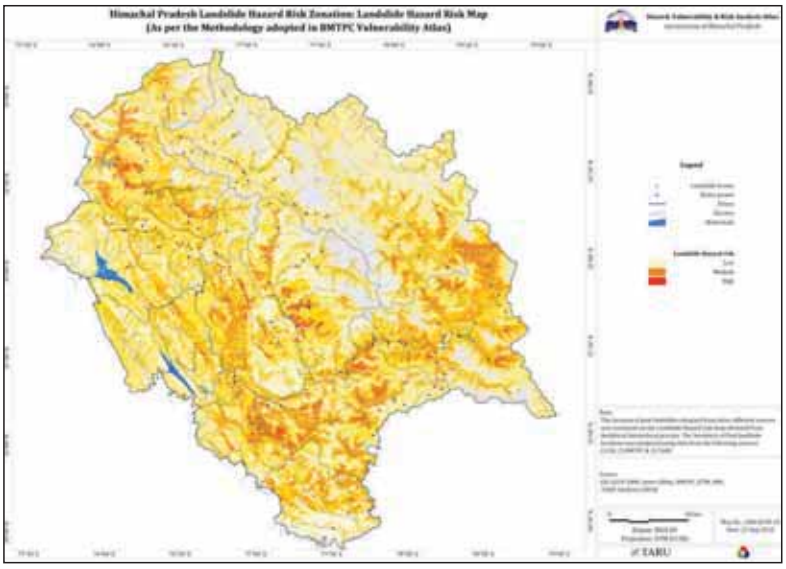
The landslide is manifested in the form of sinking of nearly 70m zone and has been reported active for more than a decade. Presently, the road is maintained by filling the subsiding portions. It has been observed that the zone is wet with seepages near its toe.

10.7.1.5.4 LANDSLIDE RISKASSESSMENT:

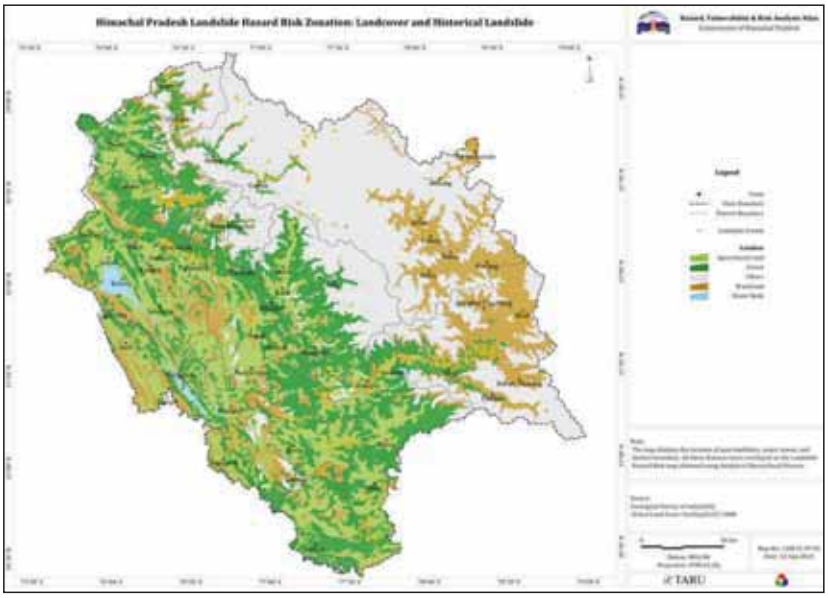
Landslides are one of the key hazard in the mountain regions particularly in the State of HP causing damage to infrastructure like roads, railways, bridges, darns, bio-engineering structures, and houses and the loss of life, livelihood and environment. Hence it essential to develop a Landslide Hazard Zonation (LHZ) delineating the areas at risk to reduce potential disaster. Landslide inventory is an essential part and forms the basic information for any landslide zoning such as susceptibility, risk and hazard zonings. It involves the location, classification, volume, and travel distance, state of activity and date of occurrence of land sliding in that area. In addition, physiographic characteristics such as slope, aspect, relative relief, geology, drainage, rainfall pattern and land use land cover are key deciding factors for slope failure. Landslide Risk analysis was carried out as part of the Hazard Rick Vulnerability Assessment (HRVA) for the State of Himachal Pradesh by TARU considering the potential damage due to landslides in any area. Vulnerable factors includes population, infrastructure, agriculture, critical facilities and so on. Major roadways, location of hydropower projects and settlement area were the elements taken into consideration to analyse the risk associated with them. Simple overlay, thematic mapping, multi•criteria selection and visual interpretation techniques were also used to understand the risk associated with each element under different Hazard risk. For Risk assessment the results obtained from AHP approach were used with different elements such as location of hydropower projects, major roadways, villages and major towns to analyse the risk associated with these elements.

Landslide Hazard Map using Multi Criteria analysis (as per the methodology adopted in BMPTC Vulnerability Atlas, Expert's Knowledge and AHP) was prepared as part of the HRVA in terms of landslides in Himachal Pradesh. The study was completed using weighted overlay technique which combines all the raster's files using common measurement scale and weights according to the influence the raster has on the particular event. Most of the area under the state of Himachal Pradesh is under threat of landslides. It is the topographical profile of the state and the extreme climatic conditions which makes it susceptible to Landslides. Hazard risk map of the state depicts that the area of the state falling under the three categories of hazard proneness viz. low, medium and high hazard. Most of the area under the state of Himachal Pradesh is under high hazard. Figure20 shows the result obtained from

three different methodologies that is as per the methodology adopted in BMPTC vulnerabilityanalysis. According to the Landslide Hazard Zonation Atlas of India published by BMPTC more than 8% of the entire area of the state is under High Hazard Risk zone but according to revised methodology using expert knowledge (EK) and AHP indicate that around 3.20% and 5.65% area respectively under High Landslide Hazard Risk. It was observed that as per the Experts Knowledge and AHP approach majority of the total area of Himachal Pradesh is under Medium Landslide Hazard Risk zone. Number of past landslide locations obtained from Geological Survey of India (GS°, TARU and BMPTC fall on the High Hazard zone obtained from three different approaches applied to form Landslide hazard risk map for the State(Map). Given the hazard zonation, much of the roads (total length of '1.628 kms) in Himachal are seasonal and get dosed during winters and monsoons due to heavy snowfall, landslides and washouts. Visual interpretation and GIS analysis indicate that most of the built-up area comes under the high risk zone. On further analysis, it was found that around 10 Mega Hydropower projects of Himachal Pradesh are under maximum threat of Landslide followed by large hydropower projects which fall under medium landslide hazard risk.



Map: Himachal Pradesh Land slide Hazard risk zonation



Himachal Pradesh Land slide Hazard risk zonation- Land covert

10.7.1.5.5 Case Studies in Himachal Pradesh:

Landslide Activity in Soldha Area of District Kangra, Himachal Pradesh

Soldha a small village situated on North of Trilokpur Town on the main Pathankot-Mandi National Highway-20. On the night of 22 October 2013 at around 3 A.M., a massive scale destruction due to landslide and mass movement along the gentle sloping terrain occurred at village Niangal under Gram Panchyat Soldha in District Kangra. Although there was no loss of life due to this massmovement(primarily because the people saved themselves by vacating the houses as the movement started), but enormous loss of property in terms of houses and agriculture land occurred due to the impact of this mass movement of massive magnitude. A total of 06 houses, 06 cowshed, loss of 03 animal, 5.60ha of agricultural land and 23ha of forest land is reported by the District Administration due to this natural calamity with a total economic loss of about 86 Lacs due to agriculture & infrastructure damage and about 86 crores due to forest land was estimated.

Inferences:

While throughout the length of Himalayas, good exposures of tertiary and pre-tertiary rocks occur, but it is in Dharamshala and its adjoining areas which also include the areas under investigation, the tertiary and pre-tertiary rocks are present within a short aerial distance. This diverse lithology within a short span of distance along with structural heterogeneity has made this part of Himalayas tectonically significant. Interestingly the area is seismically active and falls in the High Seismic Zone, Zone V. Regional thrust systems and lineaments controlled the seismo-tectonic activity in the region. Neo-tectonic activity has resulted in the contemporary geomorphological adjustments in the form of hills and depressions and movements along the active longitudinal & transverse lineaments and prominent thrusts. Rampant seismic activity in the region especially during the second half of 2013 has possible resulted in the development of failure planes especially along the thrust contacts and prominent lineaments which is further corroborated by the seismic events in Himachal & adjoining Jammu & Kashmir region during this recent past especially in the month of August & September. Based upon the preliminary observations in the field, this event does not appears to be a normal landslide caused due to the slope failure on two counts i.e. firstly the slide occurred much after the rainy season especially during the dry months and secondly the slope on which the first event of landslide occurred is gentle enough and supports good agriculture fields and cannot invoke shearing stress in the slopes to cause a failure. Moreover the aerial extent of the mass movement of the land surface is so enormous and cannot be related with normal landslide phenomena. Thus based on the above observations, it is inferred that the Soldha mass movement/landslide deciphers an unique example of the tectonically induced landslides related to neo-tectonic activity occurring along the contact margins of Jawalamukhi thrust. However more supporting data is required to understand this significant event that has occurred in the District Kangra of Himachal Pradesh in order to relate it to the seismo-tectonic attributes of the region.

Soldha Landslide, District Kangra

Lake formation along Biling Lungpa, Lahaul & Spiti District Himachal Pradesh

Recently a lake was formed in Lahaul & Spiti district of Himachal Pradesh. In the first week of June 2014, a small lake was formed along the Billing Lungpa which is a tributary of Bhaga River and joins it on its right bank near Keylong. Due to landslide, this stream was blocked with the result water started accumulating and eroded agriculture land as well as two cow sheds. Although there is no major destruction, but still the threat was there. On the basis of the request received from District Administration through Revenue Department, a field survey was carried out from 19-23 June 2014 and based on the field as well as satellite data analysis for 13 June 2014 and July 2013 a technical report has been compiled. The results envisages that the slide was triggered due to the break in the cleavage plane of the Quartzitic rock bed resulting into huge slide down of the rock mass chocking the river course. As the rock fall due to frost activity is the common phenomena in the Higher Himlayan region and this seems to be the old slide zone which has been active in the past also. Although there does not seem to be any major threat as on day as the outlet seems to be normal, but there is need to create more passage for the outflow at the second breach in order to vacate the accumulated water using some local techniques or some other measures.

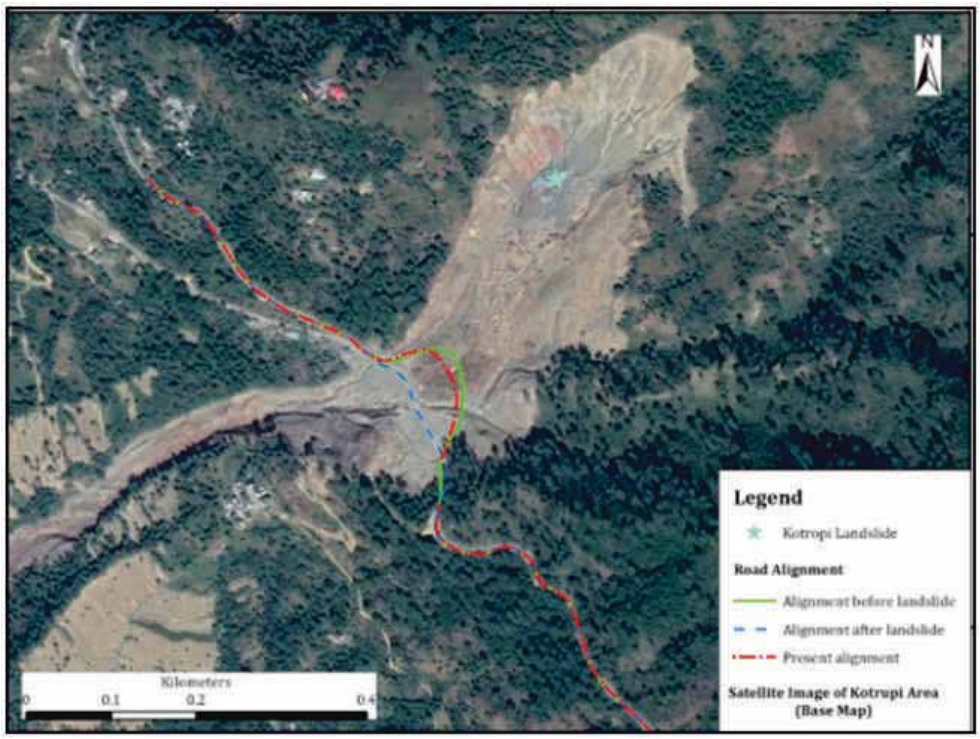
Disastrous Landslide at Kotrupi , District Mandi, H.P.(Singh et al 2020)

Tho Kotrupi landslide is located on Mandi-logindorNagar-Oathankot National Highway(NH)-134 with center coordinates of 31°54'46.29" N latitude and 76°53131.90"E longitude (as shown in Figure).The landslide falls in Seismic Zone V, which represents highlyvulnerable seismic area. The landslide lies in the Mandi district which is geographically located within 31°13'-32'05'N latitudes and 76°37'-77°251E longitudes. The area of the slide is measured to be around 133,674m and width is 190m, while the rur•out length is 1155m assessed from high resolution satellite image.

Landslide Event on 13 August 2017

A massive landslide occurred near Kotrupi village in Mandi district during early hours of 13 August 2017 (01:00-02:00 AM local time).The debris from landslide killed more than 50 people when two HRTC (Himachal Road Transport Corporation) buses (i.e.Manali-Katra and Chamba-Manali) along with other private vehicles were swept away and buried under the debris (Royet.a1.2018, Sharmaet.al., 2018, Pradhanet.al., 2019) (G512017). News reports suggests that approximately 300m of road stretch of national highway (NH-154) has been completely buried under debris, thus disrupting communication on an important route. Immense quantity of debris released from the landslide blocked the drainage up to 1km in the down-stream. The area

was subsiding due to presence of nalla, which made the region swampier. Due to this catastrophe, the new alignment of the NH was carried out by Public Works Department (PWD). As the Kotrupi landslide witnessed minor scarp failure in July 2018, the road was washed off and the authorities changed the road alignment again. The present stretch of NH-154 follow the same alignment, which existed before the incident of 13th August 2017.TheKotrupi landslide and the road alignments are shown in Figure

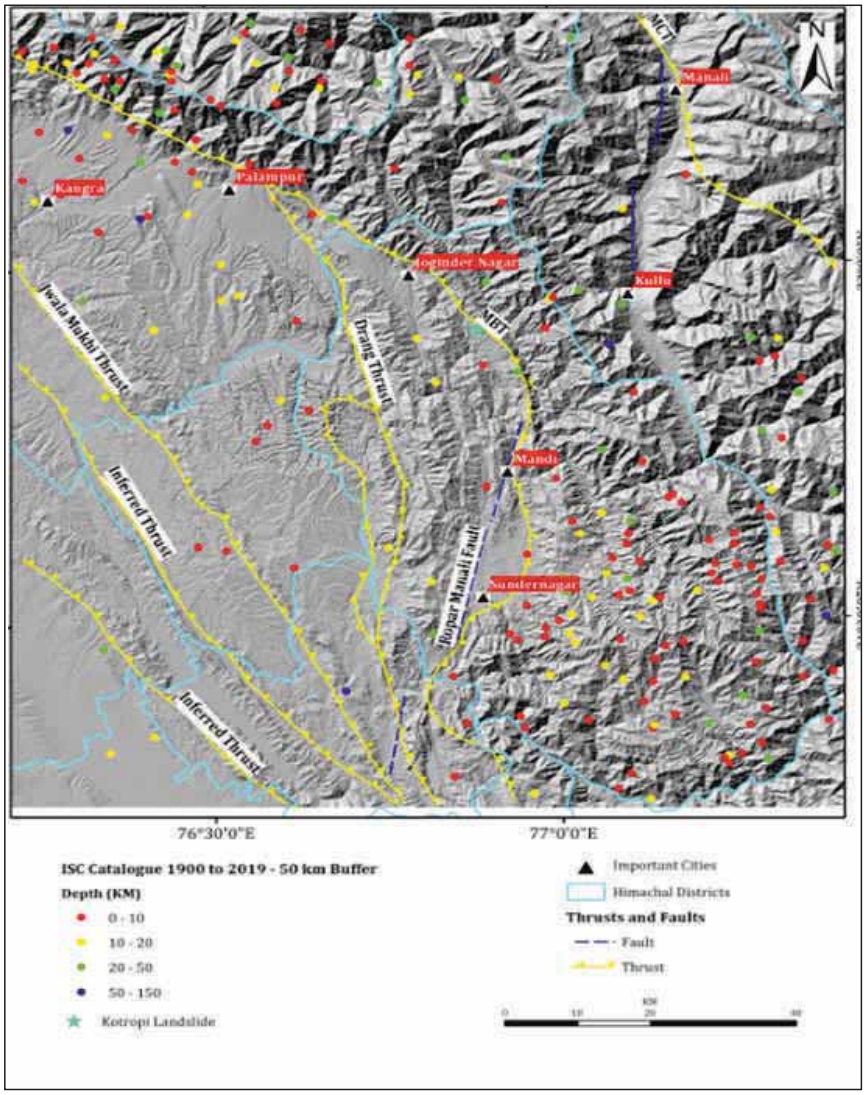


Kotrupi Landslide and the road Alignments

Field Photogrpah of Kotrupi Landslide

GEOLOGICAL OBSERVATIONS

The primary rock types found in and around the Kotrupiand slide area are red shales, dolomite of Shali formation and sandstone, shale of Siwalik Group (Royetal.,2018,Sharma et.al.,2018).The red shale rock present in the outcrop is loose, highly crushed and almost weathered in to the soil. The shale beds are present with interspaces,which are filled with loose soil and crushed rock material. Highly crushed and thinly bedded weathered sandstone intercal ted with shale beds is present at few places. The study area (Kotrupi landslide) is sandwiched between Siwaliks nd Shah formation along the thrusted contact of MST. In the west of MST, local thrust/faults like Drang,hvalaMukhi and Ropar Manalifaults (Thakur et.al.,2019) passes as shown in (Figure).These structural settings in the vicinity of the andshde area create favourable conditions for high vulnerability of the slope failures. Due to its weak and fragile topog phy and lithology, the area in between Ghatasani and Padhar region encounters many landslides. However, th Kotrupi landslide is one of its kind due to its large size and losses occurred

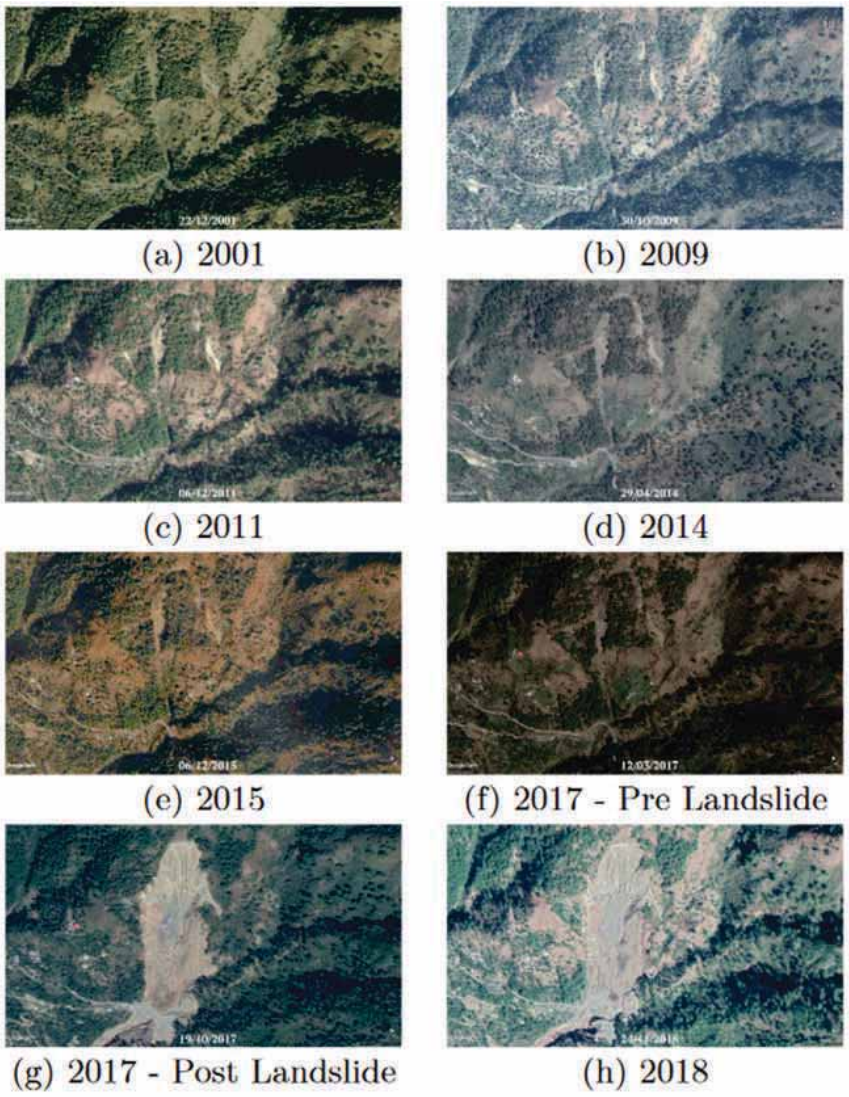


Ropar-Manali fault that passes through the Kotrupi landslide location.

The earthquake epicentres within 50km buffer zone of study area has been marked. The Main Boundary Thrust (MST) and Main Central Thrust (MCI) is marked in the map (Modifiedatter(Thakuretal.,2019)

Results

The Kotrupi landslide is one of the biggest of its type that took place in Himachal Pradesh. The initial report suggested that it occurred due to excessive rainfall. However, landslide scar can be seen on the previous years satellite images from December 2001 to March 2017 on Google Earth. From the satellite images, it can be inferred that this catastrophe is not a mere one-day event rather decades-long process. Cracks were developed well before the occurrence of the event; however, rainfall might have triggered the slide. Local residents report that this area has always been unstable where small and slideshad occurred in the past. A huge landslide also occurred at this location on 13 August1977.After two decades on 3 August 1997, the landslide reactivated and some part of the slope failed, which can be seen on satellite images of the year 2001(Map:(a)).The landslide reactivated again on 13 August 2007, but not much attention was given to it, as it was a small event and did not affect much. Again, after a decade, in the early hours of 13 August 2017 this landslide was reactivated. The Figure shows various images of Kotrupi area prior to landslide and after landslide. The scar can be seen expanding from surficial crack to massive landside from 2 001 to 2 018 in Map (a) and (h).


(a) 2001 (b) 2009

(c) 2011 (d) 2014

(e) 2015 (f) 2017 - Pre Landslide

(g) 2017 - Post Landslide (h) 2018

Figure: Landslide Reactivation - The existence of crack (Year 2001) can be clearly seen in (a). The development and enlargement of crack can be seen in subsequent images (b)-(f). Landslide occurrence can be seen in (g)and (h). Change in Roadalignment isalso visible.

10.7.2 WATER AND CLIMATE RELATED DISASTERS

10.7.2.1 AVALANCHE HAZARDS IN HIMACHAL PRADESH

An avalanche may be defined as the sudden downward motion of the snow mass whkhmay contain rocks, soil, ice and trees. Snow avalanches in the Higher Himachal Himalaya are common high frequency low magnitude process where slope, aspect, relief and surface gradient are conducive for initiation of failure. As a material, snow has some mechanical properties in common with soil, such as cohesion, angle of internal friction, and density, all related to one another in a complex way. When snowfalls on a sloping hillside and accumulates, the conditions which govern whether or not an avalanche occurs are similar to those in the case of shallow soil landslides on a long slope. If the shearing strength is exceeded by the down slope component of weight, an avalanche will develop. The depth of snow accumulation before a slide takes place depends on the properties of density, cohesion, and friction in the snow and the slope angle in the same way as these conditions apply to soil on an infinite slope. The snow depth at which the stressesare exceeded isusually referred toasthe critical depth.

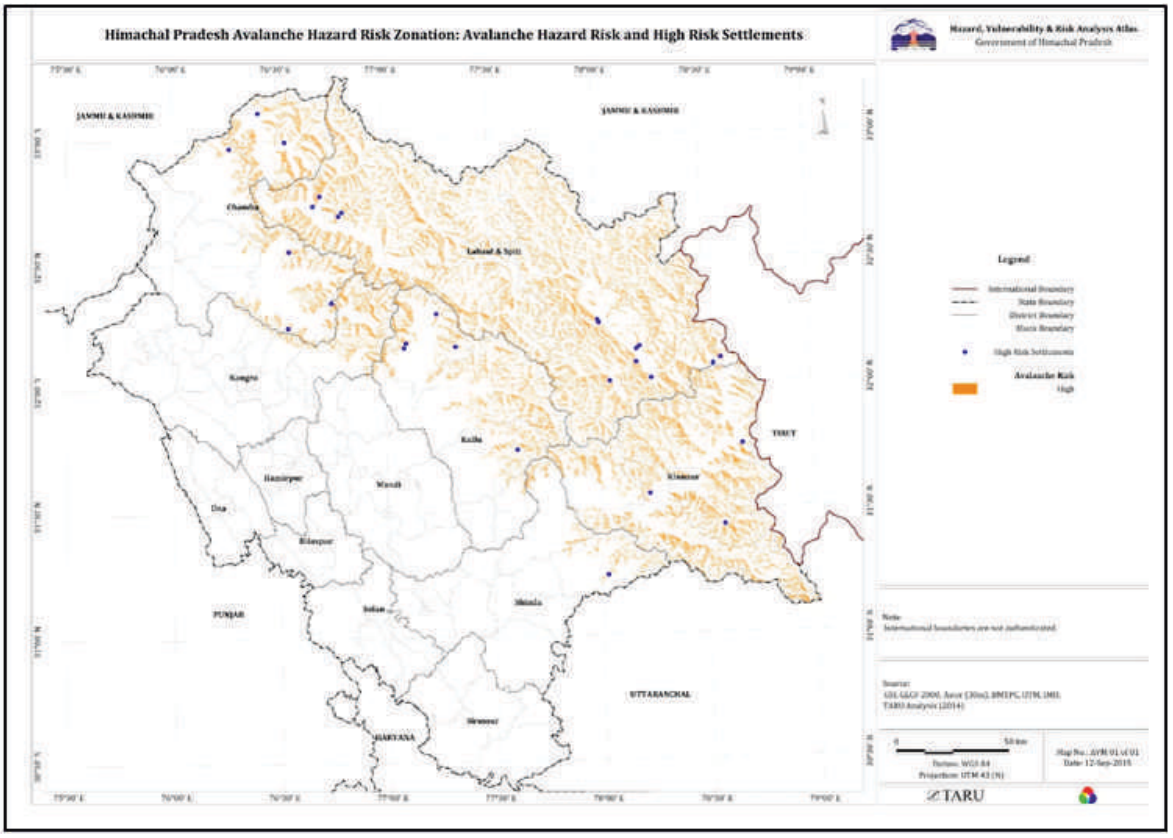
Shallow avalanches are common during winter months (snow precipitation related to the mid-latitude westerlies) in higher altitudes, feeding to glacier mass balance. Depending on the length of run-out distance and catchment area, these avalanches may be catastrophic. A single snowfall event contributing over 2-3 feet of snow accumulation in the high probability snow avalanche area are more at risk, given the existing investments in infrastructures. Based on our analysis the high probability area comprise of only 1.2% of the total geographical area within the state leading to limited possible impact on built infrastructure and population. Moderately probable avalanches occursin about 1S% of the geographical area; which are mainly confined to higher altitudes that feed glaciers sustenance and mass balance. Even though the extent of area is large the low population density around these areas do minimize the extent of the risk. Nevertheless, the extent of developmental activities including roads and bridges around the avalanche prone areas have increased inthe recent past which might lead to increased economicwInerability. Therefore there is a need to develop a mechanism to artificially trigger avalanchesin the event of single snowfall spell in excess of 2feet or more to avoid large scale damage. Since the regional govemment is in the process of infrastructurel investments by constructing all weather roads dedicated action force may be constituted to artificially trigger avalanches in avalanche risk prone areas.

Himachal Pradesh too has a great threat from avalanches particularly the higher regions in the Kinnaur and Lahaul & Spiti districts of the Great Himalayan Ranges.Avalanches have a history of damage in Himachal Pradesh.lna number of ways, avalanches of snow resemble certain kinds of landslides, but important differences are involved. The Higher Hills comprising the districts of Kinnaur, Lahaul and Spiti, Chamba, and Ku II u are particularly vulnerable to the hazards of avalanches. The destruction caused as a result of avalanche in the past in Himachal Pradesh is confined to higher reaches only. The prominent events of avalanche damage in Himachal Pradesh are as per Table and the district wise breakup of avalanches in M.P. isgiven in Table

AVALANCHE HAZARDAND THE DAMAGE OCCURRED

Location	Date/Year	Damage Occurred
Lahaul and Spiti	January 1975	Earthquake shocks triggered the avalanche of great dimensions damaging road net work
Lahaul and Spiti	March 1978	About 30 people killed, road and property damaged.
	March 1979	About 237 people killed. Communication disrupted
Lahaul and Spiti	March 1991	Tinku avalanche occurs every year 4-5 times from Jan to March. Road was blocked for 40 days in 1991
	September 1995	Due to avalanche, huge chunk of debris came down which later changed into flood
Lahaul and Spiti	November 1997	Along the Rani Nala, but fortunately there was no casaulity
Lahaul and Spiti	March 2011	PindriNala, 2 laborers died
Chamba	February 7,2019	At Sunka Tapri –Bharmour damaging 90.56 lakh property loss
Pangi	February 7,2019	G.P. Sechu , 11 houses damaged fully and 77 cattle loss
Pangi	February 15,2019	Sural damaging 1 pakka house fully
Kullu	February 21,2019	AT Anni four pakka houses partially and 1 cowshed damaged
Kinnaur	February 20,2019	At Namgiya Dogri , 6 army personal died
Lahaul & Spiti	January 20,21,22,22,27,01 February	At Bangru nallah, Gwazang nallah, Gwazang, Pyaso nallah, Greetu nallah and Chhokhamg-Mooray , no damage was reported
Lahaul & Spiti	February 15,2019	Lossar- Chichham road blocking 1Km road stretch
Lahaul & Spiti	February 22,2019	At Thambi nallah wherein 5 LMV and 4 tractors were washed
Himachal Pradesh	Winter 2019	59 avalanches reported killing 6 person during winter 2019

Source: SASE, DRDO, Chandigarh & Memorandum of Damages SDMA,Govt of H.P.



(Source: Vulnerability Atlas-SDMA ,H.P.)

AVALANCHE HAZARD MAP

Districtswise Breakup of the Avalanche Accidents in Himachal Pradesh

Sr.No.	District	No. of Accidents	Persons involved	Persons killed	Persons injured
1	Chamba	12	59	53	0
2	Kinnaur	32	144	129	9
3	Kullu	6	13	9	4
4	Lahaul & Spiti	21	397	298	53
5	Shimla	2	6	1	5

Source: SASE, DRDO, Chandigarh

10.7.2.1.2 SNOW AVALANCHE PROBABILITY ZONES CLASSIFICATION

Based on the study conducted for HRVA with reference to avalanche hazard in Himachal Pradesh, the multiplicative function is used for calculating avalanche risk index.

A Risk index = f (S,A, L) Where: A Risk index = Avalanche risk index S = Slope A= Aspect L = Land cover Categorisation of Avalanche Risk Index The avalanche risk index contains the highest value as 27. These are the zones where all three parameters (slope, aspect and land cover) favor the occurrence of a snow avalanche. The lowest value is zero, where at least one of the parameter have nil (zero) probability for avalanche. Based on the above analysis the results were classified into four probability risk indices. A value "0" is considered as zoneof nil probability and "C being high probability of occurrence.

Himachal Pradesh: Snow Avalanche Probability Zones

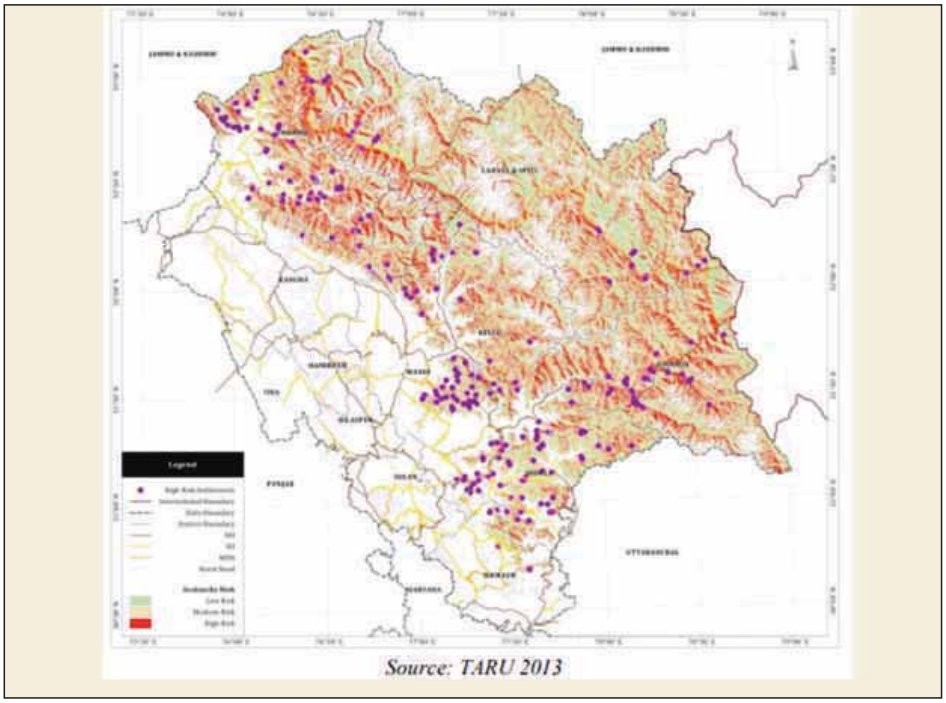
Categorization of Snow Avalanche Probability Zones

Probability Category	Probability Type	A Risk Index Value
0	Nil Probability	0
1	Low	01-09
2	Medium	10-18
3	High	19-27

Himachal Pradesh: Snow Avalanche Probability Zones

Probability Category	Probability Type	Area (sq. km)
0	Nil Probability	8,068
1	Low	21,385
2	Medium	5,076
3	High	424
Notes: Values calculated above 2000 metres Due to tolerance Limit, variations in total area are ± 2.16 percent		

The snow avalanche probability zones for Himachal Pradesh is presented in Map. The high probability zones are the ideal sites for the occurrence of snow avalanche following snow fall. These regions have least frictional resistance for avalanche failure; hence the flow path and run-out surface analysis of these regions must be analyzed in detail for further understanding of snow avalanche damage capabilities.



Avalanche Probability Zones, Himachal Pradesh

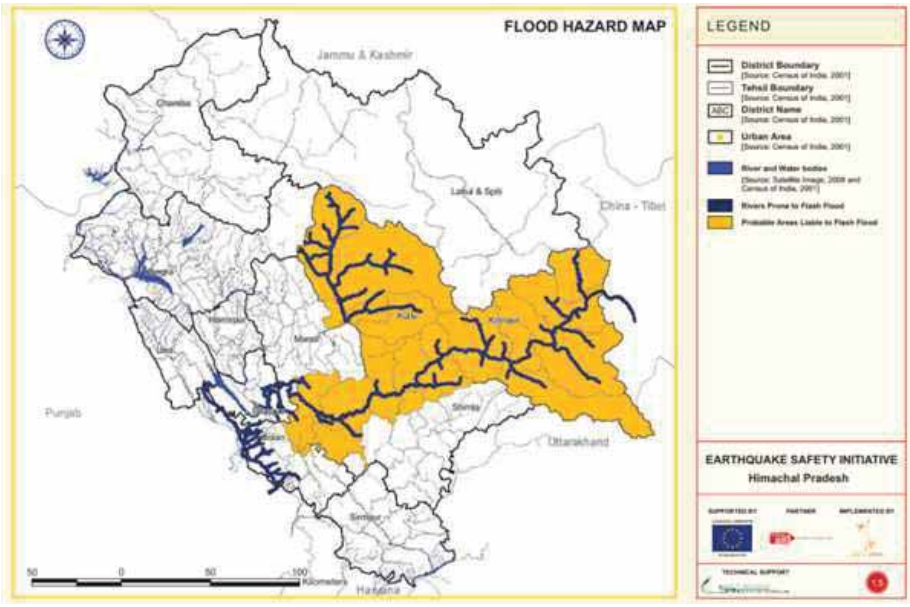
10.7.2.2. FLOOD HAZARDS

Floods are another form of natural disasters which the state experiences every year. Due to the diverse topography of the area, the flood problem in the state is largely isolated in nature. High monsoon rains in the area of the Shiwalik and Lower and Mid Himalayan ranges causes extensive floods during the rainy season. In the upper reaches of the Beas and Satluj valleys,flash floods occur and bank erosion takes place because of steep slopes of rivers and high river flows due to heavy rains. Often the flash floods are caused by cloudbursts, glacial lake outbursts and temporary blockage of the river channels. As a result of breaches in embankments and damage to various utilities like irrigation /flood control schemes and houses are also observed. The rivers which are prone and important from flood hazard point of view are as per the Table & Map.

The Rivers of importance from flood damage angle

Sr.No.	Vulnerable Rivers	Major Tributaries
1	River Satluj	Spiti, Sangle khad, Ali khad, Gambhar khad,Sir khad, and Swan river
2	River Beas	Uhl and Suketi khads
3	River Ravi	Siul
4	River Yamuna	Pabbar,Giri and Bata

Source : Vulnerability Atlas Himachal Pradesh



(Source: Vulnerability Atlas-SDMA ,H.P.) Rivers Prone for Flood Hazards in H.P.

Although widespread floods inundating large areas like in the plains problems do not occur in the state because of topographical nature, continuing attention is necessary to reduce flood hazards in the state. As per the available record during the floods of 1990, 1989,1988, 1985,1978 and 1971, considerable damage was caused to housing and infrastructure. The history of damage occurred due to floods in the State during the past is as per

Devastating Floods, which caused heavy damages to Private, public as well as Government property

Sr.No.	Prominent Flash Floods	History of Damage Occurred
1	8 July 1973	Lake formed by the blockage of Satluj River due to nathpa rock fall damaging Sanjay Vidyut Power House cuasing revenue loss of Rs.45 Million.
2	In Satluj basin two blockades were observed in Spiti valley. One on Parchu River between Sumdo and Kaurik during the landslide along the right bank created by 19Jan.1975 earthquake, which occurred along the Sumdo-Kaurik fault. Blockade was 60m in width and 150m in length which created temporary lake. In March this lake burst causing flash floods in Spiti valley	
3	On 29th Sept. 1988(2.30 a.m.) a flash flood occurred due to cloud burst in Soldan khad causing huge damage to property.	Caused heavy loss of life and property in the Soldang village Washed away 2 km of NH-22 across Soldan khad Washed away the Bhabanagar water works Created landslides along the eastern slopes of Soldan khad and damage road to Ponda Lake was formed on the Satluj river near confluence Block stopped the flow of Satluj river for about 30 minutes and created a temporary lake having dimensions roughly about 6000 m long, 200-250 m wide and 25-30 m deep extending up to Wangtoo bridge Lake water entered Sanjay Vidyut Pariyojna and damaged the Power House

Sr.No.	Prominent Flash Floods	History of Damage Occurred
4	Second flood occurred along Maling nalla due to Maling landslide debris between 31st July and 2nd August 1991.	Cloud burst and flash flood along Soldan khad in Satluj valley Flood washed away 15 houses, 35 bigha of agriculture land and about 600 apple trees in Soldang village. 32 persons and 35 cattle heads lost their lives. Flash flood and landslide on 2nd August 1991 along Maling Nala in Lower Spiti valley damaged 1500m road section of NH-22 and washed away agriculture land along Leo village situated downstream.
5	24 Feb 1993 Satluj River blocked twice due to major landslide and rock fall near Jhakri amnd Nathpa damaging NH-22.	
6	Another flash flood occurred in two phases along Duling khad on 4th& 5th September causing extensive damage in Tapri, district Kinnaur First flash flood occurred on 4th September 1995m at 2pm, after cloudburst in the upper catchment of Duling and damaged the PWD rest house.	Huge debris formed a fan along Satluj river and formed a lake by partially blocking the river. Flash floods caused heavy damage due to change in river course of Satluj from left to right bank and increased the toe and lateral erosion at Tapri. Washed 19 houses , HRTC workshop along with 3 buses Change in course is still causing toe erosion to NH-22
7	High magnitude floods have also recorded in Beas valley in 1902,1945,1993,1995 . Continuous anthropogenic pressure on existing Geo-Eco system has increased the severity and damaging impact of these flash floods.	
8	4th& 5th Sept.1995 flash floods in Kullu valley	Caused damage to the tune of Rs.759.8 million. Heavy rains and flash floods caused water saturation along loose Quaternary deposits along slopes and excessive bank erosion which led to landslides in Kullu valley
9	February 1993	500m road section of NH-22 washed away by Jhakri slide.Rs.10 million loss to road and forest land , a village on the upper slope was in danger
10	Flash flood on the night of 31st July and Ist August 2000 in Satluj valley	Flash flood in the Satluj valley resulting in the increased water level of Satluj river upto 60feet above the normal level. The flash flood was termed as the one that occurs once in 61,000 years. Widespread damage in the valley right from its confluence with the with Spiti river near Khab to downstream areas. Extensive damage to 200 km of NH-22, washed away 20 bridges, 22 Jhulas and badly damaged 12 bridges. About 1000 irrigation, sewerages, flood protection and water supply schemes were badly damaged. Extensive damage to hydel projects including NJPC, 135 people and 1673 cattle lost their lives. The total estimated loss was to the tune of Rs.1466.26 Crore.
11	Flash floods on the night of 22nd July 2001 in Sainj valley in district Kullu	Cloud burst in the upper reaches of Sainj valley caused flash floods in two nallahs viz. Sainj and Jeeba affecting about 40 families. 2 bridges on Sainj and Jeeba nallas and plenty of fertile land was washed away. Connecting road to Siund and Sainj was also washed away at a number of places. Two persons were washed away and 5 cattle perished. Some other areas in Kullu district were also affected due to excessive rains in July and population of 6355 was adversely affected.
12	17th& 19th July 2001 floods in Mandi district	Excessive rains caused damage to 160 houses in Mandi district and destroyed 11 cattle and one person.

Sr.No.	Prominent Flash Floods	History of Damage Occurred
13	Flash flood on the night of 31st July and Ist August 2000 in Satluj valley	Flash flood in the Satluj valley resulting in the increased water level of Satluj river upto 60feet above the normal level. The flash flood was termed as the one that occurs once in 61,000 years. Widespread damage in the valley right from its confluence with the with Spiti river near Khab to downstream areas. Extensive damage to 200 km of NH-22, washed away 20 bridges, 22 Jhulas and badly damaged 12 bridges. About 1000 irrigation, sewerages, flood protection and water supply schemes were badly damaged. Extensive damage to hydel projects including NJPC, 135 people and 1673 cattle lost their lives. The total estimated loss was to the tune of Rs.1466.26 Crore.
14	Flash floods on the night of 22nd July 2001 in Sainj valley in district Kullu	Cloud burst in the upper reaches of Sainj valley caused flash floods in two nallahs viz. Sainj and Jeeba affecting about 40 families. 2 bridges on Sainj and Jeeba nallas and plenty of fertile land was washed away. Connecting road to Siund and Sainj was also washed away at a number of places. Two persons were washed away and 5 cattle perished. Some other areas in Kullu district were also affected due to excessive rains in July and population of 6355 was adversely affected.
15	17th& 19th July 2001 floods in Mandi district	Excessive rains caused damage to 160 houses in Mandi district and destroyed 11 cattle and one person.
16	Flash floods on the night of 29th and 30th July 2001 in Chhota Bhangal and Baijnath Sub Divisions of Kangra district	Caused widespread damage in the area. 12 deaths occurred due to flash floods and loss of 150 cattle was reported from the area. Bridge connecting Deol and Baijnath was also washed away. Total estimated loss was to the tune of Rs.18.27 Crore.
17	Flash floods on the night of 9th August and 10th August 2001 on Moral-Danda peak in Rohru Sub-Division in Shimla District	Flash floods occurred along two streams , one along the Devidhar area and another along Darkali in Rampur Sub Division. Damage to infrastructure like roads, bridges, agriculture land, horticulture land, footbridges, village paths, residential houses, and water mills and loss of 3 lives and 390 cattle and destruction of private property. Total loss in both the Sub Divisions was 145.15 lacs. In Rohru Sub Division 7 bridges, 8 village paths,8 water supply schemes, and 1 power house was damaged besides 16 houses, whereas in Rampur Sub Division, 10 bridges, 8 village paths, 1 water supply schems,1 soil conservation plant, 7 residential houses and 16 water mills were damaged.
18	Flash floods on the night of 21st and 22nd August 2001, cloud burst in Ani Sub Division of Kullu District	Due to flash floods in village Badhali 2, houses in which a couple was buried alive and their two children injured. In village Sarli 7 people lost their lives, 15 houses were washed away besides the loss of 12 cows, 18 oxen and 40 sheep and about 115 bighas of agriculture and horticulture land was washed away.
19	Flash floods in Sihunta area and Tissa areas of Chamba district on the night of 12-1th August 2001	Washed away 9 hectare of fertile land, 2 small bridges causing a total loss to property of Rs.2 crore.
20	Flash floods due to cloudbursts in Gharsa valley on 16th July 2003 in Kullu district	Due to these flash floods 21 people lost their lives, 21 people suffered major injuries and 9 are missing
21	Flash floods in Kangni nala near Solang in Kullu district on 7th August 2003	30 people lost their lies and 19 were injured and 9 people were missing.2 people lost lives due landslides in Bhang nala.

Sr.No.	Prominent Flash Floods	History of Damage Occurred
22	Flash flood in Satluj river due to breach in the Parechhu lake in Tibetan catchment on 26th June 2005	Extensive damage as a result of rise in water level of Satluj river due to a breach in the Parechho lake formed in Tibetan catchment. Washed away the NH-22 at a number of places, 10 bridges, 11 ropeways washed away, 15 motorable bridges and 8 jeepable and footbridges damaged/affected.10km stretch of Nyh-22 between Wangtoo and Sumdo was washed away and various link roads were damaged. Total loss estimated to the Govt. as well as public property was to the tune of 610 crore.
23	Flash floods during July 2005	Flash floods in Pabbar river in Rohru Sub Division resulted in heavy losses to roads, bridges, public buildings, residential houses, cowsheds, private land. Chirgaon block was totally cut off. On July 7,2005, flash flood in Baspa river took place causing the loss of 6 bridges and 600 mt link road to Sangla.More than 3000 cattle perished in different parts of the state leading a total loss of Rs.55980.76 Lacs.
24	15 August 2007,Bhavi Village, Ghanvi Shimla District	58 persons died, all roads leading to village cut off.
25	7August 2009,Dharmpur, Mandi District	2 persons died.

Source: Bhandari,1988; Sah et al.1996,Sah & Mazari 1998;Sah and Bist 1998 'Paul et al, 2000,Revenue Department (Govt of Himachal Pradesh)

Cloudburst in Manali

Two persons were killed, 22 injured while at least a dozen went missing after heavy downpour triggered by cloudburst at MSP-7 near South portal of Rohtang Tunnel on intervening night of Wednesday and Thursday on 21st July, 2011 near Manali, District Kullu. A body was recovered by riverside from Nehru Kund and another near Old Manali, about 20 km from the spot. The flash flood startled around 130 labourers on the site at around 12.30 am and 22 injured labourers were rescued within an hour. The scene could have been even horrible if the cloudburst had occurred few minutes earlier. Around 130 labourers were working on the site till 11.30 pm. They heard a loud sound of flowing water and debris. Most of them escaped while 22 got trapped in debris and two were drowned to death. The labourers were working for Garg and Garg, a private construction company, on approach road to Rohtang tunnel. They were building snow galleries (avalanche tunnels) at MSP-7, around 20 km from Manali.

(Source :SDMA Reports)

10.7.2.2.1 Floods due to Climate Induced Hazards in Himachal Pradesh

The entire Hindukush-Himalaya reason is prone to the geological or climatically induced hazards of various forms and nature. However, there is a clear indication that not only the frequency of such hazards is increasing with time but also their intensity and impact on the lives and livelihood of people, living in the area, is increasing in severity. The recent incidents of cloudburst, flash floods in Leh, Shimla, Haridwar, Almora, Uttarkashi and Badrinath etc. witnessed in the Himalayan region of India and the floods in Pakistan were the part of the climatic inductions. However, these were few of the nationally reported incidents but there were numerous incidences, which were not reported. Many hazards were caused due to the geological disturbances. However, such disturbance intensifies the nature of hazards when they cause massive amount of water or rock to collapse on the human settlements and their resources. Leh was the worst example of water-induced hazard. Himachal, Uttarakhand, & Jammu were also affected by hydrological hazards. In Himachal, there were several incidences of cloudburst, floods and landslide, recorded this year.

Mountain ecosystems harbor a wide range of significant natural resources and play critical role in the ecological and economic processes of the Earth. Deforestation, landslides, land degradation, desertification and Glacier Lake Outbursts Flooding (GLOF) are some of the common environmental issues in the mountain regions. The major challenge currently faced by the mountain environment is the escalation of these issues through atmospheric as well as man-induced changes.

Mountain systems are particularly sensitive to climate changes. Since industrialization, human activities have resulted in steadily increasing concentrations of greenhouse gases-particularly carbon dioxide (CO2), methane (CH4), chlorofluorocarbons (CFCs) and nitrous oxide (NOx)- in the atmosphere. As these gases absorb some of the radiation emitted by the Earth rather than allowing it to pass through the atmosphere to space, there is general consensus that the Earth's atmosphere is warming.

The fifth Intergovernmental Panel on climate change (IPCC 2013) report states with 95 percent confidence that humans are the main cause of the current global warming. Most of the observed increase in global average temperatures since the mid-20th century is very likely [90 percent confidence] due to the observed increase in anthropogenic greenhouse gas concentrations.Global warming is the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century and its projected continuation. Since the early 20th century, Earth's mean surface temperature has increased by about 0.8 °C (1.4 °F), with about two-thirds of the increase occurring since 1980. Warming of the climate system unequivocal, and scientists are 95-100% certain that it is primarily caused by increasing concentrations of GHGs produced by human activities such as the burning of fossil fuels and deforestation. Climate model projections were summarized in the 2007 Fourth Assessment Report (AR4) by the (IPCC). They indicated that during the 21st century the global surface temperature is likely to rise a further 1.1 to 2.9 °C (2.0 to 5.2 °F) for their lowest emissions scenario and 2.4 to 6.4 °C (4.3 to 11.5 °F) for their highest.

Analysis of the temperature trend in the Himalayas and its vicinity shows that temperature increases are greater in the uplands than lowlands areas. Regional changes in climate have already affected diverse physical and biological systems in many parts of the mountain regions. Shrinkage of glaciers, thawing of permafrost, late freezing and earlier break up of ice on rivers and lakes, pole ward and altitudinal shifts of plant and animal species, declines of some plant and animal population, and earlier emergence of insects have been observed (IPCC, 2001). Climate influences weathering processes, erosion, sediment transport, and hydrological conditions. It also affects the type, quantity, quality, and stability of vegetation cover and, thereby, biodiversity. Mountain systems are particularly sensitive to climate changes. Small changes in climate can produce significant regional or larger-scale effects. In particular, marginal environments are under high stress. Small

changes in water availability, floods, droughts, landslides and late frosts can have drastic effects on agriculture economics. The most likely scenario in the mountain environment due to climate change will be as that the Mountain environments are likely to be among the most severely impacted ecosystems as a result of climate change.

A warmer climate will cause lower-elevation habitats to move into higher zones encroaching on alpine and sub-alpine habitats.

High-elevation plants and animals will lose habitat area as they move higher with some 'disappearing' off the tops of mountains. Rising temperatures thus increase the importance of connections between mountain areas.

Rising temperatures may cause mountain snow to melt earlier and faster in spring shifting the timing and distribution of runoff. This in turn affects the availability of freshwater for natural systems and for human uses. Earlier melting leads to drier conditions with increased fire frequency and intensity.

Glaciers around the world have been shrinking. Retreating glaciers decrease the reliability of water flows and change habitats.

In the Himalaya, glaciers cover approximately 33000 sq km area, and this is one of the largest concentrations of glacier-stored water outside the Polar Regions. Melt water from these glaciers forms an important source into run-off of North Indian Rivers during critical summer months. This makes these rivers perennial and has helped to sustain and flourish the Indian civilization along the banks of Ganga and Indus. This supply is available during dry periods and naturally regulates the flow of large rivers thus compensating extremes of precipitation. Glacial activity also generates sediments. However there have been several evidences in recent geological history about the glacier mass fluctuations resulting in the stream runoff originating from them. Stream runoff is an important component in planning of water resources and micro and mini hydroelectric projects. Glacier mass fluctuations are also indicators of global climatic changes. In the context of the Himalayan glaciers, which are source of many giant north Indian rivers, systematic monitoring of Himalayan glaciers is of paramount importance in view of their large number and area covered.

Global warming has already caused a significant glacier ice loss since the Little Ice Age (AD 1550-1850) (Denton and Hughes, 1981) resulting in both glacier retreat and thinning (loss of ice volume). Many glaciers in the Himalayan mountain chain are reported to be gradually retreating (Mayeswki and Jeschke, 1979; Li et al., 1998; Kulkarni and Bahuguna, 2002; Raina, 2004; Kulkarni and Alex, 2003; Kulkarni et al., 2005; Kulkarni et al., 2006). Catastrophic natural processes triggered by these glacier changes were responsible for considerable death and destruction throughout the mountains. These processes included ice avalanches, landslides and debris flows, outbursts from moraine-dammed lakes and also outbursts from glacier dammed lakes. Glacier avalanches have occurred where glaciers have retreated up steep rock slopes. Sources of debris flows are frequently moraine complexes exposed during glacier retreat, which may be ice-cored. Outbursts from moraine dammed lakes result from the catastrophic breaching of the moraine dam - a process that is commonly initiated by glacier avalanches - generated waves that overtop the moraine. Himalayan and Trans-Himalayan glaciers are in general state of retreat since 1850 AD. Most of the Himalayan glaciers are covered by debris, which slows down their melting.

GLACIER LAKE OUTBURSTS FLOODS (GLOF)

In the Himalayas, during the retreating phase a large number of lakes are being formed either at the snout of the glacier as a result of damming of the morainic material known as moraine dammed lakes or supra glacial

lakes formed in the glacier surface area. A glacial lake is defined as a water mass existing in a sufficient amount and extending with a free surface in, under, beside and/or in front of a glacier and originated by glacier activities and/or retreating processes of a glacier. Most of these lakes are formed by the accumulation of vast amounts of water from the melting of snow and by blockade of end moraines located in the down valleys close to the glaciers. In addition, the lakes can also be formed due to landslides causing artificial blocks in the waterways. The sudden break of a moraine/block may generate the discharge of large volumes of water and debris from these glacial lakes and water bodies causing flash floods namely GLOF. A Glacial Lake Outburst Flood (GLOF), also known as a jökulhlaup in Icelandic (A jökulhlaup is technically a sudden and often catastrophic flood that occurs during a volcanic eruption, but is also used to describe other sorts of glacial flooding), can occur when a lake contained by a glacier or a terminal moraine dam fails. This can happen due to erosion, a buildup of water pressure, an avalanche of rock or heavy snow, an earthquake, or if a large enough portion of a glacier breaks off and massively displaces the waters in a glacial lake at its base. Many countries has a series of monitoring efforts to help prevent death and destruction that are likely to experience due to these events. The importance of this situation has magnified over the past century due to increased population, and the increasing number of glacial lakes that have developed due to glacier retreat. There are a number of GLOF events that have been reported worldwide. There are number of such events that have happened in Nepal Himalayas but no such event has been reported so far from Indian Himalayas. On the basis of earlier studies carried out in Himachal Himalayas inSatluj basin, there are about 38 such lakes in entire Satluj basin out of which 14 falls in Himachal part. Similarly 50 moraine dammed lakes in Chenab basin and 5 supra glacial lakes have been mapped using remote sensing. The state of Himachal Pradesh invariably experience flash floods, the cause of which is unknown. In the year 2000, the Satluj valley experiences the heaviest floods causing loss of more than 800 crores. It is still a matter of investigation weather the floods were caused by cloud bursting or due to Glacier Lake Outburst Floods (GLOF) phenomena. The formation of landslide dammed lakes in high altitude zones such as Parachoo in the upper catchment of Spiti basin in Tibet caused tremendous threat to the life and property located in the downstream areas. It is therefore necessary that a constant and repeated monitoring of the upper catchment areas having international dimensions required to be carried out on a regular basis.

Basin wise inventory of moraine dammed glacier lakes in Himachal Himalaya:

Based on the analysis carried out for the year 2013 & 2015 in all the basins in Himachal Pradesh using LANDSAT 8 & LISS III satellite data, the distribution of total number of lakes is as per Table 4.1 & Fig.4.1 The inventory thus generated is further divided into the number of lakes based on their aerial range with area more than 10 ha, 5-10 ha and the lakes with area less than 5 hectare. Thus the Satluj basin as a whole includes a total of 390 lakes out of which 303 are of smaller dimensions i.e with area less than 5 ha, 45 lakes with aerial range between 5-10 ha and 42 lakes with area more than 10ha indicating an overall increase of 119 lakes with that of total number lakes as mapped in 2013 in Satluj basin. Likewise in Chenab basin (Chandra, Bhaga, Miyar) a total of 192 lakes have been delineated in Chenab basin comprising (64 lakes in Bhaga sub basin, 22 in Chandra sub basin and 106 in Miyar sub basin). Thus the Chenab basin as a whole shows an increase of 76 lakes between 2013 and 2015 i.e. total number of lakes in this basin has increased from 116 (2013) to 192 (2015) which is almost four times more than the lakes which were identified earlier using 2001 (55) satellite data (Randhawa et.al. 2005). When these 192 lakes seen based on their aerial range, it has been found that maximum lakes (182) falls in the category where the area is less than 5 hectare, 06 lakes where area is between 5-10 hectare and only 04 lakes where area is more than 10 hectare. In Beas basin (Upper Beas, Jiwa, Parbati), total number of lakes 89 comprising (09 lakes in Upper Beas, 41 lakes in Jiwa and 39 lakes in Parvati sub basins) have been delineated during the year 2015, which shows an increase of 22 lakes with respect to 2013 i.e total

number of lakes as mapped in Beas basin in 2013 (67) has increased to 89 lakes in 2015. Further analysis of these 89 lakes reveals that 80 lakes are smaller onehaving area less than 5 hectare, 07 lakes with aerial range between 5-10 hectare and 02 lakes which are having area more than 10 hectare. Likewise in Ravi basin, a total of 34 lakes have been mapped in 2015 which have been increased from 22 lakes in 2013. When seen based on aerial distribution ,it is found that 03 lakes are having area more than 10 hectare, only 01 lake is having area between 5-10 hectare and 30 lakes are such which have area less than 5 hectare.

Distribution of lakes in different sub basins in Himachal Pradesh based on LISS III satellite data analysis for 2015.

	Name of the basin	No. of lakes with area >10ha	No. of lakes with area between 5-10 ha	No. of lakes with area <5ha	Total No. of lakes
1	Chenab	04(2015) 3(2013)	06(2015) 08(2013)	182(2015) 105(2013)	192(2015) 116(2013)
	Bhaga	02(2015) 1(2013)	03(2015) 03(2013)	59(2015) 10(2013)	64(2015) 14(2013)
	Chandra	02(2015) 02(2013)	01(2015) 02(2013)	19(2015) 15(2013)	22(2015) 19(2013)
	Miyar	----	02(2015) 03(2013)	104(2015) 80(2013)	106(2015) 83(2013)
2	Beas	02(2015) 02(2013)	07(2015) 02(2013)	80(2015) 63(2013)	89(2015) 67(2013)
	Jiwa	----	04(2015) 02(2013)	37(2015) 37(2013)	41(2015) 39(2013)
	Parvati	02(2015) 02(2013)	01(2015) ---(2013)	36(2015) 26(2013)	39(2015) 28(2013)
	Beas	----	02(2015) ---(2013)	07(2015) ---(2013)	09(2015) ---(2013)
3	Ravi	03(2015) 02(2013)	01(2015) 01(2013)	30(2015) 19(2013)	34(2015) 22(2013)
4	Satluj	42(2015) 40(2013)	45(2015) 75(2013)	303(2015) 75(2013)	390(2015)391(2013)

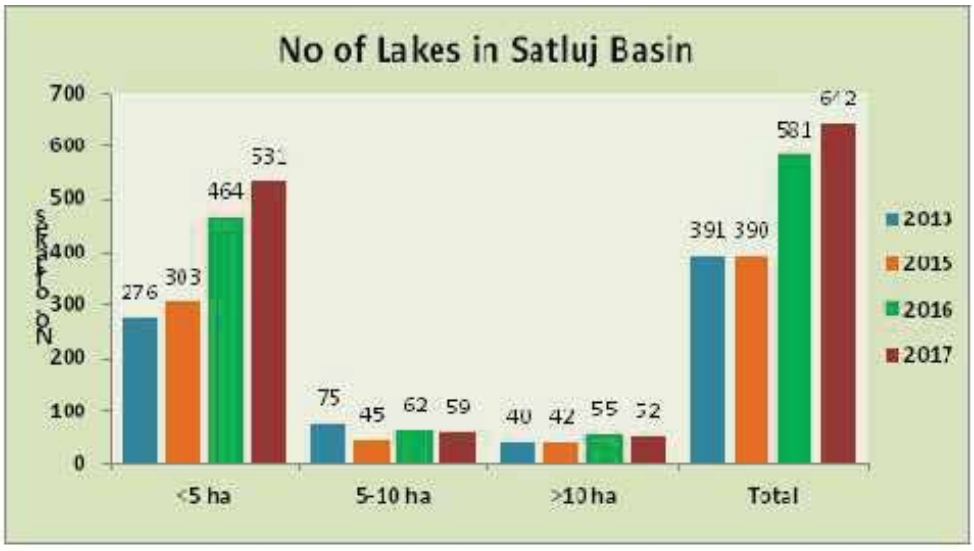


Fig.11.1 Distribution of lakes in Satluj basin

Fig.11.2 Distribution of lakes in Chenab basin

Fig.11.3 Distribution of lakes in Beas basin

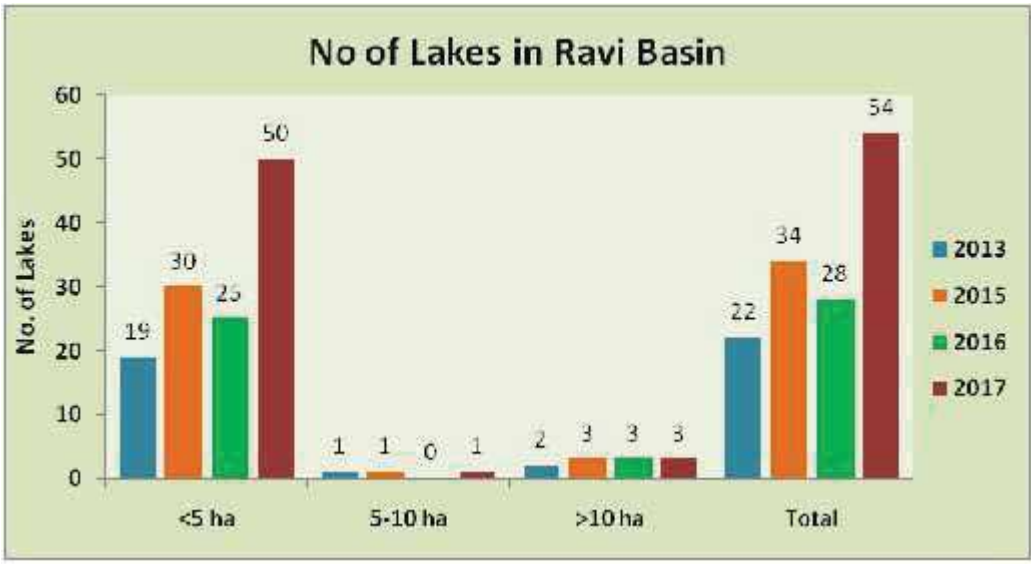


Fig.11.4 Distribution of lakes in Ravi basin

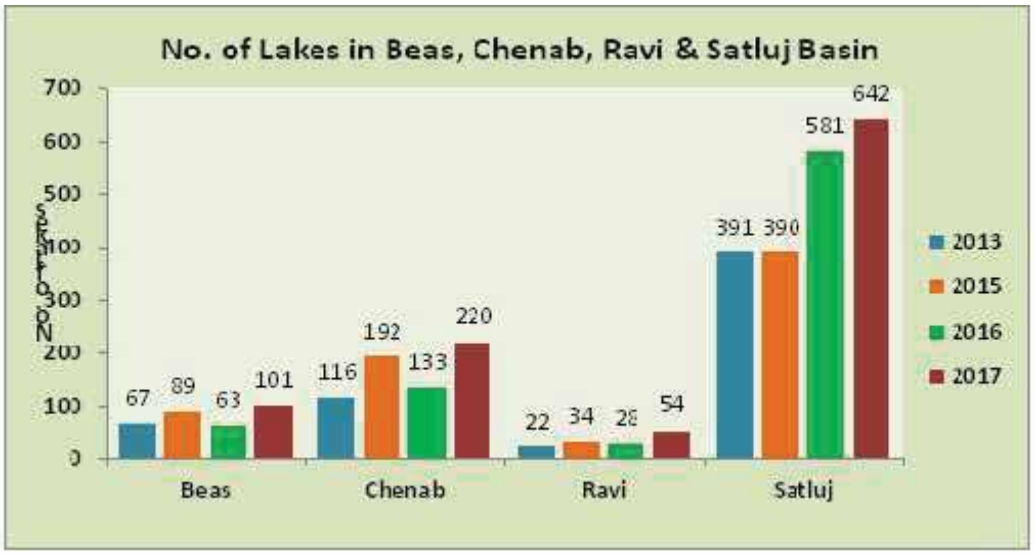


Fig.11.5 Distribution of lakes in Chenab, Beas, Ravi & Satluj basin

12. Distribution of lakes with area more than 10ha

Based on the satellite data interpretation for the year 2017, the study area has been studied to understand the temporal variation of all such lakes with area more than 10ha. In Satluj basin the total number of such lakes has increased from 40(2013) to 42(2015) to 55(2016) to 52(2017) respectively. Likewise in other basins, i.e. in Chenab, the number of lakes varies from 3(2013) to 4(2015) to 2(2016) and 5(2017), in Beas basin the number varies from 2(2013) to 2(2015) to 3(2016) &4(2017) and the Ravi basin, the number of lakes varies from 2(2013) to 3(2015) to 3(2016) & 3(2017)respectively (Table 12.1 & Fig 12.1).

Distribution of lakes with area more than 10ha

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Distribution of lakes with area more than 10 ha in different subbasins in Himachal Pradesh based on LISS III satellite data analysis.

Sr. No.	Lake Id.	2015	2016	2017	2018	2019
Bhaga						
1	6	----	6.21	10.23	9.92	10.94
2	11	10.39	7.92	9.84	11.21	10.40
Chandra						
3	1	90.51	90.18	115.51	95.03	98.68
4	3	151.42	131.58	179.64	160.99	162.07
Miyar						
5	209	----	----	16.08	15.06	15.97
Jiwa						
	----	----	----	----	----	----
Parvati						
1	21	12.68	13.81	12.88	13.14	14.56
2	26	13.52	11.28	15.47	13.82	15.21
3	50	----	10.01	14.58	13.30	11.83
Upper Beas						
4	6	----	7.54	10.86	9.82	10.47
Ravi						
1	10	16	12.05	14.42	14.63	???
2	16	30.97	27.28	34.50	11.35	
3	31	11.72	11.2	12.16	12.38	

Sr. No.	Lake Id.	2015	2016	2017	2018	2019
Satluj						
1	49HWL	23	----	----	38	24.58
2	67	12	13.04	8.06	8	24.58
3	85	----	----	----	----	34.89
4	86	9	10.88	10.11	10.06	10.10
5	87	9	10.06	9.38	10.5	10.41
6	99	19	18.37	17.12	18.8	14.72
7	101	24	24.65	21.37	22.8	21.10
8	122	7	16.16	15.34	16.5	16.86
9	173	3	9.32	7.65	----	13.20
10	184	----	----	----	----	23.32
11	209	33	36.38	----	----	33.76
12	145(HWL)	41584	41646.22	41498.50	41233.9	41640.43
13	179	25	26.26	25.07	25.6	24.26
14	184	27	19.51	19.15	25.5	19.96
15	210(HWL)	57	64.32	59.43	59.17	63.72
16	894	10	----	9.90	9.7	10.15
17	1063HWL	45	39.79	----	----	44.09
18	138(HWL)	26065	26538.79	25891.56	25634.8	25920.91
19	178	205	190.71	204.05	206.39	201.14
20	181	13	13.72	18.07	19.28	12.39
21	1093(HWL)	5515	5676.31	5787.38	5854.36	5992.49
22	1094HWL	16	13.83	12.82	12.62	14.85
23	1128	23	24.45	23.95	25.14	25.00
24	1133	17	15.23	16.09	15.86	16.18
25	1153	63	64.41	66.74	69.2	74.10
26	1155	16	16.38	16.14	17.47	14.27
27	1156(HWL)	11	11.85	11.56	11.69	11.74
28	1164	15	15.12	14.94	14.86	16.08

Sr. No.	Lake Id.	2015	2016	2017	2018	2019
29	1092HWL	----	14.69	13.63	----	14.13
30	1363HWL	----	28.25	17.77	----	22.24
31	1375HWL	----	47.91	43.26	----	28.96
32	1510	----	54.52	54.37	54.38	52.93
33	1512	----	23.53	23.62	24.23	21.47
34	1518	----	13.78	12.53	14	12.19
35	1527	----	11.17	10.47	11.43	11.37
36	1548	----	17.95	14.62	19.91	17.41
37	1557RS	----	69.88	96.36	80.87	92.85
38	1349HWL	----	352.60	292.13	322.95	335.79
39	1095(HWL)	----	17.26	14.31	15.58	17.22
40	1565	----	16.38	18.11	17.36	19.13
41	1566(HWL)	----	22.81	24.35	18.76	10.77
42	1782(HWL)	----	----	----	29.1	30.65
43	1774RS	----	----	----	11.69	12.93
44	1771RS	----	----	----	12.22	14.99
45	1776RS	----	----	----	----	13.98
46	1654	----	----	----	----	22.28
47	2180	----	----	----	----	23.56
48	1039HWL	----	----	----	----	12.16
49	1144HWL	----	----	----	----	89.47
50	2167HWL	----	----	----	----	214.31
51	1146	----	----	----	----	10.60

(HWL-High Altitude Wetlands) (RS-River Section)

Sr. No.	Lake Id.	2015	2016	2017	2018	2019
29	1092HWL	----	14.69	13.63	----	14.13
30	1363HWL	----	28.25	17.77	----	22.24
31	1375HWL	----	47.91	43.26	----	28.96
32	1510	----	54.52	54.37	54.38	52.93
33	1512	----	23.53	23.62	24.23	21.47
34	1518	----	13.78	12.53	14	12.19
35	1527	----	11.17	10.47	11.43	11.37
36	1548	----	17.95	14.62	19.91	17.41
37	1557RS	----	69.88	96.36	80.87	92.85
38	1349HWL	----	352.60	292.13	322.95	335.79
39	1095(HWL)	----	17.26	14.31	15.58	17.22
40	1565	----	16.38	18.11	17.36	19.13
41	1566(HWL)	----	22.81	24.35	18.76	10.77
42	1782(HWL)	----	----	----	29.1	30.65
43	1774RS	----	----	----	11.69	12.93
44	1771RS	----	----	----	12.22	14.99
45	1776RS	----	----	----	----	13.98
46	1654	----	----	----	----	22.28
47	2180	----	----	----	----	23.56
48	1039HWL	----	----	----	----	12.16
49	1144HWL	----	----	----	----	89.47
50	2167HWL	----	----	----	----	214.31
51	1146	----	----	----	----	10.60

(HWL-High Altitude Wetlands) (RS-River Section)

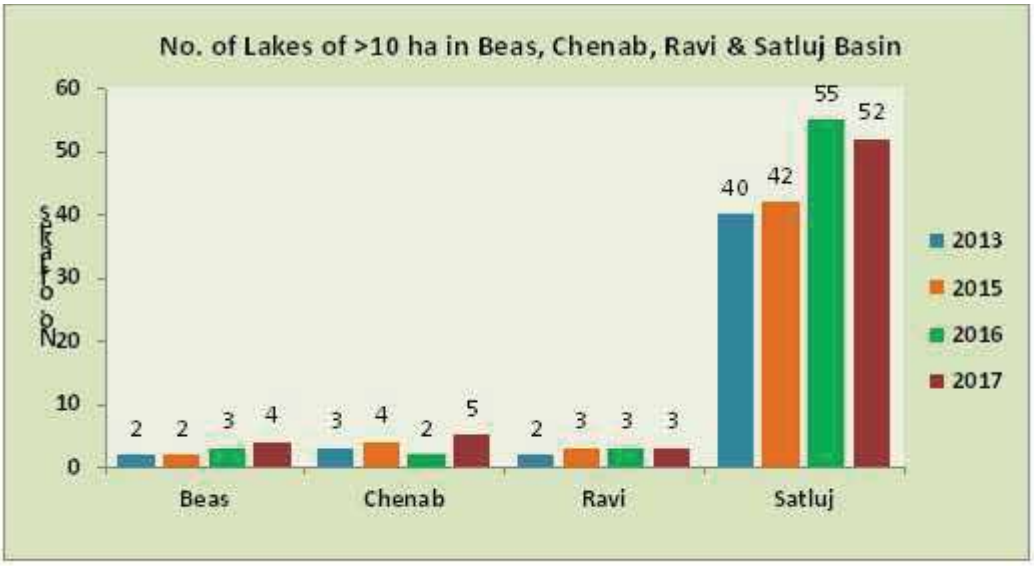


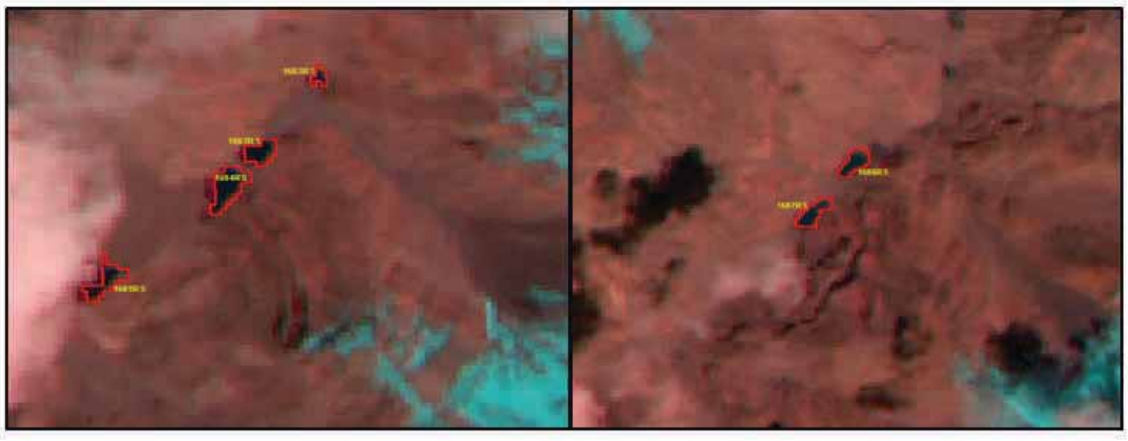
Fig.12.1 Distribution of lakes with area >10 Ha in Chenab, Beas, Ravi & Satluj basin in 2013, 2015, 2016 & 2017

Concluding Remarks

Based on the IRS-RS2-LISS-III satellite data having spatial resolution of 23.5mts and Landsat 8 MSS satellite data having spatial resolution of 30mts for the year 2019, the study area was analyzed in order to make an updated inventory of moraine dammed glacial lakes known as GLOFs (Glacial lake Outbursts Floods) in Himachal Himalaya comprising the Satluj, Chenab, Beas and Ravi basins. The Satluj basin has been studied in detail right from its origin from the Tibetan Himalaya, whereas the other basins have been analyzed for their areas of interest in Himachal Pradesh. I he results based on the analysis thus obtained reveals that in Satluj basin, a total of 562 lakes from the Satluj catchment covering 8 satellite imageries(96-48,96-49,97-48,97-49,98-48,98-49,99-49,100-49) having spatial resolution of 23.5 mts. have been mapped during 2019.

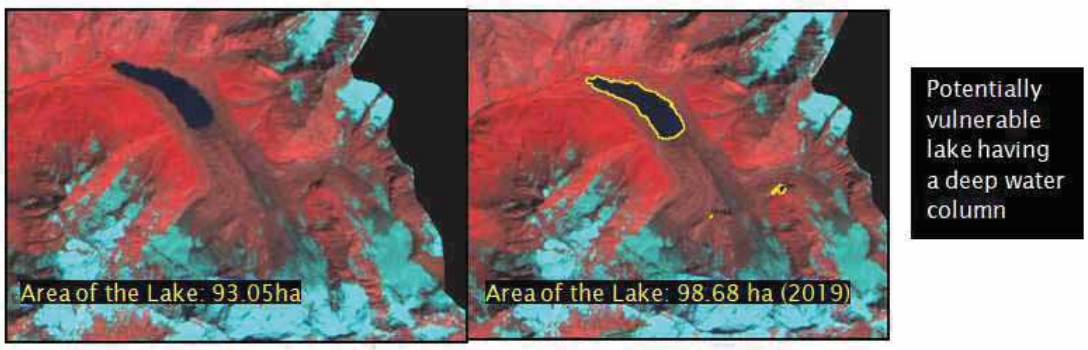
Further based on the LISS-Ill satellite data analysis for 2019 in Sailuj basin , total of 562 lakes have been delineated out of which about 81% (458) lakes are the small one with area less than Sha, about 9% (53) falls within the aerial range of 5-10ha and about 9% (51) are the big one with area more than 10ha. The comparative analysis based on LISS III data reveals that total number of lakes in the Satluj catchment varies from 642(2017) to 769(2018)to 562(2019) reflecting an overall increase of about 19% between 2017-18 and a reduction of about 26% between 2018-19, which is mainly due to the non-availably of good quality LISS III data products in 2019. Out of the 562 lakes/wetlands mapped in 2019 using LISS III satellite data, basin 1 i.e. Spiti basin constitutes about 12%(73) of the total lakes mapped (562) which is about 58% less than 2018(176). Likewise basin 2 i.e. the Lower Satluj basin constitutes 9%(52) of the total lakes mapped which is about 46% less than 2018(98)and the Upper Satluj basin i.e. the basin 3 constitutes of 77% (437) lakes in 2019 which is about 11%less than 2018(495).

As far as the big lakes based on LISS III satellite data is concerned, the analysis reveals that the number varies from 52(2017) to 49(2018) to 51(2019) reflecting an overall increase of about 4% between 2018-19.The Parechhu Lake in the Tibetan Himalayan Region was also monitored separately during the ablation period of 2019 and does not show any major change in its water spread and seems to be stable based on the observations made which have been reported to SJVNL as well as to the Government during 2019. Besides this, the landslide on the upstream side of the lake depression was also monitored in order to assess any change in the water level by virtue of the la ndside which may block the river course causing major threat like that of the Parechhu formation during the year 2004.

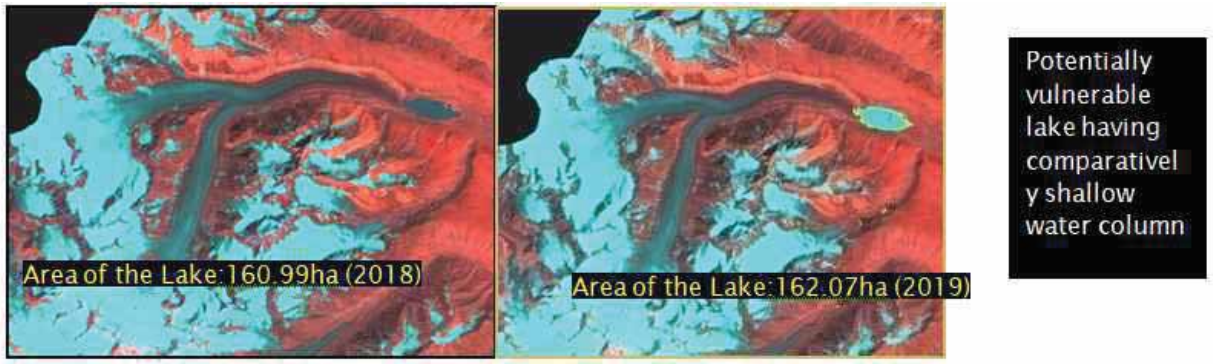


Accumulation of water along river cour sein Spiti basin

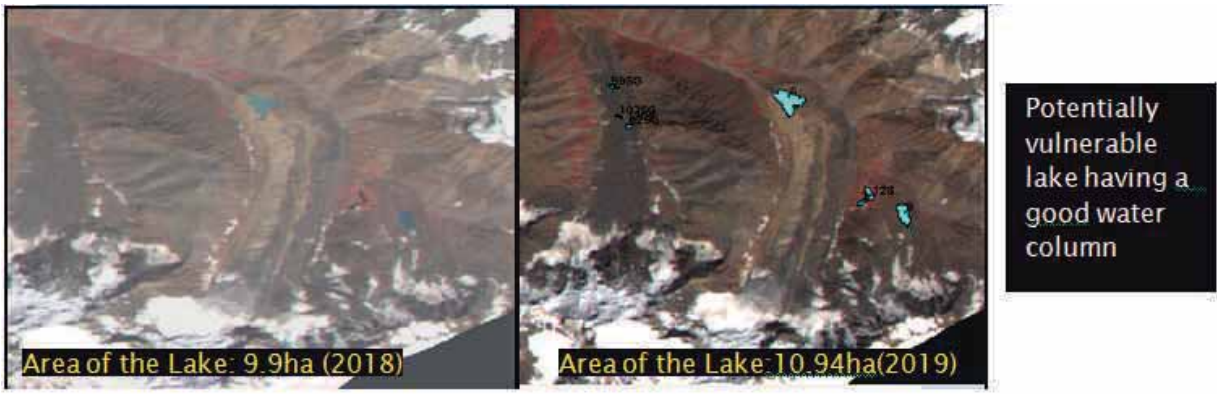
The Chenab basin which mainly originates from the Himachal Himalaya comprises of the Bhaga, Chandra and Miyar sub basins. Based on the analysis carried out, it is found that in Chenab basin, a total of 220 lakes have been delineated comprising (56 in Bhaga sub basin, 46 in Chandra sub basin and 118 in Miyar sub basin) and when seen with respect to 2016, it indicates an increase of about 65% in the total number of lakes in this basin between 2016 & 2017. Thus in the Chenab basin the number of lakes mapped during 2013 to 2017 varies from 116 (2013), 192 (2015) , 133(2016) and 220(2017) which is about four times more than the lakes which were identified in earlier studies 2001 (55) using IRS 1C satellite data (Randhawa et.al. 2005).The areal distribution of 220 lakes suggest that 207 lakes are the small one with area less than 5ha, 08 lakes are having area between 5-10ha and 5 lakes are big one with area more than 01ha.



Moraine dammed lake formation at Geepang Gath Glacier Snout in Chandra Basin

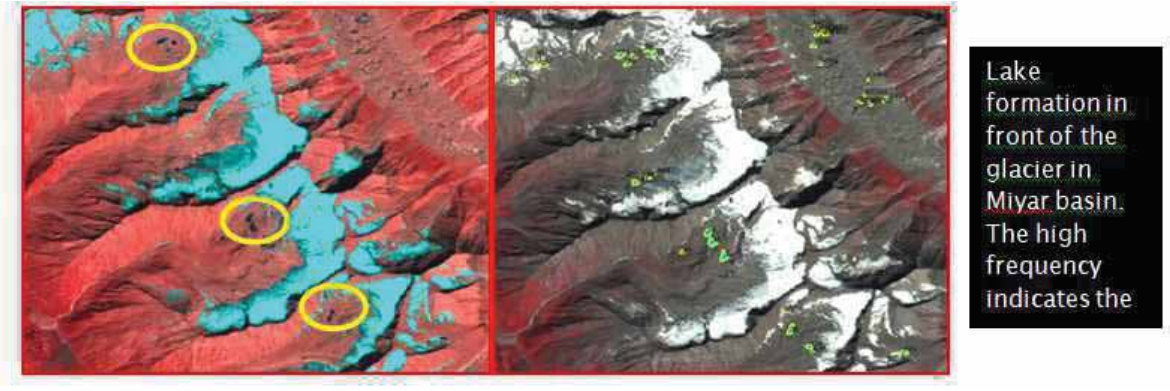


Moraine Dammed Lake Formation at the Snout of Samudri Tapu Glacier



Moraine Dammed Lake Formation at the Glacier Snout in Bhaga Basin

Moraine Dammed Lake Formation at the Glacier Snout in Bhaga Basin



Moraine Dammed Lake Formation at the Glacier Snout in Miyar Basin

The Beas basin (Upper Beas, Jiwa, Parvati), has a total of 101 lakes comprising (25 in Upper Beas, 32 lakes in Jiwa and 44 lakes in Parvati sub basins) for the year 2017 could be mapped in comparison to the total number of lakes as mapped in Beas basin in 2013(67),2015(89) and 63 (2016) respectively. Further analysis of these 101 lakes reveals that 92 lakes are smaller one having area less than 5 hectare, 05 lakes with aerial range between 5-10 hectare and 04 lakes which are having area more than 10 hectare. Likewise in Ravi basin, a total of 54 have been mapped in 2017 in comparison to the 22 lakes in 2013, 34 lakes as mapped in 2015 and 28 lakes in 2016. When 54 lakes are seen based on aerial distribution, it is found that 03 lakes are having area more than 10 hectare, 50 lakes are such which have area less than 5 hectare and 01 lake which has area between 5-10 ha have been mapped in 2017 in this basin.

As far as the temporal variation of all such lakes with area more than 10ha is concerned, there has been a considerable increase in their total number in Satluj basin i.e the total number of such lakes has increased from 40(2013) to 42(2015) to 55(2016) and to 52(2017)respectively. Likewise in other basins, i.e in Chenab, the number of lakes varies from 3(2013) to 4(2015) to 2(2016) and 5(2017), in Beas basin the number varies from 2(2013) to 3(2015) to 3(2016) to 4(2017) and the Ravi basin, the number of lakes varies from 2(2013) to 3(2015) to 3(2016) to 3(2017) respectively. Thus it is very important that since these lakes are the big one and needs to be monitored regularly in terms of their spatial behavior, so that any eventuality arising out of these lakes could assessed well in advance in order to a minimize the post disaster effects in the catchments. Besides this, the other category of lakes in each basin with area between 5-10ha are also potential sites which can cause considerable damage in if any one of these bursts.

Based on the above analysis carried out for 2017, it is found that there is a considerable increase in the total number of lakes in each basins with respect to the preceding years which reflects that formation of such lakes i.e moraine dammed glacial lakes or the lakes due to the melting of Himalayan glaciers in the Higher Himalayan region is on the increasing side. The analysis further reveals that the higher number of smaller lakes i.e. the lakes with area less than 5 hectare indicates that the effect of the climatic variations is more pronounced on the glaciers of the Himalayan region resulting in the formation of small lakes in front of the glacier snouts due to the damming of the morainic material resultant of the melting of the glaciers. The recent tragedy of 2013 in the Uttrakhand Himalaya has also been correlated with the bursting of a lake having a total area of about 08 hectare in front of the snout of the Chorabari glaciers that caused widespread damage in the downstream areas besides the heavy rainfall (Dobhal et.al.2013). Thus the magnitude of such lakes as far as the destruction is concerned cannot be overruled. Besides this, the lakes with area >10 hectare and the area between 5-10 hectare can be seen as the potential vulnerable sites for causing damage in case of bursting of any one of them. Thus a proper monitoring of all such lakes is very much essential in the Himalayan region in order to avoid any eventuality like in Uttrakhand in future, which will not only save the precious human lives but also the public and the Govt. property.

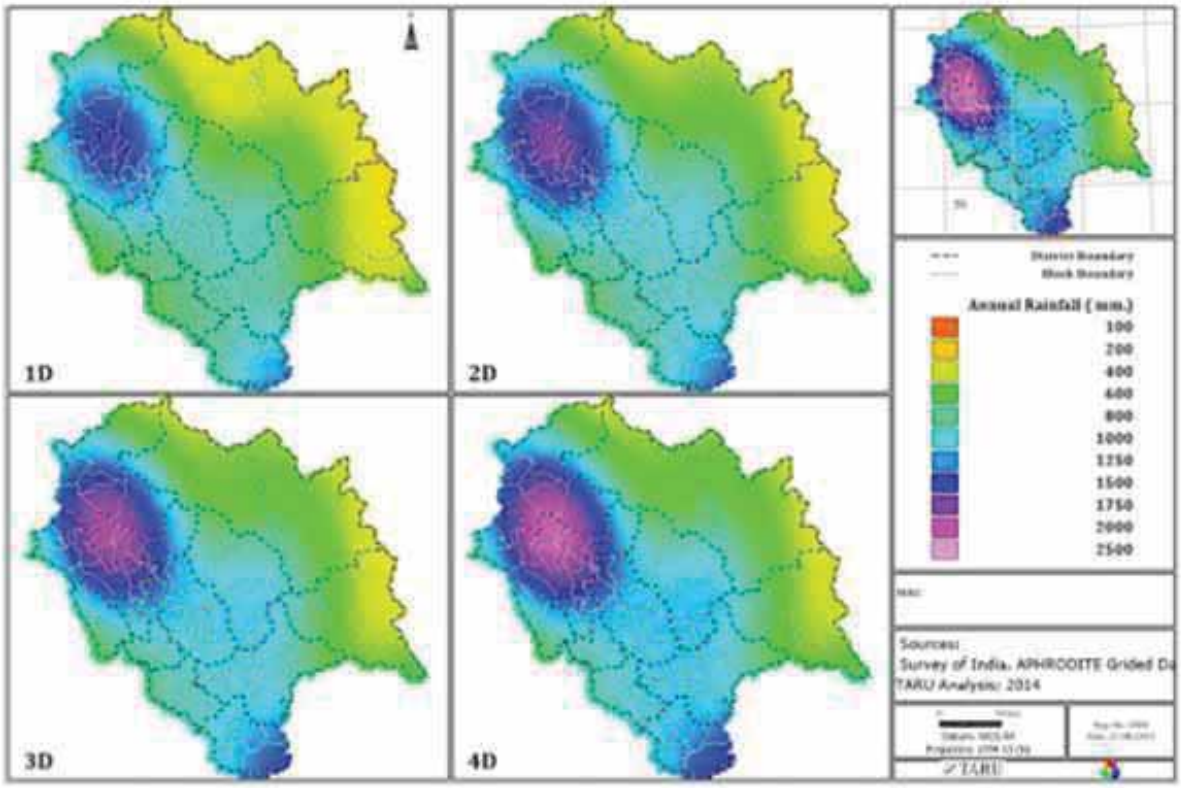
10.7.2.3. HAILSTORMS/DROUGHT

Besides the major disasters, the State being characterized by diverse topography, experiences inclement weather conditions; sometimes excess rains or drought or hailstorms. The crop vulnerability from droughts alone cannot be estimated without detailed data on soils, local meteorology, aspect and slope and crop cultivars. Therefore, the tehsil/block level crop area and production time series was used to estimate the crop vulnerability. This method can be improved, if the time series data at block/Tehsil is systematically collected and collated. Crop losses estimations were done for rice, wheat, Barley, Maize, Rape& Mustard crops. Among horticulture crops, Potato, Apple, Mango and allnuts. For each crop, the first decile to fourth decile losses are presented as maps in the accompanying atlas. Financial losseswere also estimated at block/Tehsil level based

on average prices of 2013. The results are presented in the maps. The once in cereal 10 year crop losses can be as high a 25% compared to the median crop value. The Maize and wheat shows the highest losses among all the six crops. Once in a decade horticultural losses can be as high as %%compared to the median values. These results in indicate the need for irrigation, pest control as well as mitigating impacts of risks like hailstorm etc. As the state is promoting horticulture on horticulture on a large scale, extension activities will require further focus. The decile based methods for assessing the drought risk as well as crop vulnerability are simple and can be improved with systematic collection of data. Strengthening data collection system is necessary to build reliable time series data is necessary

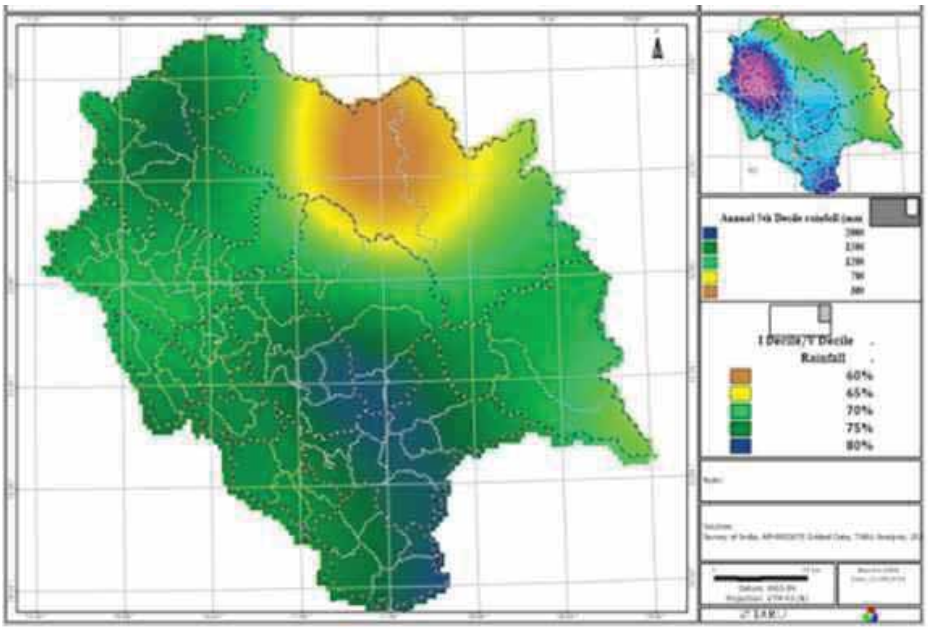
DROUGHT INTENSITY ACROSS THE STATE.

Based on the study conducted for HRVA with reference to the drought analysis in Himachal Pradesh, the following map shows the median (Inset) and 1D to 4D annual precipitation pattern across the state. This map is derived by krigging the gridded data. The Map shows the Annual Median and 1st Decile to 4th Decile Rainfall.



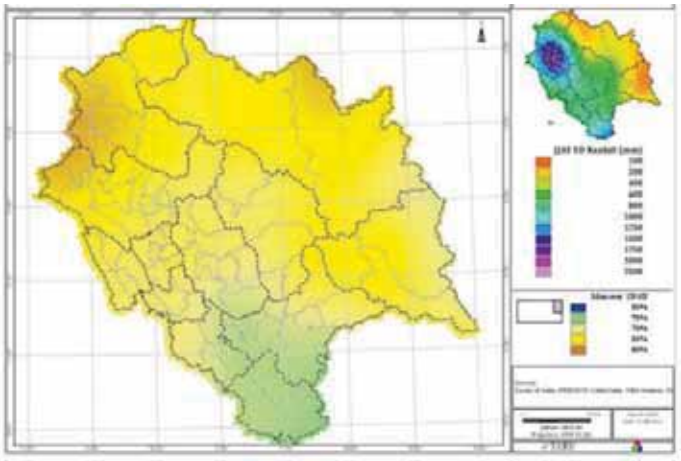
Annual Median (Source: HRVA Atlas, SDMA, H.P.)

The results show that the once in 10 year rainfall can be significantly lower than the median rainfall. Nearly half the state gets less than 1200 mm of annual median rainfall. Given the high slopes and skeletal soils, the moisture retention is likely to be low and regular and frequent rainfall is required for water demanding crops. The Ratio of 1D/5D provides picture of variation in annual rainfall across the state. The map in Map presents the variability of the rainfall across the state.



1D/5D Rainfall (Source:HRVA Atlas, SDMA, H.P.)

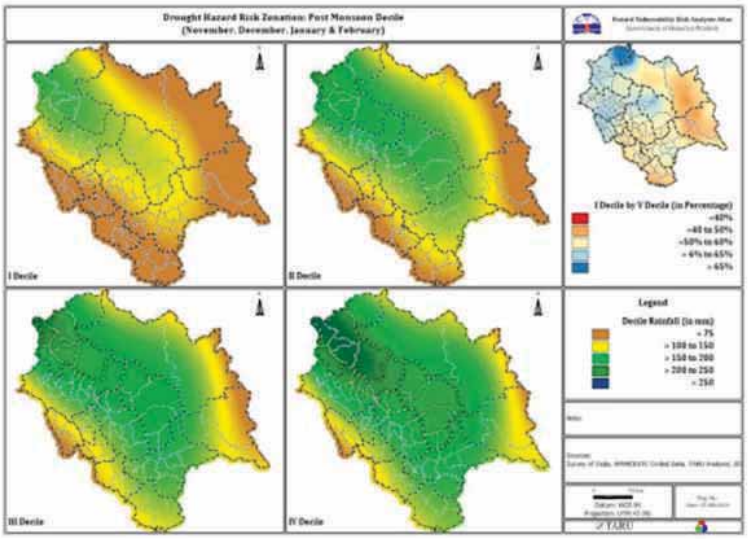
Shimla, Kangra Chamba and parts of Sirmaur districts show lowest reduction in 1D rainfall compared to the median rainfall. In other districts, the ratio is about 70 to 75%. The annual ratio is unable to capture that the possible drought intensity in a 10 year cycle. Therefore the Monsoon median and Monsoon 1D/50 was used to understand drought vulnerabilityacross regions. The picture of this ratio across the state is presented in the Map.



Source: Aphrodite Gridded data (1951-2007)

Monsoon 1D/5D ratio (June, July, August & September)(Source:HRVA Atlas SDMA ,H.P)

The Figure indicates that almost all parts of the state except region around Shimla faces medium to high drought risks in monsoon rainfall. Parts of Chamba and Kangra as well as Lahaul & Spiti show lowest ratios indicating highest risk of droughts. The Shiwalik region has medium risk while parts of Kinnaur also has medium risks. Shiwalik region of Hamirpur faces summer water shortages due to lack of any perennial sources. Since the soils in Hamirpur and Sandy and shallow, the meteorological droughts can translate in to agricultural droughts. In high risk zone, the once in 10 year drought may be nearly two third of the median monsoon rainfall, which can cause severe distress to the rainfed agriculture. Winter rainfall is important for the wheat and other Rabi crops. At least three to four rains/irrigation are required to support winter wheat in this region. The winter sowing starts from Late October therefore November to February rainfall deciles are presented in the Map.



Source: Aphrodite data (1951-2007); Taru Analysis

Winter Rainfall Pattern (November, December, January and February)(Source: HRVA Atlas ,SDMA,H.13)

Both Shiwalik as well as cold desert zone shows lower rainfall compared to the Central mountain region. The highest risk of lower rainfall can be observed in the southern and south eastern parts of the state. The cold desert region cannot grow any crops due to cold winters, and the precipitation occurs as snow in the cold desert region. However, the snowmelt supports the next year's summer crops to a great extent.

10.7.3 Chemical, Industrial & Nuclear Related Disasters

Industries in Himachal Pradesh are rather new and most of them, except pharma and chemical industries do not store or use large amount of accident/hazard prone chemicals. Due to fragile ecosystem and uncertain rainfall and risks of landslides and flash floods, the Hydel projects are some of the risk-prone industries. The disaster risk from natural events are analysed in respective hazard risk sections. The primary study of industries did not provide major disaster events based on recollection. Out of the 143 industries contacted only 40 respondents could recall any event casing impacts on their industries.

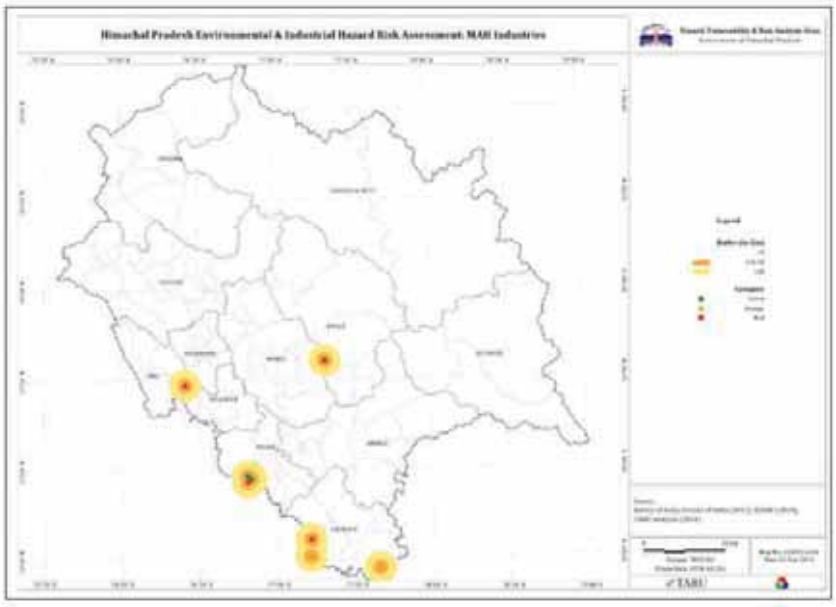
Major Accident Hazard Industries(MAH)

Estimated area and Population (2011) in Buffer Zones of MAH Industries

District	Estimated Population (2011)	Estimated Area (sq. km.)		
Km>	5 Km	10 km	5 km	10 km
Bilaspur	-	9219	1.5	48.9
Hamirpur	-	18,052	1.8	52.5
Kullu	11,208	32,005	53.4	185.4
Mandi	5,599	20,534	24.5	126.3
Sirmour	44,231	1,02,747	176.5	497.7
Solan	37499	70523	107.3	289.5
Una	8591	47578	74.8	199.0
Grand Total	104846	295563	439.7	1399.4

Source AGSAC. Dept of labour & Employment, TARU Analysis

The above table shows that Sirmaur district has the highest area and population under risk from any MAH industry related accidents with three MAH industries located in the district. It is necessary to do detailed risk studies to design mitigative andemergency measures.



Location MAH Industries in Himachal Pradesh(Source: HRVA Atlas, SDMA, H.P)

10.7.4 Accident Related Disasters

10.7.4.1 Forest Fires in Himachal Pradesh

In Himachal, forest fires are an annual and widespread phenomenon. Most fires are witnessed during summers, when the forests become littered with dry senescent leaves and twinges thereby increasing the probability of starting and spreading of fire. The fire season in HP starts from the month of April (SAARC-SOMC,2007) and extend till monsoons. In June 2007, forest fire destroyed around two hundred hectares of forest in Himachal Pradesh (HP). In an another event of June 2012, forest fires destroyed more than 20,000 acres of forest land and caused a loss greater than Rs.2 million of green property. This event, started in the Hamirpur circle but extended to neighboring districts including Shimla, Nahan and Mandi (Indian Express, 2012). Analyzing the spatial extent and distribution of forest fires is essential for sustainable forest management. Knowledge of cause, extent and impact of forest fires on ecosystems, and their link to the goods and services that people derive from forests is limited. Without a proper understanding of the causes and effects of fire such as ecological or socioeconomic, or cultural, it is not possible to strive for fire management that meets the livelihoods needs of forest-dependent communities while also conserving forests and biodiversity. Such understanding is essential to arrive at negotiated tradeoffs in integrating actual fire management practices into existing forest management.

Based on the HRVA carried out for Himachal Pradesh by TARU, an attempt was also made to model the forest fire risk zones based on historical data collected from national and international organizations. Medium to high resolution satellite imageries were used to validate the presence of scar or fire damage. The results of the analysis indicate that majority of districts in HP are under high to very high fire risk zones. Within each of these high risk districts, more than 56% of area are prone to or have the possibility of being affected by fires. For example, Sirmaur has around 86% of its area under high to very high risk zone followed by Hamirpur (78%),Shimla (74%) and Mandi (73%). The district of Solan has experienced maximum number of forest files over the last 8 years (since 2005) followed by Una and Mandi. But the extent of fire damage has been found

tube more in the district of Shimla followed by Kangra and Chamba.

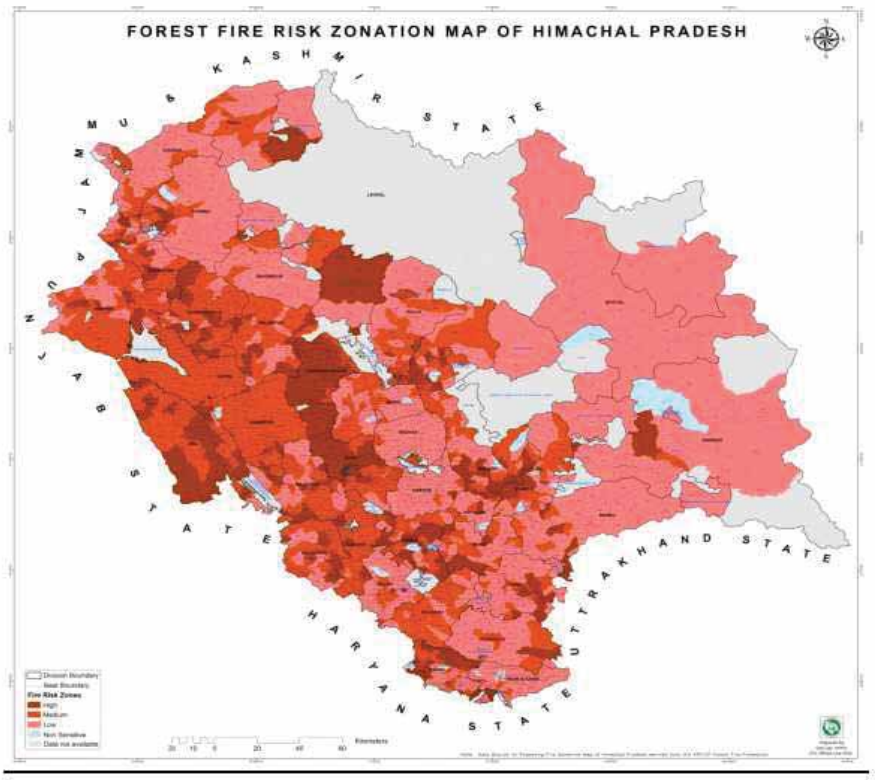
The Forests of Himachal Pradesh known for their grandeur and majesty are like a green pearl in the Himalayan crown. These life supporting systems are presently under great stress due to impact of modern civilization, economic development and growth in human and cattle population. The forest of the state are prone to fires attributed to both anthropogenic and other reasons. The destruction of rich flora and fauna of the State due to forest fires will have serious repercussions on the ecological balance of the State. The rich forest wealth of the State has been subjected to the numerous fire incidences. Some of the fire incidences occupying the total area under different districts is as per Table . Fire season starts from mid-April, when there is no rain for months, forests become littered with dry senescent leaves and twinges, which could burst into flames or ignited by the slightest spark. In June 2007, forest fire destroyed 2,000 hectares of forest in Himachal Pradesh (SAARC-DM Center, 2007). Forest fires are mostly anthropogenic in nature in Himachal Pradesh and may occur due to the following reasons:

Forest floor are often burnt by villagers to get a good growth of grass in the following season or for a good growth of mushrooms, Wildgrassor undergrowth is burnt to search for animals, Firing by miscreants, Attempt to destroy stumps of illicit fallings.

Forest Fire incidences in Himachal Pradesh

Year	No. of fire Incidences	Areas Affected (In Hectares)
1995	1669	57143
2000	1900	36887
2001-02	301	5719
2002-03	282	4204
2003-04	550	9896
2007-08	550	8393
2008-09	572	6586
2009-10	1906	24849
2010-11	870	7837
2011-12	168	1758
2012-13	1798	20773
2013-14	397	3237
2014-15	725	2500
2015-16	672	1730
2016-17	1832	6625
2017-18	670	1759

Source : SDMA Himachal Pradesh& Forest Department (Forest Protection & Fire Control, Bilaspur)



(Directory of Forest Fire Control and Management, Himachal Pradesh)

10.7.4.2 FIRE HAZARDS:

Fire Incident at village Chichwari, Tehsil Chirgaon, Rohru, Shimla Fierce fire on 24th December, 2011 at village, Chichwari, Gram Panchayat Rohal, Tehsil Chirgaoo, Rohru, district Shimla destroyed 67 houses. According to newspaper reports 150 sheep/goat and 50cowsand calves perished in the fire. The fire which started at around 1130 midnight when the villages were sleeping engulfed the entire village. The blasts of LPG cylinders intensified the fire. According to reports fire loss was estimated at Rs.9.Ocrore.

Source: SOMA Reports In April 2014, 13 houses gutted, property valued at 2 crore was destroyed, inflicted losses on 31 families, 4 of which lost their homes in Kully area.

On 15thNovernber, 2015, in Banjararea firegutted - 49 Residential houses, 3 cowsheds, 2 shops, 3 temples & 2 bhandars fully damaged and 4 Residential houses partially damaged inflicting loss on 113 families and total 64.91 lacs relief were distributed. On 2nd December 2016, in Ghar Patti Kais near Kully, 10pucca houses completely & 3 partially) have damaged consisting of 25 families comprising of 93 members in all & totaldarnage worth Rs. 1.75Crores.

1. ROAD ACCIDENTS IN HIMACHAL PRADESH

With the increase of road connectivity and increasing number of vehicles plying, the number of road accidents and loss of precious human lives has been increasing day by day. The data from 2001-02 to 2018 would show an increasing trend in the number accidents and the victims. The hilly terrain of the State and rash and negligent driving are the major cause of these accidents. The department of PWD has identified numerous accident prone spots and the department is in the process of improving them to reduce road accidents. The details of accidents occurred during the past in H.P.

Number of Accidents in Himachal Pradesh

Sr.No.	Year	Road Accidents	Persons Killed	Injured persons
1	2001-02	2,226	804	3,798
2	2002-03	2,830	695	3,917
3	2003-04	2,607	867	4,188
4	2004-05	2758	920	4674
5	2005-06	2807	863	4833
6	2006-07	2756	886	4688
7	2007-08	2906	945	4867
8	2008-09	2846	838	4637
9	2009-10	3409	1196	5560
10	2011	3099	1072	5462
11	2012	2899	1109	5248
12	2013	2981	1054	5081
13	2014	3058	1199	5576
14	2015	3015	1096	5239
15	2016	3153	1163	5587
16	2017	3114	1202	5453
17	2018	3110	1206	5553

Source: Analysis of Different documents from Government (Transport Deptt) and private sources

10.7.4.4 OTHER HAZARDS

Stampede. The State is known as land of Gods. Many famous temples are located in the State such as Sri Naina Devi, Baba Balak Nath, Ma Chintpurni, Ma Jawalaji, Ma Braheswari and Sri Chamunda Nandikeshwari Dham to name a few. Large number of devotees throng these places every year. A human stampede at the temple of Naina Devi occurred on 3 August 2008. 162 people died when they were crushed, trampled, or forced over the

side of a ravine by the movement of a large panicking crowd. Possibility of such instances is always there if there is any laxity on the part of the management.

Air Crash.

The State has two airports and more than 120 helipads / helicopter landing sites in the State. Punjab Governor Shri Surendra Nath and nine members of his family were killed when the government's Super-King aircraft crashed into high mountains in bad weather on July 9, 1994 in Himachal Pradesh. Sh.Surendre Nath was then acting Himachal Governor also.

10.8 Damage History due to Natural hazards in Himachal Pradesh:

Based on the data base collected from the Memorandums of Department of Revenue, the following is the history of the damage occurred due to different hazards in Hiamchal Pradesh from 2013 onwards.

Damage occurred during 2013 due to rains in various parts of the state are as follows:

- **Human lives lost:** As a result of landslides, a total of 29 people lost their lives in the entire state. (**22** in Kinnaur, **5** in Shimla and **2** in Sirmaur district).

- **Animals lost:**
  - **Total animal lost-23449**
  - **Milch animals-114**
  - **Sheeps-22752**
  - **Draught animals- 583**
  - **Total Loss on this account has been assessed at Rs 4.50 Crores.**

- **Houses damaged: 3246** houses have been fully or partially damaged in various parts of the state due to landslides triggered by heavy rain and snowfall with overall loss to private property worth **Rs 100 Crores.**

- **Damage to Roads:** More than **4100** roads in the state have been affected due these rains and floods resulting into huge loss. The total losses on this account have been assessed as **Rs. 1006 Crores.**

- **Damage to Irrigation and water supply schemes:**
  - **Total schemes affected-2263**
  - **Water Supply-1527**
  - **Irrigation-630**
  - **Sewerage schemes-22**
  - **Flood Protection works-84**
  - **Total loss has been estimated at Rs. 214.12 crores**
  - **Damage to Agriculture Crops:** The total agricultural area affected is **20,573** Ha out of which in **7,142** Ha area the crop loss is >50%. The overall loss to crop as assessed is **Rs 200.37 Crores.**

- **Damage to Horticulture Crops:** There were huge losses to fruit crops in the State especially in Kinnaur District due to recent heavy rains. The Upper areas of Kinnaur district have experienced heavy snowfall during this period in the month of June, which is an unprecedented weather phenomenon, which has damaged more than 50% of fruit crop especially Apple. The losses on account of this have been assessed to the tune of Rs 301.11 crore.

- **Damage to electricity infrastructure:** The electricity infrastructure has been severely damaged especially in district Kinnaur. It is estimated that the total loss on this account is **Rs 472.35 crores.**
- **Damage to community/Government assets:** A lot of community assets in the state like School buildings, Panchayat Bhawans, community centers, village paths etc. have been extensively damaged resulting in a loss of over **Rs 165 Crores.**
- Total cumulative losses suffered by the state are **Rs 2521.90 Crores.**

Details of damages caused by snow and avalanche in District Kinnaur during 2013

- **Human lives lost:** Due to avalanche, landslides and cold wind 17 human lives have been lost and 13 people received grievous injuries.
- **Damage caused to public infrastructure:** a total of 579 km of roads, 1 bridge (Pangi Nalla Bridge) and many culverts have been severely damaged. The total loss of **Rs 23.14 Crores** is assessed.
- **Damage to irrigation and water supply schemes:**
  - **Water supply-113**
  - **Irrigation schemes-67**
  - **The total loss has been estimated Rs6.54 crores.**
  -
- **Damage caused to public infrastructure: Public buildings:** Huge damages were caused to the public buildings such as revenue building, panchayat ghars and others assets owned by panchayats, PHC and rural educational institutions such as aanganbariand primary schools. The total loss in terms of money on this account has been estimated to **Rs 43.82 crores.**

- **Damage to Agriculture Crops:** The total agricultural area affected is **9816 hectares.** The total loss to agriculture crop and cultivated land is estimated about **Rs. 1 crores**

- **Damage to Horticulture Crops:** The losses on account of this have been assessed to the tune of **Rs34.09 crores.**
- **Damage caused to public infrastructure: Power:** loss in respectof works belong to the HPSEBL has been estimated at **Rs 10.36 Crores.**
- **Animals Lost:199**productive livestock of private individuals died. Loss on this account has been assessed as **Rs. 0.22Crores.**

Damage occurred during 2014 due to rains in various parts of the state are as follows:

- **Human lives lost:**Due to flash floods, landslides and cloudburst etc. total **45** people lost their lives in the entire state. District wise detail is as follows:

- **Animals Lost:698** animals including cows, sheep and goats have lost their lives. Loss on this account has been assessed as **Rs. 0.22 Crores**.
- Houses Damaged: 1272 houses have fully or partially been damaged in various parts of the state due landslides triggered by heavy rainfall and with overall loss to private property worthRs 3.71 Crore. Beside, 692 cowsheds have also damaged.

- Damage to Roads: Many districts especially Hamirpur, Shimla, Mandi and Kangra received huge magnitude of rainfall, suffered excessive damage to roads, bridges and culverts. More than 336 roads in the state have been affected due to these rains and floods resulting into huge loss. The total losses on this account have been assessed as Rs. 450.00 Crores.

Damage occurred during 2014 due to rains in various parts of the state.

Sr. No.	Districts	Loss of lives (Persons)
1	Bilaspur	2
2	Chamba	-
3	Hamirpur	9
4	Kangra	5
5	Kinnaur	8
6	Kullu	-
7	Lahaul-Spiti	-
8	Mandi	9
9	Shimla	-
10	Sirmaur	10
11	Solan	2
12	Una	-
Total	**H.P.**	**45**

Damage to irrigation and water supply schemes:

- Total schemes affected- 2726
- Water supply-1969
- Irrigation-716
- Sewerage schemes-18
- Flood protection works-23
- Total loss has been estimated- Rs 120.00 Crores.

- Damage to Agriculture Crops: Damage to crops has been reported in the districts of Hamirpur, Kinnaur, Shimla, Sirmaur and Una. The crops have been damaged particularly Maize and Vegetables. The total agricultural area affected is 12136 hectares. The total loss to agriculture crop and cultivated land lands due to heavy rain is estimated about Rs. 26.68 crores.

- Damage to Horticulture Crops: the losses on account of this have been assessed to the tune of Rs 162.00 crores

- Damage to electricity infrastructure: The electricity infrastructure has severely been damaged especially in districts Shimla, Mandi, Kangra, Hamirpur and Sirmaur. The total loss on this account has been assessed Rs 3.87 Crores.

- Damage to Community/Govt. assets: A lot of community assets in the state like Mahila Mandal Bhawan, Community Centers and village paths etc, have been extensively damaged due to rains resulting in loss of over Rs 50.00 crores.

- Total cumulative losses suffered by the state are Rs 832.67 crores.

Damage occurred during 2015 due to rains in various parts of the state are as follows:

- **Human lives lost: 17** persons have lost their precious life in the State.
- **Animals lost: - 16** animals including sheeps, goats, buffalo etc. perished. Loss on this account has been assessed as **Rs 0.01 Crores.**
- **Houses damaged: 230** houses and cowsheds have fully or partially been damaged in various parts of the state during the current winter season with overall estimated loss to private property worth **Rs 0.50 Crores.**
- **Damage to roads:** Due to high density and quantity of hailstorm/unseasonal excessive rains, the PWD infrastructure i.e. roads, bridges and culverts has been severely damaged during the current winter season. The total losses on this account have been assessed as **Rs. 53.12 Crores.**

Damage to Irrigation and water supply schemes:

- Total affecting schemes-1787
- Water Supply-1595
- Irrigation-187
- Flood Protection-5
- Total loss has been estimated as Rs. 55.84 crores

- **Damage to Agriculture crops:** The overall loss to crops in terms of money value as assessed is **Rs. 59.23 crores** out of which loss on area where crop loss is more than 50% is **Rs. 22.61 Cr.** Therefore, the total loss to agriculture crop and cultivated lands due to heavy rains is estimated about **Rs. 59.23 crores.**
- **Damage to Horticultural crops:** The losses to fruit crops were also caused in the month of February & Marchdue to unseasonal heavy rains, which affected the fruit set especially the stone fruits, Mango crops & Apple in low hills of the State. The total is amounting to **Rs. 41.22 crore.**
- **Damage to electricity infrastructure:** The electricity infrastructure has also severely been damaged especially in districts Shimla, Chamba, Kinnaur and Lahaul& Spiti, Una, Hamirpur, Mandi due to heavy snowfall, hailstorm of high intensity and untimely heavy rains. The total loss has been assessed at **Rs 37.81 crores** on this account.
- Fisheries: Due to hailstorm all the raceways, brood, tanks, grow out ponds and nurseries of Fisheries and hatchery and staff quarters also got damaged. The total loss on this account has been assessed as Rs. 0.75 Crores.
-
- Health: More than 175 Primary Health Centers and Civil Dispensaries have been damaged due to heavy hailstorm and snowfall. The total loss on this account has been assessed as Rs 0.60 Crores.
- Education: More than 190 Schools buildings have fully/partially been damaged due to heavy hailstorm and snowfall. The total loss on this account has been assessed as Rs 0.82 Crores.
- Damage to community/Government assets: A lot of community assets in the state like community centers, village paths etc. have been extensively damaged due to unseasonal rains resulting in a loss of over Rs. 12.00 Crores.
- Total cumulative losses suffered by the state are Rs 277.19 Crores

Damage occurred during 2016 due to rains in various parts of the state are as follows:

Human lives lost:

- Due to flash floods, landslides and cloudburst etc. total 40 people lost their lives in the entire state. District wise detail is as follow

Damage occurred during 2016 due to rains in various parts of the state

Sr. No.	Districts	Loss of lives (Persons)	Missing	Relief Funds
1	Bilaspur	1		0.04
2	Chamba	7	3	0.28
3	Hamirpur	-		
4	Kangra	2	2	0.08
5	Kinnaur	-		
6	Kullu	8		0.32
7	Lahaul-Spiti	-		
8	Mandi	5		0.20
9	Shimla	9	5	0.36
10	Sirmaur	5		0.20
11	Solan	3		0.12
12	Una	-		
Total	**H.P.**	**40**	**10**	**1.60**

- Animals Lost:136 animals including buffalo's sheep and goats died. Loss on this account has been assessed as Rs. 0.23Crores.

- **Houses Damaged:**
  - Total Houses Damaged-2283
  - Fully damaged Kuchha and Pucca houses-219
  - Partially damaged Kuchha and Pucca houses-1072
  - Cowsheds, gharats, shops and labour sheds – 992
  - Total loss on this account is estimated Rs 15.27 Crore.
  -
- Damage to Roads: The total losses on this account have been assessed as Rs. 595.02 Crores.

- **Damage to irrigation and water supply schemes:**
  - Total affecting schemes-3349
  - Urban water supply-42
  - Rural water supply-2417
  - Irrigation schemes -843
  - Flood protection-26
  - Sewerage schemes-2
  - The total loss has been estimated Rs 151.24 crores.

- **Damage to Agriculture Crops:** The overall loss to crops has been assessed to Rs 6.64 crores. The cultivated land has also been damaged and loss is around Rs 0.20 crores.

- **Damage to Horticulture Crops:** The losses on account of this have been assessed to the tune of Rs19.99 crores.

- **Damage to electricity infrastructure:** The electricity infrastructure has severely been damaged throughout the state. The total loss on this account has been assessed Rs 69.66 Crores.

- **Fisheries:** Trout fish farm, Hamni, Tehsil Banjar, district Kullu and its property vis. Nurseries and ponds have been damaged and loss of Rs 1.00 crore is assessed.

- **Education:** The total loss on this account has been assessed asRs 0.10 Crores.

- **Damage to Community/Govt. assets:** A lot of community assets in the state like Community Centers and village paths etc, have been extensively damaged due to rains resulting in loss of over Rs 3.02 crores.

- Total cumulative losses suffered by the state are Rs 863.97 crores.

Damage occurred during 2017 due to rains in various parts of the state are as follows:

- Human lives lost: Due to flash floods, landslides and cloud burst etc. total 75 people lost their lives in the entire state. District wise detail is as follows:

  During monsoon season 338 deaths occurred out of which 75 deaths can be directly attributed to flash floods, landslides and cloud bursts etc., and remaining 263 deaths occurred due to road accidents.

- **Animals Lost:199** animals including cows, buffalo's sheep, horses and goats died. Loss on this account has been assessed as **Rs. 0.22Crores.**

- **Houses Damaged: Total 2195**
  - Fully damaged Kuchha and Pucca houses-140,
  - Partially damaged Kuchha and Pucca houses-1073
  - Cowsheds, gharats, shops and labour sheds - 982
  - Loss on this account has been assessed as Rs13.30 Crore.
- **Damage to Roads:** The total losses on this account have been assessed as Rs. 433.25 Crores.

- **Damage to irrigation and water supply schemes:**
  - Total affecting schemes-4263
  - Urban water supply-27
  - Rural water supply-3106
  - Irrigation schemes -1072
  - Flood protection-34
  - Sewerage schemes-24.
  - The total loss has been estimated Rs188.65 crores.
- Damage to Agriculture Crops:the overall loss to crops has been assessed to Rs18.19 crores. The cultivated land has also been damaged and loss is around Rs 0.89 crores.
- Damage to Horticulture Crops: The losses on account of this have been assessed to the tune of Rs214.26 crores.

District wise detail of Loss of Life and Relief Funds

Sr. No.	Districts	Loss of lives (Persons)	Missing	Relief Funds (Crores)
1	Bilaspur	5	-	0.20
2	Chamba	3	-	0.12
3	Hamirpur	2	1	0.08
4	Kangra	1	-	0.04
5	Kinnaur	3	6	0.12
6	Kullu	2	-	0.08
7	Lahaul-Spiti	1	-	0.04
8	Mandi	48	-	1.92
9	Shimla	7	-	0.28
10	Sirmaur	1	-	0.04
11	Solan	-	-	-
12	Una	2	-	0.08
Total	**H.P.**	**75**	**7**	**3.00**

- Damage to electricity infrastructure: The electricity infrastructure has severely been damaged throughout the state. The total loss on this account has been assessedRs10.36 Crores.
- Education: 36 Nos. of primary school buildings have been damaged.The total loss on this account has been assessed asRs 0.54 Crores.
- Damage to Community/Govt. Assets: A lot of community assets in the state like Community Centers and village paths etc, have been extensively damaged due to rains resulting in loss of overRs 3.46 crores.
- Total cumulative losses Rs914.05 crores.

During monsoon period of 2018 , a total of 343 people lost their livers due to flash floods, landslides, cloud burst and road accidents across the State.

- Animals lost: Total 1285 Sheep, goats, cows, horses and buffaloes etc. Loss on this account has been assessed as Rs.0.87Cr and Rs 0.10 Cr. Structural loss to animal husbandry.
- Structures damaged Total:- 6023
- Fully damaged Kaccha and Pucca houses-567
- Partially damaged Kaccha & Pucca houses-3171
- Cowshed, Gharats, shops a nd labor sheds— 2285
- Loss on this account has been assessed as Rs. 43.03 Cr.
- **Damage to roads:** Due to flash flood and landslide, the PWD Infrastructure i.e. Roads, Bridges and culverts have been severely damaged during the current Monsoon season. The total losses on this account have been assessed as Rs. 929.27 Cr.
- **Damage to Irrigation and water supply schemes Total 6602, IPH** schemes have been damaged.
- Urban Water Supply-40
- Rural Water Supply-4816
- Irrigation schemes- 1746
- Total loss has been estimated till date as Rs. 430.04 Crore

- **Damage to agriculture crops:** Due to heavy rainfall in some parts of the state, the crops have been affected. The damages caused to standing Kharif crops due to heavy rains in the state was assessed is Rs. 105.08 crores. The cultivated land has also been damaged/washed away due to siltation/landslides/avalanches and loss in terms of money value is around 16.03 crores.
- **Damage to Horticultural Crops:** Damage to horticulture crops was assessed to the tune of Rs. 2.43835 crores
- Total losses to the Electricity infrastructure was assessed Rs. 24.50 Cr. and the education sector was 5.05 Cr.
- Total cumulative loss the Government during 2018 was 1594.01Cr.
- During monsoon period of 2019, a total of 89 peoples lost their lives due to flash floods, landslides, lightening, fire, drowning and cloudbursts etc.218 people also died due to various other reasons in this period directly or indirectly related to monsoon.
- **Animals Husbandry:** A Total 555 animals died; which includes sheep, goats, cows, horses and buffaloes in a major incident of lightening, that happened at Shimla. In district Shimla 30 families lost their livelihood as 190 sheeps and goats died. Other infrastructure related animal husbandry suffered a loss of Rs. 0.15 Crore. In this season, the loss has been assessed as Rs.0.68Cr.
- **Structures damaged:** Due to the current disaster, a number of houses and others assets suffered moderate to severe damages. The details are as under:-
- Fully damaged Kaccha and Pucca houses-231.
- Partially damaged Kaccha & Pucca houses-1535.
- Cowshed, gharats, shops and laborsheds-1174.
- Total-2940.
- Loss on this account has been assessed as Rs. 19.17 Cr.
- **Damage to roads:** Nearly 23905 km of road length has been adversely affected. Due to flash flood and landslide, the PWD Infrastructure i.e. Roads, Bridges and culverts have been severely damaged during the current Monsoon season. The total losses on this account have been assessed as Rs. 594.99 Cr.
- **Damage to Irrigation and water supply scheme:** Schems of !PH were significantly affected, due to the current disaster. The damage recorded is given below:
- Urban Water Supply-44Nos.
- Rural Water Supply-4134Nos.
- Irrigation schemes-1519Nos.

Total loss has been estimated till date as Rs. 321.26Crore

- Damage to agriculture and horticulture sector during 2019 monsoon season was assessed as Rs. 87.51Cr and 34.35 Cr.
- Damage to electricity and education infrastructure was Rs.25.00 Cr and 34.35 Cr respectively.
- Cumulative losses during 2019 monsoon were —Rs.1237.0SCrores

During 2019 winter period 408 Persons lost their lives due to rain/snow/snow avalanche, landslides and road accident.

- **Animals lost:** Total 207Nos. sheep, goats, cows, horses and buffaloes, etc.have perished by the period Loss on this account has been assessed as Rs 0.19Cr.
- Structures damaged Total:-1346Nos.
- Fully damaged Kaccha and Pucca houses-210
- Partially damaged Kaccha & Pucca houses-783
- Cowshed, Gharats, shops and laborsheds-353

Loss on this account has been assessed as Fts.10.46Cr.

- Cumulative damage to PWD department in the infrastructure was Rs.242.27 Cr and IPH Department was Rs.43.97Cr.
- Damage to horticulture crops was to the tune of Rs.50.04Cr.
- Cumulative losses during 2019 winter were —Rs.374.21Cr.

Images of Search and Rescue Operation at Lahaul Spiti and Chamba
Rescue Operation at Stingri, Lahaul & Spitiduring 2018 (SDMAR eports)




Rescue Operation at Bathal, Chatru and Chotta Dhara (Lahaul & Spiti)


Community helps during Rescue Operation at Stingri, Lahaul & Spiti

10.9 Institutional Mechanism to mitigate the disasters in the State

The Government of Himachal Pradesh formulated a State Level Disaster Management Committee under the Chairmanship of Chief Secretary to take stock of the disaster situation in the state and monitor and administer the State Disaster Management Plan in Himachal Pradesh. Government also constituted five sub- groups as per the guidelines framed by the HPC of Govt of India.

Disaster Management- an Institutional Mechanism

On 23rd December, 2005, the Government of India took a defining step by enacting the Disaster Management Act, 2005, which envisaged creation of the National Disaster Management Authority (NDMA) headed by the Prime Minister, State Disaster Management Authorities (SDMA) headed by the Chief Ministers, and District Disaster Management Authorities (DDMA) headed by the District Magistrates or Deputy Commissioners as the case may be, to spearhead and adopt a holistic and integrated approach to disaster management (DM). According to the Act - there will be a paradigm shift, from the erstwhile relief-centric response to a proactive prevention, mitigation and preparedness-driven approach for conserving development gains and to minimize loss of life, livelihood and property.

Institutional Mechanism at the State level

The Disaster Management Act 2005 lays down a three tier institutional structure for disaster management at the National, State and District levels in the form of NDMA, SDMA, and DDMA. National Policy on Disaster Management (NPDM) has further specified the roles and responsibilities of various organisations for disaster response. To fulfil the DM Act Provisions, State Government has already constituted a State Disaster Management Authority (SDMA).

State Disaster Management Authority (SDMA) and State Executive Committee (SEC)

It will be the primary responsibility of the State Government to respond to natural disasters and provide relief to the affected people. Section 22 (2) (g) of the DM Act stipulates that the SEC under the State Chief Secretary shall 'coordinate response in the event of any threatening disaster situation or disaster'. SEC shall give directions to any Department of the State Government or any other authority or body in the State regarding actions to be taken in response to any disaster.

Disaster Response being a multi-agency function, other Departments of the State Government will provide emergency support in their relevant domains at the State/District levels.

Govt of Himachal Pradesh vide order No. Rev.D(F)4-2/2000-V dated 1-06-2007 constituted the SDMA and the Members of the State Disaster Management Authority (SDMA)

1.	Hon'ble Chief Minister	Chairperson
2.	Hon'ble Revenue Minister	Member
3.	Chief Secretary	CEO, ex-officio
4.	Additional Chief Secretary –cum- FC (Rev)	Member
5.	Principal Secretary (Home)	Member
6.	Principal Secretary (PWD)/I&PH	Member
7.	Principal Secretary (Health)	Member
8.	Director General of Police	Member
9.	Secretary (Revenue)	Member Secretary

Government of Himachal Pradesh in pursuance to DM Act 2005 also constituted the State Executive Committee (SEC) to assist the State Authority in the performance of its functions and to coordinate action in accordance with guidelines laid down by the State Authority and ensure the compliance of the directions issued by the State Government under the Act ibid and consists of the following members:-

1.	Chief Secretary	Chairperson
2.	Principal Secretary (Home)	Member
3.	Principal Secretary (Health)	Member
4.	Principal Secretary (PWD)	Member
5.	Principal Secretary (Revenue)	Member Secretary

State and District Crisis Management Group

The crisis management group at State and district level have been constituted for the State. The State Crisis Management Group (SCMG) is headed by the Chief Secretary. The SCMG shall normally handle all crisis situation and advise and guide the District Crisis Management Group (DCMG) also. The DCMG is headed by the District Magistrate and is responsible for on-scene management of the incident emergency.

District Disaster Management Authority (DDMA)

Section 30(2)(xvi) of the DM Act stipulates that DDMA under the Chair of the Collector or District Magistrate or Deputy Commissioner, as the case may be and the co-chair of the elected representative of the local authority, shall 'coordinate response to any threatening disaster situation or disaster'. The Collector/District Magistrate/Deputy Commissioner, as the head of administration at the district, shall be the focal point in the command and control for disaster response at the district level, in accordance with the policies/guidelines/instructions from the national and State levels. Depending on the nature of disaster and response, he will be the Responsible Officer for managing disasters and emergencies.

All the Department/Agencies of the Central and State Government in the District /City involved in response and relief will work in accordance with the directions of the Responsible Officer.

The lower administrative units of Districts viz. Subdivisions under the administrative control of a Sub-Divisional magistrate /officer and Block and Tehsils under the administrative control of Block Development Officer/Tehsildars will coordinate the functioning of the various departments in their respective jurisdiction.

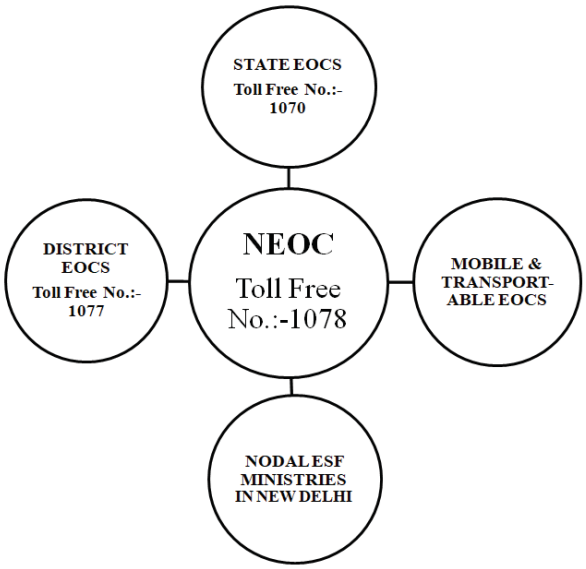
The Incident Response Teams at Subdivision and Block levels under SDO/SDM or BDO/Tehsildar and each department level as the case be will be responsible for all response and relief works.

Besides the institutional frame work of SDMA and DDMA, the state should have the following at the state and district level.

State Emergency Operation Centre (SEOC) and District Emergency Operation Centre (DEOC)

It has been observed that at the time of a calamity/disaster, communication services are the first to go out of order. It has therefore been decided to put in place multi-mode and multi-channel communication systems so that enough redundancy is available. In order to have the established network at the time of any calamity, the State Emergency Operation Centre (SEOC) and the District Emergency Operation Centre (DEOC) have been established and are made functional. The communication network between the national and the State EOCs and the site of the emergency/crises has also been worked out which is described the diagram given below.

CONNECTIVITY MATRIX



Emergency Operation Center plays a vital role in the Emergency Operation activation. It coordinates the flow of information with respect to activities associated with relief operations. During the normal times it maintains a systematic database of the resources available, important phone numbers, names and addresses of important government and non-government officials, international bodies, NGOs. During crisis it is expected to function as a center for decision-making and help flow of information horizontally and vertically to the respected departments for smoother relief operations.

As per the Government of India national framework for disaster management, the States are being assisted to set up control rooms/emergency operations centres at State and district level. Assistance for this was being given under the GoI-UNDP project in the States covered by the project (HP was covered under this project). Assistance under the Modernization of Police Scheme was also available for setting up EOCs. The control rooms, which will function round the clock, will be composite control rooms to look after law and order issues as well as disaster management. Equipment were also provided for these control rooms under the disaster risk management {GoI-UNDP DRM programme, (2002-09)} to the selected states. Hazard zone-wise standard layout, structural design and construction drawings have been developed for State and District EOCs.

To coordinate the entire disaster/emergency operations effectively, the existing Control Room at the national level has been being upgraded as National Emergency Operations center (NEOC). The NEOC is equipped with satellite phones, GPS, computers, emergency lights, GIS information system etc. in five on-site emergency coordination kits in ready-to-use mode. Staffs in the NEOC have been trained. A state of the art underground an all-hazard resistant NEOC with superior structural features and communication facilities has been set up.

The function of control room is not only to control disaster but also to look after rehabilitation and mitigation. No one knows when disaster will strike, so it's better to be prepared from beforehand to reduce loss of life. We can summarize the function of control room in three simple phases:

- Preparation
- Prevention
- Mitigation

Emergency Operation Center monitors different disaster mitigation programme and co-ordinates with different organization. It also conducts evaluation of the programmes, and immediately takes up necessary measures. Besides, the EOCs may act as control rooms for various other purposes such as law and order problem, elections, VIP movements and other activities requiring coordination. State Disaster Response Force (SDRF)

Emergency Support Functions Plans, based on ESF Plan at National level, the State Government shall designate Primary and Secondary Departments/Agencies for each ESF and mandate them for making plans for providing emergency support at the State and district level.

Incident Response System (IRS)

Under IRS an incident commander and officers trained in different aspects of incident management, such as logistics, operations, planning, safety, media management etc. form a specialist incident management team to manage the disaster /emergency.

Section 23 of the DM Act 2005 provides that there shall be DM plan for every state. It outlines the broad coverage of the plan as well as the requirements of consultation in the preparation of the State Plan. It also provides for annual review and updating of the state plan, and enjoins upon the state Governments to make provisions for financing the activities to be carried out under the state plans. It provides for the department of the state Government to draw up their own plans in accordance with the State Plan. The State Plan shall be prepared by the State Executive Committee (SEC) in conformity with the guidelines to be issued on related matters by the SDMA having regard to the guidelines laid down in this regard by the NDMA, and after such consultation with the local and district authorities and the people's representative as the SEC may deem fit. The state plan prepared by SEC shall be approved by the State Disaster Management Authority (SDMA).

SOCIETY AND ENVIRONMENT

CHAPTER-11

11 Introduction

Himachal Pradesh is a predominantly mountainous state in the Western Himalaya and has anarea of 55,673 sq. kms. Altitudes in the state vary between 350m and 6,975m. It is located between latitude 30° 22' to 33° 12' N and longitude 75° 45' to 79° 04' E. The state has three distinct geographic regions, which are: the Shiwaliks with altitudes up to 1500 m; the middle Himalayan region with heights between 1500m and 3000m and Himadris which are higher than 3000m. About one third of Himachal is permanently under snow, glaciers and cold deserts where tree growth is minimal due to extreme climatic conditions. The average annual rainfall is about 1800mm and temperatures vary between sub-zero to 35 C. The major rivers of Himachal Pradesh are the Satluj, Beas, Ravi, Chenab and the Yamuna.

Apart from the pockets of British India that came into being only in the 18th century, Himachal was divided into several hereditary kingdoms. After India's independence on 15 August 1947, these integrated with the Union of India. The state of Himachal Pradesh came into being the following year on 14 April 1948 and was granted full statehood on 25 Janauary1971.

Pre-historic sites backed by the excavation of stone-age tools have been located in Una, Bilaspur, Kangra and Sirmaur. There are also inferences of Harappan and subsequent ancient civilisations. The epic Mahabharata records the region to have held small tribal republics, 'Janapadas' and these are regarded to be the successors of the 'Mavanas' which were territorial units controlled by local strongmen. But migration with all its cultural influences has marked the development of the people of Himachal. The descendants of many remain to the present day – and Kolarian and Indo- Aryan language speakers are regarded to be amongst the earliest people. Coins and excavations stand testimony to large and prosperous communities in the centuries before the Common Era. The rise and fall of the great empires of north India sent their own eddies into the hills and the Rajput states have left an indelible impression over Himachal – many of which were founded by adventurers or chieftains fleeing the rise the imperial Mughals. The rise of the martial Gurkhas in neighbouring Nepal in the eighteenth and nineteenth centuries led cause to a force that was finally repelled by the British – who in turn, established their own spheres of influence and built the 'hill stations' of today's Himachal.

11.1 Pressure

All across human history, we have been a ected or have a ected the world around us. Much of the natural world has been destroyed by the actions of our species and yet, a fair bit has also been preserved by our interventions. Considerable uncertainties and complexities have emerged with alterations in the natural environment. Issues like pollution and climate change have started impacting our daily lives. Health is a ected with pollution; farming and agricultural stability with climate change.

Numerous research papers and scholarly works had been in existence when a popular, yet path-breaking book examined the interface between humans as a species, the societal-collective we form and our environment. This book, Rachel Carson's 'Silent Spring' (1962), studied the impact of pesticides and the damage they caused. It also looked at the larger impact humans had on the world around them. This led to the ban on the chemical DDT in several countries, as well as a ban on some other pesticides. This was perhaps the first widely read and substantially influential text on how society impacts the environment and the other way round.

This book was published almost six decades ago. It was a time when 'climate change' and its severe impact was still a thing of the future. In this interim, the interface between society and the natural world has accelerated and much of this has been to the detriment of the environment. Himachal Pradesh has not been an island removed or isolated from these changes. This paper looks at some of these issues and at the vast web that entwines both society and the environment.

The word 'Environment' comes from the French word 'environ', a noun that literally means the surroundings or conditions in which an animal or plant lives or operates; the word is synonymously used for 'habitat'. Alternatively, environment also means the natural world as a whole or in a particular geographical area. The 'natural environment' encompasses all living and non-living things that occur as a matter of course. The core components of natural environment are air, water, soil, land, forests, wildlife, flora and fauna. This is a composite of the natural world of land, water, air, plants and animals that surround all living beings and this forms the basis of their existence, growth and development. In turn, this has two broad components: Biological –which is the biotic component of flora and fauna and the Physical, which is the abiotic component; in turn, the latter is further sub-divided into solid earth or the Lithosphere and the water component, the Hydrosphere and Atmosphere, with its gaseous composition. All told, these are interlinked, inseparable and a form a complex yet a composite unit or units.

11.2 State

All organisms constantly interact with each other, and with their environment. Sometimes, they influence and change one another in very visible ways – like in the way we are witnessing rising temperatures and extreme climate today. Sometimes the changes are subtle and almost imperceptible – like the way humans are constantly evolving and yet retain vestigial parts of their bodies like the tailbone at the end of the spine or the caruncle, the pink part in the corner of our eyes. The first is from the time we had tails and the second, is remnant of the reptilian eye. Both took millions of years of interacting with the environment to alter their characters.

While this is how evolution and the environment have altered us, it may be noted that of all organisms on the planet, human beings are the most skillful and evolved. The human species uses or exploits the environment to fulfill its physical, social and economic needs. Humans have played a proactive role in the usage, modification, degradation and change of the natural environment and, in the present age, threatened not only to their own existence but also that of other organisms.

'Society' means the aggregate of people living together in a more or less ordered community and dependent on each other for survival. This also implies persistent social interaction and the sharing of a common culture. Down the years, human lifestyles have changed considerably. From prehistoric hunter gatherers, humans moved to plant domestication and agriculture and then to science, technology and industrialization.

11.3 Impact

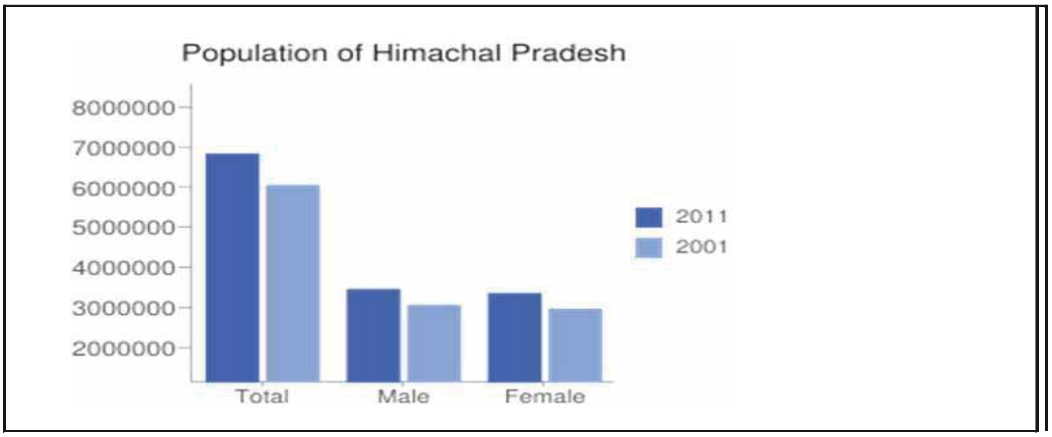
Social and environmental issues are interwoven. Other animals in the natural environment rigidly occupy a particular niche. It takes long time, which passes through several generations over hundreds of years and may lead to tiny changes in the food habit, habitat or behavior of an organism. Change and adaptation in them is very slow. However, human has an evolved and complex brain, use of verbal and written language to transfer and transmit knowledge and e□ective use of hands has almost diversified its adaptation in behavior, habitat and food habits from herbivore to carnivore to omnivore and consequently exploited environment tremendously.

11.4 Response

Throughout the history, environment has a□ected mankind and also environment has been a□ected by the natural world. A good deal of environment has been lost due to human activities and indulgence. Only what is valued about human is they protect and preserve environment to some extent by some conscious actions. While several uncertainties remain, there is a realization that environmental problems are becoming more and more complex, especially as issues arise on a more global level, such as that of atmospheric pollution and global warming.

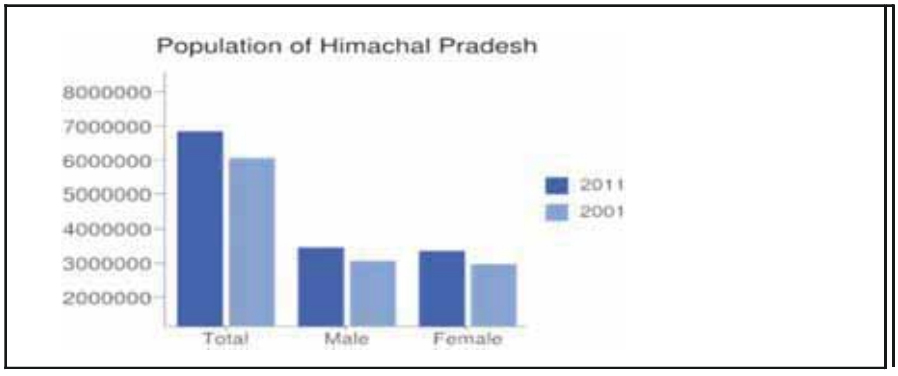
11.5 Demographic Profile of Himachal Pradesh:

Himachal Pradesh, much like other states of India, is experiencing a demographic transition. Such transition (along with forces of migration) is affecting population size, growth rate, density, age structure, sex composition and distribution patterns that are important indicators of human resources in the state. According to the 2011 census, the state accounted for a very meagre share of total population of India (0.59 %), more or less the same as in 2001. The total population of the state is 6,856,509 as per the census record. Out of the total population, 3,473,892 are males and 3,382,617 females. The sex ratio was 972 females per 1,000 males; this reflected a marginal increase 968 in 2001. The total fertility rate (TFR) per woman in 2015 was 1.7 and is one of the lowest in India.



Distribution of male / female ratio as per the Census of 2011

With extrapolations, based on a calculations arising from the Census of 2011, the population in 2019 may be placed at around 74.35 lakhs.

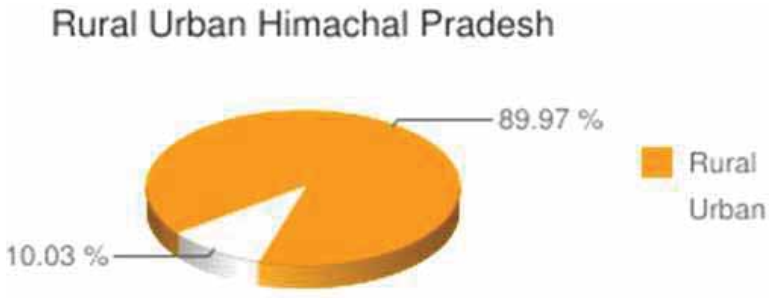


Distribution of population, decadal growth rate, sex- ratio, and population density of years 2001-2011.

	Population	Growth rate 2001-2011	Population density (persons/Km²)	Sex-ratio (Females/thousand Males)				
Name	**Persons**	**Males**	**Females**		**2001**	**2011**	**2001**	**2011**
Himachal Pradesh	6856509	3473892	3382617	+12.81	109	123	968	974
Chamba	518844	260848	257996	+12.58	71	80	959	989
Kangra	1507223	748559	758664	+12.56	233	263	1025	1013
Lahaul-spiti	31528	16455	15073	-5.10	2	2	802	916
Kullu	437474	224320	213154	+14.65	69	79	927	950
Mandi	999518	496787	502731	+10.89	228	253	1013	1012
Hamirpur	454293	216742	237551	+10.08	369	406	1099	1096
Una	521057	263541	257516	+16.24	291	338	997	977
Bilaspur	382056	192827	189229	+12.08	292	327	990	981
Solan	576670	306162	270508	+15.21	259	298	852	884
Sirmour	530164	276801	253363	+15.61	162	188	901	915
Shimla	813384	424486	388898	+12.58	141	159	896	916
Kinnaur	84298	46364	37934	+07.61	12	13	857	818

Provisional Population Totals Paper-I of Census 2011

This steady growth and certain large scale projects, have impacted an environment that had not seen any major threa or change caused by human activity for centuries. If adversity came, like the earthquake of 1905 that left several thousand people dead, these events emanated from the forces of nature. The last few decades have seen a spurt in human activity in several spheres – roads, construction, substantialindustrialization along the state's peripheral areas and hydroelectric projects. The change wrought by these underscore the need balance development and human aspirations with nature's stability. Water security, protection of the forests and wildlife, an emerging urban-rural divide, erosion of traditional values and the arrival of a drug menace are altering the interface between society and environment.



Rural vis a vis urban Himachal as per the Census of 2011

11.6 Occupational Structure of Society:

Himachal's pre-colonial landscape was dominated by a subsistence economy which was agro-pastoral in character. Commercial agriculture was minimal – and of this, opium was the only significant crop. In trade, barter was the norm. Villages varied in size from the single house dochi to something larger that could hold several dozen or more residences. As in the centuries gone by, agriculture continues to form the main occupation of Himachal Pradesh. Over 60% of the population directly depends on agriculture for its livelihood. Due to Himachal's topographic conditions, terraced cultivation is widely practiced in the State. As described by the Planning Commission, the economy of the state is predominantly of 'mixed farming, agro-pastoral, silvi-pastoral and agro-horticultural'. Most of the group-based farming systems that engage the maximum number of farmers are in and around the primary river basins.

11.7 Land Utilization Patterns

	Himachal Pradesh	India's Average
Land available for cultivation out of total land holdings	75.3% of total area	85.9% of total area
Net Area Sown	11.9% of total culturable area	45.8% of total culturable area
Irrigation facilities	20% of net cropped area	45% of net cropped area

The per capita GSDP in HP is Rs. 1,30,511 but the agriculture GSDP per cultivator is only Rs. 49,032 which is one of the lowest in the country. Source: Statistical Abstract -CSO & According to data prepared by the Ministry of Statistics and Programme Implementation (GOI), out of Himachal's total geographical area of 55.67 lakh hectares, the area of working holdings is about 9.55 lakh hectares and this is operated by 9.61 lakh farmers. The average holding size is about one hectare. The distribution of land holdings according to the Agricultural Census shows that 87.95% of the total holdings are of small and marginal farmers, while about 11.71% of holdings are owned by semi-medium and medium farmers and only 0.34% by large farmers. The particular suitability of Himachal's climate and terrain has resulted in the altering of land use patterns from agriculture to fruit crops in the past few decades. The area under fruits, which was 792 hectares in 1950-51 with total production of 1,200 tonnes increased to 2,24,352 hectares during 2014-15 and the total fruit production in 2014-15, was 7.52 lakh tonnes, which during 2015- 16 has been reported to be around 9.29 lakh tonnes.

Apart from the significant output of fruits, other crops cultivated in the state are mainly cereals like wheat, rice, maize, and barley. The state also produces pulses and oilseeds. Cash crops like potato, ginger, garlic and peas come from the state. Floriculture is picking up as is the cultivation of exotic herbs, medicinal plants and unusual vegetables.

11.8 Forests of Himachal Pradesh

As a percentage of the total area with the state, about 66.5% is under the classification of 'forest' as against the national figure of 21%. Forests constitute a significant, if not the single major component of the environment in Himachal. The greatest interface between society and the natural environment is between humans and forests. All traditional settlements in Himachal were dependent on a few basic things – access to arable land, water and forest produce. The rights to forest produce became defined as 'bartaan'. The most significant of these was timber and this wound down to grasses for fodder.

These woodlands are storehouses of rich biodiversity and are essential to regulate the water flow in rivers and streams, check soil erosion, floods and droughts and also maintain the ecological balance and quality of environment for the survival of mankind. Forestry activities generate substantial economic opportunities, especially for the rural population.

The forests of Himachal Pradesh are rich in vascular flora, which forms a prominent vegetation cover. Out of total 45,000 species of plants found in the country as many as 3,295 species (7.32%) are reportedly found in the state. More than 95% of species are endemic to Himachal and characteristic of Western Himalayan flora, while about 5% are exotic, introduced over the last 150 years. According to the National Forest Policy, 1988, at least two thirds of the geographical area should be under forest in the hill states. In Himachal Pradesh, 20% of the area is inaccessible and beyond tree line. The State Government aims to bring 50% of the area under forest cover.

Geographical distribution of Forests of Himachal Pradesh.

Forest area	Area Km²	Percentage of geographical area	Percentage of Forest Area
Forest area (legally defined)	37033	66.52	100
Area Under Tree Cover	14683	26.37	39.64
(i)Dense Forests	3224	5.79	8.7
(ii)Moderate dense Forests	6381	11.46	17.23
(iii)Open Forest	5078	9.12	13.71

(Based on the Forest Survey of India Report,2013)

Legal Classification of Forest

S. No.	Management Classification	Area Km²	Percentage
1.	Reserved Forests	1896	5.12
2.	Demarcated Protected Forests	11387	30.75
3.	Un –demarcated Protected Forests	21656	58.48
4.	Un-classified protected Forests	976	2.63
5.	Others (Managed by Forest Department	370	1.00
6.	Not Managed by Forest Department	748	2.02

(Forest Department)

DISTRICT WISE FOREST COVER OF HIMACHAL PRADESH 2013 (Area in Km^2)

District	Geographical area	Very Dense Forest	Mod. Dense Forest	Open forest	Total
Bilaspur	1167	24	171	167	362
Chamba	6522	853	773	811	2437
Hamirpur	1118	39	91	114	244
Kangra	5739	310	1221	533	2064
Kinnaur	6401	82	262	260	604
Kullu	5503	586	785	588	1959
LahulSpiti	13841	15	32	147	194
Mandi	3950	373	735	567	1675
Shimla	5131	739	1037	610	2386
Sirmaur	2825	130	568	687	1385
Solan	1936	55	404	391	850
Una	1540	18	302	203	523
Grand total	**55673**	**3224**	**6381**	**5078**	**14683**

11.9 Linkages between Forests and Rural Livelihood

Since most rural communities live in close proximity to forests, management of forest resources of the ecologically sensitive Himalayan state, contributes significantly towards ecological stability and the economic development. These traditional managements practices, evolved over centuries of treating forests as intrinsic parts of human existence. The local inhabitants in Himachal Pradesh have acquired rights on forest use through legal forest settlements. However, traditionally, local people who inhabit an area are very conservative and use collective participatory approaches for the management and use of forests products and pastures for their survival and existence. Hence, people protect resources that are used by them. The control is exercised through their local institutions for example local deity committees for conflict resolution generally by consensus and fines. The interdependence amongst people is very high. There is a strong commercial activity involved as edible nuts, cumin seeds, morels, and medicinal plants found in the area are highly valued and source of cash income. It demonstrates the good forest- good livelihood linkages in Himachal.

11.10 Some of the forest products which are managed through local management are:

Edible Pine nuts and Black Cumin: The residents of Kanam, Neshang and Akpa villages of district Kinnaur have rights of use to forests products to sustain themselves. The sale of some quantity to NTFPs is also allowed. The vegetation around these villages is sparse and people's dependence on natural forests is very high. The villagers mainly rely on forest products like edible pine nuts or Neoza / Chilgoza , (*Pinus Gerardiana*), black cumin *(Nigella Sativa)*, morels *(Morchella Esculenta)*, medicinal plants and grass. The inhabitants have organized

themselves for the protection, collective collection and management of these products through deity committees. Pine nut is an indigenous species to inner Himalayas which occurs over 40-50 hectare area around these villages. The cones are collected during the month of October for seeds which are sold as valuable dry fruit. Cumin herbs are collected on the specified date decided by the deity committee by employing one person from each family. Each person collects herbs on a prescribed day and extracts the seed for himself. Each family gets around 5-6 kg seed from these collections every year.

11.10.2 Grass in Kinnaur and Pangi:

Crops and livestock predominantly substitute to the income of the families in the rural areas of Himachal Pradesh. Villagers do not allow grazing of animals in the areas protected for grass cutting. Animal grazing is allowed only in highland pastures called Kandas. In the adjoining areas of the village, grazing is strictly prohibited and a watcher appointed by the committee on rotation basis for its protection. Grass cutting is done in September before the onset of winters and the grass is used for feeding animals during the winters. Each family gets about one quintal – 3 head loads of 30-35 kg having 120 hand bundles. Fines are imposed on families found indulged in grazing and are credited to the deity's account.

11.10.3 Willow Coppice in Lossar village (Spiti):

Wild Willow (*Salix fragillis*) an arboreal shrub, occurs naturally on river and stream beds in village Lossar situated at 3900m in Spiti where no other woody species is seen. Coppice shoots are harvested and are extensively used as small timber, firewood, fodder etc. by local people. The branches are used to support the roof in locally constructed mud-roofed houses and leaves and small branches are fed to livestock.

11.10.4 Extraction of morel and medicinal plants in the Nathpa Forests of Kinnaur:

Villagers who rear sheep and goat in the forest pastures collect morel, Guchhi (*Morchellaesculenta*) and medicinal plants for sale. Guchhi is a nutritious wild mushroom which grows naturally in these forests and has good market value. These are generally collected by the grazers and sold to supplement cash income for the household. It is collected from the forests during May and June. The market price of a kilo of gucchi is upwards of Rs. 10,000/-

11.10.5 Honey from wild bees:

Collecting honey from wild bee colonies is one of the ancient human activities and is still practiced in many parts of the world. Bees are an integral part of our lives and environment, without them, life would take a very different turn. There are around 25,000 species of bees in the world. Bees provide important natural products and services. They play an important role in food production, it is for this reason bees have been used for commercial pollination in agriculture and horticulture.

The modern bee keeping in Himachal Pradesh was introduced in 1934 in Kullu and 1936, in Kangra valley. In view of the importance of honey bee in the successful pollination of fruit plants and increasing its production and the production of valuable honey and bee wax, the department of horticulture has initiated bee keeping apiaries' in the State.

The increased use of pesticides in agriculture and horticulture has exposed honey bees to a continual array of chemicals like miticides, insecticides, fungicides, herbicides etc. many of these pesticides are found in bee wax, pollen as well as adult and pupal bees. These compounds cause delayed development, shortened adult longevity and immune system impairment in bees. In the past few years, the importance of bees in our eco-systems is being increasingly underscored.

11.11 Major Community Pressures on Forests:

Timber Distribution (TD) Rights: Once every three to five years a family with land in Himachal Pradesh may be allocated trees to build or repair a house under the timber distribution (TD) rights, with a nominal fee of Rs. 5.00. Until late 1960s, the market rate of timber was low and it was mostly used for the construction of houses. But in recent times with the upsurge of horticultural practices and boom in apple cultivation has lead to rise in economic strata and building of big houses, roads, markets and urban areas and consequently demands for timber has increase dimmensely. This led to certain unhealthy and illegal practices like unlawful felling and smuggling of timber – especially of valuable deodar trees.

Forest lands, Grazing and Nomads: Large numbers of cattle and livestock move across various migratory routes in the state for grazing and many consider this a double edged sword as close to ground grazing affects the overgrowth, while the droppings of animals provide fertilizer. As per the India State of Forest Report (2011), out of the total number of 5.22 million heads of livestock, an overwhelming 5.18 million or 99.7% were dependent of forests.

Medicinal plants: There are varieties of more than 900 species of plants having medicinal value that grow naturally in the forests of Himachal Pradesh. Of these, around 34 species are extracted and traded extensively. As many of these plants yield the end product from the roots, the plants are often pulled out, the relevant part extracted and the rest is discarded. There is no mechanism for the restoration of extracted plants and this is leading to a steady depletion of naturally re-growing herbs and medicinal plants.

11.12 Fuel wood:

Fuel wood remains the principal component of rural domestic energy in India. Most of the fuel wood is derived fromforest trees growing in homesteads, farmlands and common land outside forests. With increasing population, the area under agriculture has increased and forest cover has shrunk. Himachal Pradesh being hilly state, climate is largely cold, fuel wood is required not only for cooking but also to keep the dwelling warm. According to a study average per capita consumption of fuel wood was annually 523 Kg. the consumption varied in di□erent land holdings, its 292 Kg for landless class, 569 Kg for farmer having more than four hectares. Consumption was still higher upto 715 Kg in zones where climatic conditions are harsh and severe and electricity supply is erratic.

According the Forest Survey of India (2011) out of the total area of over 37,000 sq kms of forest, 0.00005 million tonnes of fuel wood was extracted from Himachal's forests. The number of persons using wood extracted from forests was 5.646 million. The quantum used for house building was 5.667; for furniture 0.534 and for agricultural implements, 0.078 Million Cubic Metres.

11.13 Energy consumption in Lahaul and Spiti

As per the thesis of Tenzin Chhoerup of the Dr. YS Parmar University of Horticulture and Forestry published by Krishkosh (1914) the following is the pattern of energy consumption in the Trans Himalayan District of Lahaul & Spiti, an area that is subjected to a prolonged and severe winter: The fuel consumption pattern indicated that the major fuels used were, wood (49.53%), cowdung (32.26%), kerosene (9.39%) and LPG (8.74%). On basis of income, maximum consumption of fuel wood was by household with monthly income of Rs. 4,000-8,000. LPG and cowdung were consumed maximum by income group of Rs. 8,000-16,000 per month. On basis of landholding fuelwood consumption was found maximum for landholding size of 1-2 ha, cowdung and LPG were consumed more by the income group of Rs. 8,000-16,000. On family size basis maximum fuel wood

consumption was noticed for household with <4 members, cowdung and LPG in 7-8 members, and kerosene also in family size with <4 member. More APL families (80.91%) consume fuelwood for heating as compared to BPL families (76.0%) followed by cowdung which is consumed more by BPL (19%) than APL (16.36%).

The APL families (84.09%) consume electricity for lighting as compared to BPL families (78%) followed by kerosene which is consumed more by BPL (22%) than APL (15.91%). People of tribal and remote area of the district place electricity as a first choice with about (91%) people and kerosene with (9.38%) people preferring the same. (79.38%) households consume fuelwood for heating followed by cowdung (17.19%), kerosene (2.19%) and electricity (1.25%) households. The study revealed that annual fuel wood consumption of the district was 905.2 tonnes all of which is being supplied by government on subsidize rates.The annual kerosene consumption of the district worked out to be 0.24 million liters. The annual LPG consumption of the district was estimated to be 32.0 tonnes and mainly for cooking. The CO^2 emission from burning of conventional sources of energy worked out to be 2445.5 tonnes per annum in the district.

11.14 Community in Himachal Pradesh have filed Forest Rights Claims

More than 100 villages in Himachal Pradesh have filed their community forest rights claims for the first time since Forest Rights Act (FRA) of 2006 came into being. This happened after the Himachal Pradesh High Court passed an order, in April 2015, asking the government to remove any kind of encroachment in the forests of the State. Himachal Pradesh is one of the few States where the act has not been implemented completely. According to Mr. Guman Singh, Convener of the forum, said that they have taken this step to bring to government's notice that the State government is still in the process of settling the claims under FRA and can therefore not evict people who depend on forests for their livelihood. According to the report furnished by the Forest Department to the court, 9612 case of encroachment over less than 10 'bighas' (five bigha is equal to one acre or 0.0809 hectares) of forest land had been registered up to September 30, 2014. The State Government had already acted on 3,392 cases of illegal encroachments by evicting the encroachers under Himachal Pradesh Public Premises (Eviction & Rent Recovery) Act.

Community involvement emerged as new paradigm in Forest Management in the late nineteenth century. Participation of local people began to be seen as a solution to deforestation. The National Forest Policy (1998), envisaged people's involvement in the development and protection of forests. The requirement of fuel wood, fodder and timber for house construction of tribal's and other villagers living near forests are high on priority on forest produce.

11.15 Interactions between human society and environment:

Interactions between human society and the environment are constantly changing. The environment, while highly valued by most, is used and altered by a wide variety of people with varied interests and values. Difficulties remain on how best to ensure the protection of our environment and natural resources. There will always be tradeoffs and, many times, unanticipated or unintended consequences. However, a well-managed environment can provide goods and services that are both essential for our well being as well as for continued economic prosperity. The environment has become one of the most important issues of our times and will continue to be well in the future too.

In general it could be said that all people (including urban dwellers), have dependence on forests, at least directly for products such as timber and paper and indirectly, for air and water. However, many people rely heavily on forests for their livelihoods and survival. Like people who live inside forests, often living as hunter,

gatherers or shifting cultivators, and who are heavily dependent on forests for their livelihood primarily on a subsistence basis. People in this category are often indigenous peoples or people from minority groups.

People who live near forests, are usually involved in agriculture outside the forest, who regularly use forest products (timber, fuel wood, bush foods, medicinal plants etc.) partly for their own subsistence purposes and partly for income generation. For those involved in agriculture, nutrient supplements from forests are often of critical importance to productivity. Such supplements can be in the form of mulch from leaves gathered in the forest. Another source of nutrient supplement is forest grazing by livestock which converts nutrients from forest biomass into manure.

People engaged in commercial activities as collecting minerals or forest industries such as logging. Such people may be part of a mixed subsistence and cash economy.

11.16 Road Building and its impact on Forests and Tree Cover:

Environmental groups have been unhappy with the way extensive road building in the state has eroded tree cover. An example of this is the four-laning of the Kalka Shimla National Highway where figures of tree loss have been placed by at between 48,000 to 60,000. It is also expected that the depletion of tree cover will continue for several years as the sharp almost perpendicular cuttings will lead to repeated landslides. Another criticism leveled against this form of 'unscientific road building' is that almost all developed countries build hill roads following the tunnel and bridge principle that minimizes ecological damage and allows for straight line and swifter movement. However, it must be mentioned that road connectivity has substantially altered the hereto isolated face of rural Himachal and led to considerable improvement in the life of the people.

11.17 Climate Change and its impact on Himachal

Altering climatic patterns and the severity of weather has had a global impact and Himachal has not been spared from its repercussions. Studies that exist in this area are still basic and there isno conclusive prognosis.
Climate change is a global phenomenon, which has become a reason of concern for both urban and rural people. For farmers, the issue is altering weather patterns and temperatures mean altered cropping patterns and lesser reliability on the quantum and date of yield. This is very visible in the apple crop and farmers are shifting to the 'spur varieties' in place of the conventional ones. Climate change has always been with us. Much of the faunal range of Himachal has come from the Holatic Floristic kingdom of the Mediterranean shores and was brought down by the ice packs during the last ice-age, yet today, human interventions have exacerbated the issue. These range from normal garbage to plastic waste, to industrial discharges and simply, to huge rises in human population. There is the danger that we are increasingly coming to a tipping point when this change will become irreversible.

11.18 Impacts of Tourism

Tourism is emerging as a very important bread earner in Himachal and contributes 6.6% to the state GDP. There is a considerable inventory of 'tourism products'.Himachal Pradesh is famous for its snow laden mountain peaks, thick dense forest, greenery and soothing climate. Places like Shimla, Kullu, Manali, Dharamsala, Dalhousie attract lots of tourists from India and abroad. Tourism is also one of the important sources of State revenue. Several issues have arisen in the interaction between society as reflected by the tourism sector and the environment. The most obvious ofthese is the additional pressure placed on resources, civic amenities and the natural and built environment.

Community based tourism may provide a constant and better source of income to rural people and also become a source for conservation of traditions, practices and customs.Himachal Pradesh has recently come up with revised Eco- tourism Policy,2017.

11.19 Mining

Mining is another core industry which plays a significant role in the economic upliftment of the country and is vital for the sustenance, wellbeing and comfort of human beings. Mining operations induce both positive and negative e□ect on environmental and socioeconomic status of adjoining areas. Open cast mining in the fragile areas has the ill e□ects of visual intrusions, landscape degradation, landslides, deforestation, migration of fauna, noise and vibration due to blasting and air pollution and hydrological imbalance. Himalayas, an ecologically fragile and a seismological sensitive zone, host immense quantums of mineral wealth like limestone, magnetite, phosphorite, gypsum, soapstone, barite, dolomite, and rock-salt.Many of the minerals are being actively mined in the region mostly by open cast method of mining mechanically as well as manually. The mighty Dhauladhar and Shivalik ranges are full of minerals and a treasure of flora and fauna.

Type of Minerals in districts of Himachal Pradesh

S. No.	District	Major Minerals
1.	Bilaspur	Limestone, Dolomite, Shale, Brick earth, Minor minerals like Sand, stone &bajri
2.	Chamba	Lime stone, Roofing slate, Magnesite, Minor minerals like Sand, stone &bajri
3.	Hamirpur	Minor minerals like Sand, stone &bajri
4.	Kangra	Roofing slate, Brick earth, Minor minerals like Sand, stone &bajri
5.	Kinnaur	Gypsum, Minor minerals like Sand, stone &bajri
6.	Kullu	Roofing slate, Quartzite crystal, Mineral water, Semi-precious stone, Minor minerals like Sand, stone &bajri
7.	Lahaul&Spiti	Antimony ore, gypsum, Minor minerals like Sand, stone &bajri
8.	Mandi	Lime stone, Rock salt, Roofing slate, Quartzsite, Minor minerals like Sand, stone &bajri
9.	Shimla	Lime stone, Quartzite, Slab slate, Minor minerals like Sand, stone &bajri
10	Sirmour	Limestone, Dolomite, Barites, Gypsum, Shale, Quartzsite, Minor minerals like Sand, stone &bajri
11.	Solan	Lime stone, Dolomite, shale, Building stone, Minor minerals like Sand, stone &bajri
12.	Una	Silica, Boulders, Minor minerals like Sand, stone &bajri

Source: Annual Administrative Report, Department of Industries, 2005-06

Kinkri Devi, activist and environmentalist was born in a poor Dalit family in Sangrah ,Sirmour district. It was a relentless struggle and war for her against irregular stone mining which was harming the environment. A local voluntary organization helped her fight this case right upto the Supreme Court of India, where judgment was in favour of stopping unscientific illegal mining. She was recognized and awarded by various organizations and Indian Government for her contribution towards environment protection and conservation. In 1995 she was invited to participate in International Women's Conference in Beijing (China), where her work was recognized by the US Government. She was conferred great respect by asking to light the lamp in the beginning of the ceremony and spoke of the cause she was fighting and how an ordinary person can make a impact.

She was not literate but the brave lady educated the world about Environment. Kinkridevi, was awarded Jhansi ki Rani Lakshmi Bai StreePuraskar in 1999. She breathed her last on 30th December, 2007.

An appropriate forest policy and its implementation is required for the recognition of economic, environmental, social and institutional and changing circumstances. The forest policies should work to achieve sustainable forest management in Himachal Pradesh forest cover, watersheds, wild life, biodiversity, habitats, maintenance and rehabilitation of its environment and also strive to enhance people's livelihood.

11.20 River bed mining in Himachal Pradesh:

Mining and quarrying has been a age old practice in Himachal since the Paleolithic age as is evident through ancient temples and monuments of Chamba, Kullu and Shimla district. Mining industry plays a vital role in the development of the State. It not only strengthens the economy but also provide gainful employment to the people. Progress and prosperity of state depends on proper extraction and management of its natural resources. Increasing demand for sand, stone and grit etc. for various developmental works is putting pressure on the nature and resulting in indiscriminate extraction and hence giving way to illegal and unscrupulous mining. Himachal Pradesh Government has notified Mineral-Policy-2013 on 24th August, 2013 for ensuring scientific mining. Minerals are non-renewable natural resources, essential for mankind and also the backbone of economic growth.

Grant of Permit for removal of Sand: For channelization of rivers and streams to protect bank erosion, the sand accumulated in the river bed and streams and the lands which has become uncultivable has been allowed upto the depth of one meter. To meet the growing demand of construction material, permission for use of minerals/materials generated from the activities like de-silting of reservoir, development of educational plots, and excavation of fish ponds, other developmental activities may be utilized in stone crushers.

Kullu Dusherra

11.21 Indigenous Forest Management Systems and Practices

The interdependence of people on forest and their relationships has been well recognized. In the recent years it has been seen that people living in and near forests often have good knowledge and techniques for forest use and its management. These systems can be described as indigenous forest management systems. Although, these systems of forest management has often been dismissed by foresters and others as being, at best, outdated 'traditional' or 'customary' systems.

Non-Timber Forest Products

In recent years there has been huge interest in the recognition of the value of NTFPs and their role in supporting the livelihoods of many rural people. There has also been a strong movement towards promotion of NTFP production and marketing as a source of sustainable income-generation. The products included garden products, fruits and nuts, other forest food, firewood, housing, canoes, customary medicines and miscellaneous forest products. It is somewhat ironic that forest dependent peoples are often blamed for forest degradation, especially when the blame is laid by interests supporting the timber trade. The e□ects of the timber trade on forest degradation and biodiversity loss will relative to the damage caused by agricultural clearance, shifting cultivation and fuel wood collection are likely to remain a topic of discussion. The timber trade frequently claims that it is only a relatively minor contributor to the degradation. Human impacts on forest condition can result from complex interactions of causes rather than be simply attributed to one practice or another. The effects of commercial logging (legal and illegal) on forest dependent people can have several dimensions:

I) Direct effects, such as reduced availability of forest products (including NTFPs) due to the effects of logging or because logged forests are closed to local people.
ii) And indirect effects due to the increased marginalization of local people as national and local government and administration increasingly cater to the interests of loggers at the cost of, or in direct opposition to, the interests of local people

- Increased competition for resources (including agricultural land) as migrant populations follow the timber industry, either to seek employment or provide services to loggers, or to occupy land cleared by logging. Economically, one of the reasons for this continued deforestation is that the immediate financial benefits to be gained from exploitation of the forests often appear to far outweigh the perhaps greater long term benefits to be gained by a lesser but more sustainable, form of use. While it is important to note that non-commercial products are often grossly undervalued in decision-making about forest use, the conclusion that this undervaluing leads to deforestation seems to miss the point. The problem is not the undervaluing of more sustainable options. Rather it is that the people who gain from shorter term use are not the same as those who would gain from longer term use.

- The key issue in understanding the relationship between forest dependent people and logging is the issue of control of the products which are valued by outsiders. This is partly a matter of tenure (to be discussed later in this paper) and partly a question of the ability of forest dependent peoples, who are often members of ethnic minorities, usually isolated geographically from the sources of power and almost always politically marginal, to influence national governments to make decisions in their favour. This has always been difficult, as the large companies involved in the international timber trade have far more to offer governments and administrators (both individually and in terms of national incomes) than marginal people. It has become more difficult as the globalization of the international economy leaves multi-national companies largely unaccountable and far too powerful for the governments of small nations to resist.

11.22 Forests land for non-Forestry usage

Under the Forest Conservation Act,1980 areas classified as forests can be diverted for non-forestry purpose after following certain legalities. Every year forest lands are diverted for non-forestry purposes in the name of development. In Himachal Pradesh so far 11541.427 hectares of forest land for 1612 proposals has been diverted under this Act. These proposals include PWD roads, hydroelectric projects, transmission lines etc amongst others.

11.23 Forest fire

Forest fire situation in India is alarming. Standing trees and fodder are destroyed in large scale and natural regeneration annihilated by such fires. In the absence of any focus or clear strategy or awareness amongst people and also no available system for fire weather forecasting, danger rating or preventive measures or fire line clearance etc. huge loss is caused to the biodiversity, new plantations, timber, soil moisture and nutrients in forests and also due to smoke and heat arising from the forest fires impacts environment to a great extent. In 2016, there were around 614 ground fires affecting 6,600 hectares in six districts of Shimla, Solan, Una, Bilaspur, Kangra, Hamirpur and Sirmaur in Himachal Pradesh. Between January and June, 2019 the Business Standard reported over 500 fires affecting an area of over 2600 hectares. As reported by the National Institute of Disaster Management (2012), half of India's forests are prone to fires, 43% are prone to occasional fires and 5% to frequent fires and 1% are at high or very high risk. Report of Forest Survey of India also says that more than 95% of wild fires in India are man-made, as villagers usually burn leaves and grass in order to get better growth of grass in following season. They also burn the needles of the pine trees, which form a slippery carpet on the floor of forest. Especially in chir pine forests, the indiscriminate disposal of litter is a cause of fires. This is especially so in areas where liquor and other bottles are thrown. These bottles act as magnifying glasses and are known to trigger fires.

Forest Fire incidences in Himachal Pradesh

Year	No. of fire Incidences	Areas Affected (In Hectares)
1995	1669	57143
2000	1900	36887
2001-02	301	5719
2002-03	282	4204
2003-04	550	9896
2007-08	550	8393
2008-09	572	6586
2009-10	1906	24849
2010-11	870	7837
2011-12	168	1758
2012-13	1798	20773
2013-14	397	3237
2014-15	725	2500
2015-16	672	1730
2016-17	1832	6625
2017-18	670	1759

These forest fires are sometimes seen as a natural process and help forests by promoting flowering, branching and seedling establishment. The fires which are limited to surface may help in natural regeneration. The heating of soil accelerates microbial activity and hasten decaying that is useful for the vegetation. However, in the temperate to alpine forests found in Himachal, this may not be the caseas is in warm and tropical forests.

11.24 Pollution and garbage disposal

Most of the people, irrespective of their educational and financial background, do not realize the environmental crisis the humanity is creating especially in the urban localities. Rising level of pollution in urban areas like Shimla, Solan, Nahan, Poanta, Una, Kullu etc. remains unchecked. The population of these towns is increasing and so are the numbers of vehicles also. Such areas are losing its sheen, serenity and pure air for breathing. The air is getting polluted due to high emissions from the vehicles.

The Government of India has launched various initiatives through the Ministry of Urban Development for ensuring e□ective solid waste management. Himachal Pradesh is the one amongst least urbanized state of India, with only 59 urban agglomerations (Census 2011). Waste material arising in the steadily expanding urban areas of Himachal Pradesh is 300-350 tons per day (SOER- 2007) much lower as compared to 100000-120000 (World Bank-2006 and HPSoER-2007) tons per day in the country. But mismanagement of even a small quantity of waste in the fragile ecosystem may lead to serious environmental and health problems.

The cities and towns are littered with garbage and give a ugly look. Door to door collection of waste material is done in only a few places leaving the remaining places chocked. The collected waste is disposed on unattended landfills and solid waste management is again a complex issue for the urban local body but this is very in respect of public health, environment and quality of life.

On the positive side, appropriate initiatives may mitigate this issue. For example, a park has been created over a landfill along the Shimla bypass.

11.25 Community forestry in contemporary Himachal Pradesh

Community involvement emerged as new paradigm in Forest Management in the late nineteenth century. Participation of local people began to be seen as a solution to deforestation. The National Forest Policy (1998), envisaged people's involvement in the development and protection of forests. The requirement of fuel wood, fodder and timber for house construction of tribal's and other villagers living near forests are high on priority on forest produce.

11.26 Poverty Alleviation and the Control of Forest Resources

11.26.1 Poverty Alleviation

The forest-dwellers are financially weak because 'powerful outsiders' exploit the forest resources. If these views are
correct, then the relevance of poverty alleviation programs to the livelihoods of forest dependent people and deforestation is questionable.

11.26.2 Some elements in community conservation

Several plant and animal species such as the peepal and khejadi trees, the Indian peafowl and Hanuman langur are revered in traditional belief systems. Instances of communities protecting sacred tanks attached to

temples, declaring sacred pools along certain stretches of rivers or protecting entire groves of trees abound in Himachal Pradesh. The Upper Beas region has maintained several sacred sites. Most villages in Kullu and Seraj have ancient temples dedicated to local gods and goddesses (devtas and devis). Some temples were within the villages, while others were located on prominent locations in the forest. The gods' homes were constructed of stone and deodar timber, most of them in similar style to human homes. Largely part of folk tradition, such systems appear to have maintained in cohesive, relatively homogeneous communities by fears of the wrath of supernatural powers following violation. Most of the villages in upper Himachal have a village deity (gram devta) and one or many trees dedicated to the deity. In most villages, a single individual of either deodar or some other species was found. If only a single tree is considered sacred,felling is not permitted even for repairs/construction of the temple. If more than one tree is sacred, felling may be permitted with acquiescence of the village deity, but only for use in the temple. In Shimla District most of the sacred groves are located in 'mixed forests', as such providing greater economic services (fuel wood, fodder, etc.) and ecological services (prevention of soil erosion, maintenance of diverse habitat for different species, nutrient cycling, moisture retention etc.) than pure-stand forests. Sacred groves are the only remnants of tree vegetation in many parts of Himachal Pradesh and they serve critical functions as sources of fuel, litter, fodder, etc. They are also richer in number of plant species than other stages of succession, and contain some plant species that are totally absent from their surroundings. The following common features characterize sacred groves in Himachal:

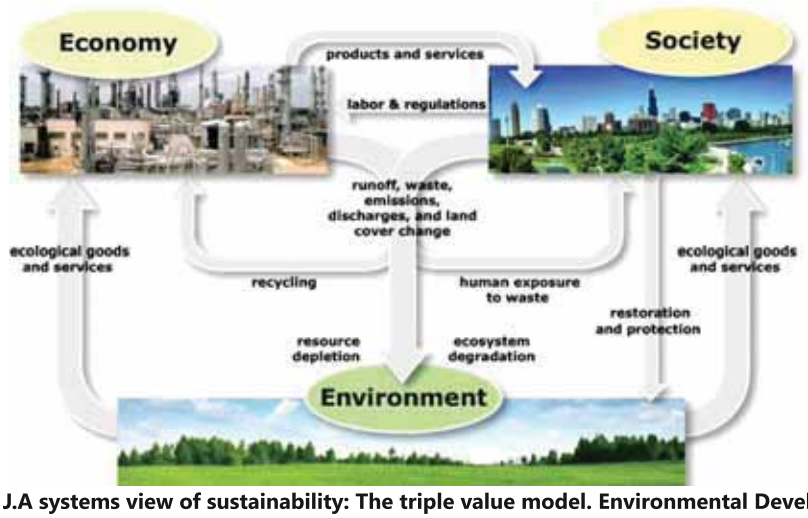
- All forms of vegetation in the grove are under protection of the deity of that grove.
- Boundaries are definite even if surrounded by forests.
- They are situated some distance away from human settlements

While economic considerations had little to do with maintaining sacred groves in the past, today people have realized their economic potential.

11.27 Society and Environment and their impact on Economy

Himachal Pradesh has many rivers with high potential for producing electricity. Many hydroelectric projects have come up on almost all major rivers in the state.The large scale felling of trees, submerging a large area has depleted the area of the biodiversity and changing the microclimate of the area. In certain cases, the water flow has substantially vanished from large sections of the river bed as it is diverted into the head race tunnels of hydroelectricity projects and released through the tail race ones, only to vanish into another head race tunnel. This can be seen along the Satluj basin in Kinnaur.

Sustainabilty Framework



Adapted from Fiksel, J.A systems view of sustainability: The triple value model. Environmental Development 2 (2012) 138-141

Poorly planned and implemented extraction of timber and non-timber products, logging and transport roads, construction of facilities for logging camps or for recreational activities in the forests and waste accumulation cause direct and indirect negative impacts on forest plant and animal resources, and on ecological functions of forests such as the conservation of biological diversity and carbon and water cycles.They also impact human health and the cultural and social foundations in and around areas of active forest utilization.The negative environmental consequences vary in the severity, irreversibility and significance depending on the form of forest utilization. The impacts might be felt at the local level or have global significance. Detailed scientific information about how forest utilization may alter environmental conditions and the environmental functions of forests is often not available. Proving both the positive and negative influences of forest utilization on the environment is often a difficult task because most impacts are rather indirect and complex.

Environmental impacts of harvesting non-wood forest products (NWFPs) and the recreational uses of forests have so far been assessed less than timber harvesting. While activities such as eco tourism and harvesting of NWFPs are considered inherently benign, studies have shown that these activities can have serious environmental impacts when devoid of careful planning and management. Unplanned harvest of NWFPs without adequate knowledge about their resource base, appropriate tools and techniques to be used, the regenerative capacity of species, their Silvicultural requirements, the seasonal variations in productivity and the local subsistence demands, can result in severe environmental damages.

11.28 Man and Nature must be in Harmony

Since earliest times, this relationship between man and nature has had a double impact. On one hand, owing to the need for survival, mankind has inevitably intervened with nature and resisted its force in order to gain the right to survive. On the other hand, nature, with its mighty force, has restrained the activities of mankind and demanded some sort of obedience. Thus, remolding and dependence as well as domination and subjugation have been part of the whole process of the evolution of the relationship between man and nature although, in different historical periods and at different development stages, the balance of power and forms of expression of these two trends have varied.

In the relationship between man and nature during primitive times, the latter enjoyed absolute superiority while man's ability to intervene with nature was extremely weak, with the force of nature surpassing by far that of man. Therefore, man's ability to remold nature was almost negligible. The great changes that emerged worldwide after the first industrial revolution of the 19th century had repercussions across the world. For the first time, man challenged nature and the environment and even talked about 'taming it'. As the decades went past, Himachal was not exempt from this global phenomenon where the predominance of the human species was asserted. Man was able to extricate himself from the domination of nature and took the step of examining nature and himself from the perspective of a subject. Although the low level of production forces limited this di□erentiation between man and nature, yet, compared with ancient times, this represented historic progress. In this period, the superior position of nature vis-à-vis mankind was more concerned with the social material and practical activities. In ideology and concept, apart from recognizing his dependence on and submission to nature, man worshipped and held it in veneration but demanded coordination and integration with it.

Throughout history, the decisive factor determining the relationship between man and nature was not ideology, but material force. Therefore, the speedy development of productive forces brought about by the progress in science conferred upon man the ability to overturn the control of nature. This signaled that the relationship between man and nature had entered into a new phase of development, which was industrial civilization. The fast development of modern natural sciences and the technological revolution continuously forged material weapons for remolding the world, and made social productive forces multiply at a shocking pace. Industrialization and modernization have increased mankind's confidence and pride. The industrial civilization not only established the dominance of mankind over nature by creating material wealth, but it also made progress in the theoretical understanding of the relationship between man and nature. Because of the theorization and systemization of the natural sciences, the ongoing study of nature has also enriched the understanding of nature by mankind. Meanwhile, the trend towards naturalism in modern Western culture has provided new vistas and made new attempts to master in depth the relationship between man and nature from the ethical and aesthetic perspectives.

Apart from being woven into the wider global web of climate change, environmental indi□erence, industrial explosion and the steady transfer of forest land to non-forest uses, Himachal is uniquely placed in terms of its geographical location, its diversity and its vast potentially stabilizing landscapes. An approach that is disconnected from environmental issues or aspects of its facets needs correction. This opens up a complete new set of academic courses that can address this issue whose complexity will only increase in the coming years. These changes have altered certain social priorities and are impacting the quality of life. While governmental interventions could have been more leadership-oriented, policies have constantly been whittled down and eroded. Fortunately, NGOs and people and moving away from reliance on Government are taking the leadership to protect Himachal's environment and its deep interface with society.

WATER RESOURCES AND ENVIRONMENT

CHAPTER-12

12 Introduction

Water is a precious natural resource without it no life can be sustainedon planet earth and known as "Elixir of Life" and "Blessing for Humanity". It is an integral part of the men's environment and the extent to which it is abundant or scarce, clean or polluted, beneficial or destructive determines to a very large degree, the extent and quality of life. Water is indispensable for sustainable socio-economic development, environmental quality, eradication of poverty and hunger, food security and for human health and well-being. Lack of clean water for drinking and good quality irrigation for crop production would mean inadequate food, ill health, diseases, drudgery and discomforts.

Indian population has grown from about 300million to over 1225 million, recording one of the highest population densities among the 185 countries (i.e. low per capita land availability) and also, according to Census 2011 Himachal showed a decadal population growth rate of 12.81 per cent as against National decadal population of 17.64 per cent. The population expanse and the resultant infra-structural developments have taken its toll on the hydrological sustainability of this mountainous region. The land use changes have had its impact on the water bodies- the accelerated surface water run-o and lowering of ground water tables. The factors like high water withdrawals, low water recharge, population pressure, urbanization, social behavior, and changing life styles have, by far, taken heavy toll on hydrological profile of the state.

The demand for water resources is continuing to increase. This increase is not only driven by the growing population but also, by the aspirations of that population for an ever increasing standard of living. At the same time, the capacity of mother earth to meet this demand is in decline because of over harvesting, inappropriate agricultural practices, pollution, etc. The unprecedented increase in human population, urbanization, industrial activities, etc. is putting enormous stress on limited fresh water availability. All these facts lead us to realization that our strategy should be to conserve every drop of rainfall and augment water resources by adopting cheap, successful and environment friendly conservation techniques. It is, therefore, essential to assess in availability, promote various activities for managing and conserving this precious and scarce resource and regulate its wise use to obtain maximum benefits.

12.1 Water Policy:

12.1.1. General Framework of National Water Policy:

Rural water supplies in India have been a private initiative from time immemorial and formed an important component of the ruler's duty towards his subjects. The Environment Hygiene Committee (1948-49) recommended a plan of action to provide water supplies and sanitation facilities to 90 per cent of the population of the country. This culminated in the National Water Supply and Sanitation Programme in 1954. Over the last six decades, there has been a significant growth in percentage allocation of funds to the rural water supply and sanitation sector especially in comparison with the outlay on urban water supply and sanitation over the same period of time.As per the national norms, the basic water requirement is 40 litres per capita per day (Lt./d). One hand pump or stand post is installed for 250 persons. Such water sources are supposed to be located at a maximum distance of 1.6 kms in plain and 100 metres elevation di erence in hills. In desert areas, an additional 30 lpcd was recommended for the use of livestock.

12.1.2. National Water Policy:

In 1987, the Ministry of Water Resources prepared a National Water Policy to provide the directions for the development of water resources throughout the country. The salient features of this policy are/were –

- Accord highest priority to domestic water supply
- Protection of ground resources by designing appropriate standards
- Monitoring of water quality
- Mapping of water resources The states have been recommended to formulate their State Water Policies, in conformity with the National policy. In Himachal Pradesh, the IPH department has prepared a draft state water policy in which major emphasis has been given to the adaptation of an integrated approach for the development of water resources. As per the estimates,the domestic water supply (rural and urban together) demands are below 5 percent of the total consumption, the majority being accounted for by irrigation.

12.1.3 Draft National Water Policy 2012

Main emphasis in the Draft of National Water Policy 2012 is to treat water as economic good which the Ministry claims to promote its conservation and efficient use. This provision intended for the privatization of water- delivery services is being criticized from various quarters. The draft also does away with the priorities for water allocation mentioned in 1987 and 2002 versions of the policy. The other major recommendations are:

- To ensure access to a minimum quantity of portable water for essential health and hygiene to all citizens, available within easy reach of the household (Jalmani)
- To curtail subsidy to agricultural electricity users
- Setting up of Water Regulatory Authority
- To keep aside a portion of the river flow to meet the ecological needs and to ensure that the low and high flow releases correspond in time closely to the natural flow regime (e-flows)
- To give statutory powers to Water Users Associations to maintain the distribution system
- Project benefited families to bear part of the cost of resettlement and rehabilitation of project a□ected families
- To remove the large disparity between stipulations for water supply in urban areas and in rural areas

12.1.4. State Water Policy

- State Water Policy of Himachal Pradesh was formulated during 2005. The Govt. of India has also circulated the National Water Policy (NWP) during 2012 based on the experience gained and progress made in the water sector. Accordingly, the state has modified the State Water Policy 2005 to incorporate the requirements of NWP- 2012 and notified Himachal Pradesh State Water Policy-2013 vide notification No. IPH-B(F)1-3/2013 dated 18th November 2013 giving top priority to drinking water followed by irrigation.

12.2. State

12.2.1.Physiography and Agro-climate:

Himachal Pradesh can be divided into four zones, based on physiography and agro-climatic factors.

Zone-I Subtropical Low-Hill Shivalik Zone

This terrain is rugged with low mountains. Annual rainfall is between 800 to 1600 mm. The areas suffer from perpetual summer shortage due to high runo□. Valleys are generally narrow with few small flat areas where good agriculture is possible. Most of the streams are situated within narrow gorges and the terrain shows signs of rapid uplift in the recent past. The altitude ranges between 500 m and 1200 m above msl.

Zone-II : Mid hill Zone
The lesser Himalayas south western of the Dhauladhar range and valley areas of the Ravi and Chenab rivers form this zone. It occupies 32 per cent of the geographical area and 53 per cent of the cultivated area of the state. Altitude ranges between 800 and 1600 m above msl. The average annual rainfall is about 1800 mm.

Zone- III: Dry hill Zone
The upper parts of the catchment of the zone II can be classified as Zone III. This zone occupies 25 per cent of the geographical area and 11 per cent of the cultivated area of the state. Altitude ranges between 1600 and 2700 above msl. The annual rainfall ranges between 1000 and 1500 mm.

Zone- IV: Cold hill Zone
The trans-himalayan zone lying between Great Himalayas and Zanskar Ranges is a cold desert. Altitude is generally above 2700 m above msl. Due to rain shadow of great Himalayas; the annual rainfall is less than 200 mm. This zone occupies 8 per cent of the geographical area and 3 percent of the cultivated area of the state.

12.3.Rural Water Supply (RWS) in Himachal Pradesh

Himachal Pradesh has a total of 17495 inhabited villages and 54208 habitations. All villages in HP have been covered under water supply schemes. A revenue village generally covers more than one habitation. In hilly terrains, small habitations have grown near cultivable lands, edges or inside forests. Most of the RWSS were constructed in 1980, under Drinking Water Decade related programmes. All villages were covered by 1994. Out of the total 54208 habitations reported in April 2019, 20128 habitations were partially covered and rest fully covered. Despite efforts to cover all the villages under RWS, the actual water availability situation is a matter of concern in the state. Much of the water shortage occurs in the Shivailk belt (comprising Sirmaur, Hamirpur, Una, Kangra and Bilaspur). The partially covered habitations are situated in the districts of Kangra, Shimla and Hamirpur with a considerable proportion of area lying in the Shivaliks. General features of these dry areas are very thin soil cover, steep slope and high run off with little water retention at catchment level. Most of the partially covered habitations are located in Kangra followed by Hamirpur. With high livestock density (121 to 315 per km2), the 40 lpcd norm is not sufficient to meet domestic needs. In some Shivalik areas, during summer there is high water crisis, some inhabitants migrate to the nearest valley water source, where water is available for their livestock.

12.3.1. National Rural Drinking Water Supply Programme (NRDWP)

All Census villages in the State have already been provided with drinking water facilities in the mid-nineties. As per survey-2003, which was finalized during March, 2005, a total of 51848 habitations have been identified out of which 31736 habitations have been categorized as slipped back habitation. As per the NRDWP, as on 1.4.2019, there are 54208 habitations in the State and the status of these habitations is as under:

Total no. of habitation as on 01.04.2019	>0 &<25%	>50&<75%	>25 &<50%	>75&<100%	Habitation with 100% population coverage
54208	863	7610	5842	5813	34080

The Government of India under NRDWP has accorded top priority to provide water supply to NC/PC (0-10 LPCD) habitations and while preparing its shelf of projects, the Govt. of H.P. accords similar priorities.

Completed water supply schemes

Zone	Circle	Number of schemes reported			
		Gravity	Lift	Tube well	Total
Shimla	Shimla	754	171	0	925
	Rohru	1286	73	0	1359
	Nahan	451	714	79	1210
	Solan	417	337	0	788
	R/Peo	532	10	0	542
Hamirpur	Bilaspur	74	197	5	276
	Una	10	42	152	204
	Hamirpur	136	271	0	407
Mandi	Kullu	868	21	1	890
	Sundernagar	1230	240	4	1474
Dharamshala	Nurpur	6	62	126	194
	Dharamshala	125	250	37	412
	Chamba	832	3	0	835
	Total	6721	2391	404	9516

[Source: Irrigation and Public Health Department (HP),htp://iph.hp.gov.in]

At present there are 9516 Water Supply Schemes completed in the State. Out of these 2391 are lift,404 tube wells and 6721 are gravity schemes.In addition to this, there are 37265 hand pumps installed in the state up to March 2019.

Map 13.1. Water Supply Schemes
[Source: Water Resources Management of HP]

12.3.2 HP State Subsidy for Rural Water Supply:

Apart from the full capital cost investment by the state, the government of HP bears more than 90 per cent of the Operation & Management (O&M) cost of rural water supply schemes. For gravity systems, the O&M cost is negligible but costs escalate to Rs.6/- per kilolitre in case of lift water supply schemes in which power alone may account for 90 per cent of cost. Public taps are totally subsidized. The IPH department charge only Rs.10/- per private tap per month in rural areas with the condition to increase the tariff by 10 per cent on the 1stof April every year as notified in 2005.Private connection accounts for less than 5 per cent of the total water supply schemes (Partial) Connections. Net recovery of O & M cost is only a small fraction of operating costs.

12.3.3.Habitation and Local Water Sources:

Most settlements are traditionally located around local water sources like springs and streams. However, considerable variation in settlement locations is found across all kind of physiographic situations like slopes, ridges and valleys. Depending on water availability, habitations in the regions can be broadly categorized as under-

- Habitation in snow fed river valley with year round water availability
- River valley settlements fed by monsoon run off and spring flow
- Spring fed valley slope settlements
- Ridge and upper slope settlements
- Settlements in gently undulating plateau
- Scattered Shivalik ridge villages

Springs are common in the lower slopes but yields are very low (<5lps) except in some limestone terrains. Ground water conditions are highly variable due to high lateral inhomogeneties in soil cover, lithology and vegetative cover. Ground water resources can be used at most only in alluvium filled valleys.

12.3.4. Traditional Technologies:

Main traditional water sources are springs. Often the quality degradation has occurred due to non-use and flow of dirty water into sources. Khatris (underground tanks which store rainwater harvested from uphill areas) are very common in many parts of the Shivaliks especially in districts Hamirpur and Kangra. These need highly impermeable rock (generally cemented conglomerates) and a sloping areas where they can be dug. They range in volume from 10 to 50 cumec. Wells are found in valley and plateau areas. The circular part of a well is the deepest and a series of steps leads into it. People have to walk down to the water and collect it. These small shallow sources (less than 8 m below ground level) can be converted into an underground chamber and fitted with a hand pump to avoid source contamination and so meet the demand of small settlements. Many households, however, do not feel the necessity of a piped supply as they have adequate storage in their Khatris and are also of the view that piped water has the taste of chlorine.

Bhagsu Nag

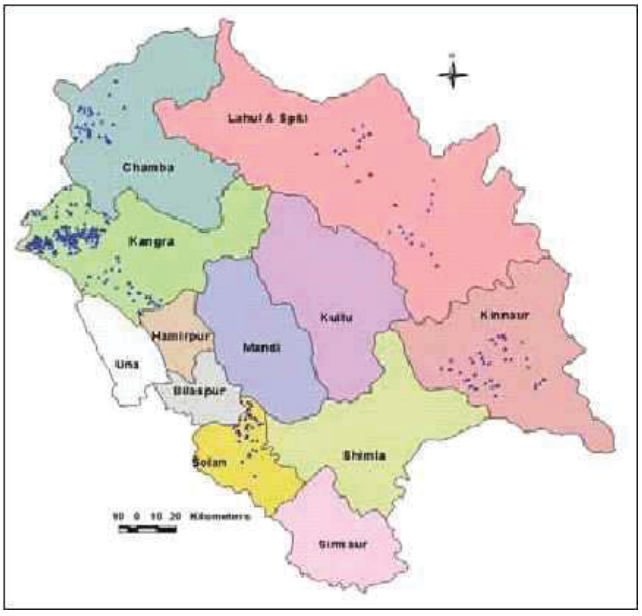
Traditional water sources in seven districts of Himachal Pradesh

District	No. of panchayats	Baories	Wells	Ponds	Springs	Others	Good condition	Bad condition	Total
Chamba	16	7	1	1	177	1	1	185	186
Hamirpur	10	60	58	2	--	--	54	66	120
Kangra	42	338	116	20	9	141	237	387	624
Kullu	11	73	4	1	5	5	43	45	88
Sirmour	43	167	19	55	53	--	27	265	292
Shimla	29	108	22	10	5	1	38	108	146
Solan	8	133	15	16	23	1	100	88	188

[Source: Directory of Water Resources in Himachal Pradesh, State Centre on Climate Change. H.P. State Council for Science Technology and Environment, Shimla (HP)]

12.3.5. Water Supply Arrangement in HP:

Main sources of rural water supply are streams and perennial springs. Three typical sources used for RWS are-
- Spring and perennial nala (drains) for gravity fed schemes
- Tube wells and hand pumps
- Perennial or seasonal stream with sub surface flow in summers.



Map 13.2. Irrigation Schemes in HP (Partial)
[Source: Water Resources Management of H.P.]

12.4. Water Resources in Himachal Pradesh

Water is one of the most vital natural resources. Surface water through precipitation (snow and rain), rivers, streams, springs, surface ponds and lakes and ground-water constitute natural water resources.

12.4.1 Surface Water

Most of the surface water resources of Himachal Pradesh flows from perennial rivers which originate from glaciers. The flow in these rivers is further augmented by runoff from the catchment area. About 90 per cent of State's drainage forms part of Indus River System. The rivers that actually originate from the State and flow through it are The Chenab, The Beas and The Ravi, The Satluj have their origin in Tibet and flows through Himachal Pradesh forming the largest river catchment in the state. The Yamuna crosses only the south eastern border but has some catchment area in the state of Himachal Pradesh. Manimahesh and Khajiar in Chamba district, Chander Tal and Suraj Tal in Lahaul& Spiti and Riwalsar, Prashar and Kamrunag in Mandi district are some of the important lakes of the state. Pandoh and Sundarnagar have man-made reservoirs besides Govind Sagar in Bilaspur and Pong dam in Kangra.

12.4.2. Drainage Network

The state is drained by five major rivers and has unique distinction of providing water to both Indus and Ganga basins. The major river systems of the region are the Chandra-Bhaga or Chenab, Ravi, Beas, Satluj and Yamuna. The catchments of these rivers are fed by the snow and rainfall and are protected by fairly extensive cover of natural vegetation.

Map 13.3. Drainage Map
[Source: Water Resources Management of H.P.]

12.4.3. Rainfall in Himachal Pradesh

In Himachal Pradesh, there is much diversification in climatic conditions due to variation in elevation (350 m to almost 7000 m) and aspect. The climatic conditions vary from hot and sub-humid tropical in the southern low tracts to temperate, cold alpine and glacial in the northern and eastern high mountains. Lahual & Spiti experience drier conditions as they are almost cut off by the high mountain ranges. It snows during the winter down to elevation of about 1500 m, but the snow does not stay for long below 2500 m. At elevation about 3,000 m, the average snowfall is about 3 m and above 4500 m there is almost perpetual snow for four months (December to March). In spite of heavy rains during the rainy season (and snow during winters), the summer months are periods of water scarcity in many areas. The average annual rainfall in the state is about 1250 mm which is quite high. The district-wise average annual rainfall is as under

District wise average annual rainfall in Himachal Pradesh

District	Average annual rainfall (mm)
Bilaspur	1100
Chamba	2213
Hamirpur	916
Kangra	2500
Kinnaur	816
Mandi	1679
Shimla	1480
Sirmour	1405
Solan	1413
Lahual& Spiti	170
Una	1100
Himachal Pradesh	1250

[Source: https://en.climate-data.org › India › Himachal Pradesh]

Generally, rainfall increases from the plains to the hills according to relief and aspect. Beyond Kullu, rainfall again decreases due to rain-shadow effect towards Lahual& Spiti and Kinnaur. Spiti is the driest (rainfall below 500 mm) region and Dharamshala is the rainiest place (rainfall over 3200 mm). About 70 per cent of the annual rainfall is received during July to September, about 20 per cent from October to March and 10 per cent from April to June. In Lahual & Spiti, winter and spring precipitation is greater than the summer and autumn. During winter and spring, westerly depressions bring cloudy weather and light rains and often cause heavy rainfall in higher regions. About 81 percent of the total cropped area in the state depends upon rains. Due to inadequacy of irrigation facilities, the success of the crops, by and large, depends upon the rains which are

often erratic.

12.4.4. Snow and Glaciers in Himachal Pradesh

Nearly 1/3rd geographical area of Himachal Pradesh remains covered under snow for about seven months in a year. There are 2,557 (estimated) glaciers, covering an area of 4161 km2 with a snow reserve of about 387 km3. Important glaciers in Himachal Pradesh are as under:

I. **Bara Shigri:** Largest glacier in the Chandra Valley of Lahaul and it is tenanted in a cirque on the middle slopes of the main Himalayan range. The glacier is above 3,950 m altitude and extends beyond 4,570 m, a 11 km length. The glacier is so heavily covered with surface moraine that ice is not visible for long stretches except along the crevices and in the ablation areas. Across the Bara Shigri is another glacier known as Chhota Shigri. It is a comparatively smaller glacier and does not reach down to the bed of the river, but it is most steep and slippery, difficult to cross.

ii. **Chandra glacier:** This glacier is responsible for forming Chandertal lake and has originally separated from Bara Shigri glacier. It is tenanted in a cirque of the towering peak. It gives water to form Chandra river which joins Bhaga to form Chenab.

iii. **The Lady of Keylong Glacier:** This glacier is situated at an altitude of about 6061 m which can be seen from Keylong and is popular among visitors. It is interesting to note that it was named by Lady Elashainghday about a century ago during British Raj. Although it is always snow covered, but in the middle of it there is seen a dark bare patch that looks like the figure of a woman walking with a load on her back. Geological Survey of India has named this spot "The Lady of Keylong".

iv. **Mukila Glacier:** The Mukila glacier of Bhaga valley is situated at the height of about 6478 m.

v. **Bhaga Glacier:** This glacier is tenanted in an amphitheater in Lahaul area of the main Himalayan range. It is a source of Bhaga river and later merges with Chandra forms Chenab afterTandi.

vi. **Sonapani Glacier:** It is only about five and half km from the confluence of Kulti Nala. The desiccated glacier lake and the old terminal moraine are visible from the Rohtang Pass. The desiccated lake, about 2.5 km in length, is a narrow meandering plain following the contours of bounding slopes and consists of such fluvio-glacial deposits as mud, fine sand, pebbles and angular gravels, through which the glacier stream runs. The glacier is about 11 km long. An ice-cli forms the snout which is mostly covered by stone, and the stream issues from an ice cave situated towards the western limb of the curved ice-cli. A large terminal moraine used to hold up the waters of the old lake. Three more old terminal moraines are cut through by the Sonapani stream after its escape from the lake-bed.

vii. **Perad Glacier:** The Perad glacier is a small easily accessible near Putiruni, which in local dialect means broken rock, that has a nice cave too. It is a small one and is easily accessible being within one kilometre of Putiruni. There is a well marked ice-cave and the glacier stream runs between two large lateral moraines.

viii. **Dudhon and Parbati Glacier:** Dudhon and Parbati glaciers impart water for Parbati stream each are about 15 km of length.

ix. **Beas KundGlacier:** This glacier is located on the south-facing slopes of the towering PirPanjal range near the conspicuous Rohtang Pass in Manali region of Himachal Pradesh. It drainages in to the Beas river.

x. **Bhadal Glacier:** It is located on the south-western slopes of the PirPanjal range in the Bara Banghal region of Kangra district in Himachal Pradesh.

xi. **Chandra Nahan Glacier:** This glacier is located in a small amphitheater on the South-Eastern slopes of the main Himalayan range in the area north-west of Rohru in Himachal

xii. **Gangstang Glacier:** The Gangstang glacier situated at the western border of the Lahaul region at an altitude of about 5,480 m streaming into Shahshanullah which joins the Chandrabhaga river at about 13 km to the south.

12.4.5 Basin-wise Distribution of Glaciers in Himachal Himalayas:

Geological history of Earth indicates that glacial dimensions are constantly changing with the changing climate. During Pleistocene, the earth's surface experienced repeated glaciations over a large land mass. During the interglacial period the climate was warmer and deglaciation occurred on a large scale. This suggests that glaciers are constantly changing with time and these changes can affect the discharge of most of the Himalayan rivers. Therefore, it is important to carry out an investigation for snow and glaciers for the proper management of Himalayan water resources.

Keeping in mind this view, Space Applications Centre had initiated a programme for the mapping of glaciers and permanent snowfields in the Satluj basin. Using Indian Remote Sensing (IRS) satellite data inventory was completed for the Satluj basin right from its origin in Tibet catchment. In this programme mainly three agencies were involved, i.e. Spacve Application Centre, Ahmedabad, Wadia Institute of Himalayan Geology, Dehradun and HP Remote Sensing Centre, Shimla. The results obtained from the investigation suggests the presence of 334 glaciers in the Satluj basin. The aerial extent of the glaciers in the basin has been calculated as 1515 km2. The study also shows the presence of 1987 permanent snowfields having a total area of 1182 km2. Thus, the total area under glaciers and permanent snowfields in the Satluj basin has been calculated as 2607 km2. The glaciers and snowfields have also been identified and delineated sub-basin- wise. When seen with reference to the aerial extent, it is observed that the maximum number of glaciers (92) falls in the category of 2.0 to 5.0 km2. Besides this a total of 38 moraine dammed lakes have been mapped in the entire basin out of which 14 lakes falls in the Himachal Himalayas.

Basin wise Distribution of Glaciers and Snowfields in Himachal Himalayas

Basin Name	Number of Glaciers	Aerial extent (km2)	Number of Snow fields	Aerial extent (km2)
Beas	51	503.725	237	312.564
Parvati	36	450.627	131	188.188
Sainj	09	37.255	59	51.934
Spiti	71	258.237	597	368.366
Baspa	25	203.300	66	64.964
Satluj	151	616.299	857	544.173
Chenab	457	1055.27	732	245.000
Total	**800**	**3124.713**	**2679**	**1775.189**

[Source: Directory of Water Resources in Himachal Pradesh, State Centre on Climate Change. H.P. State Council for Science Technology and Environment, Shimla (HP)]

Distribution of Glaciers on the Basis of their Aerial Extent in Satluj Basin

Range of Aerial Extent (km2)	Number of Glaciers	Total Area of glaciers (km2)
0.5	41	10.254
0.5-1.0	47	37.167
1.0-2.0	75	108.641
2.0-5.0	92	296.208
5.0-10.0	51	377.649
>10.0	28	687.202

[Source: State of Environment Report]

Similar investigations were carried out in the Chenab and Ravi basins in Himachal Pradesh. The mapping was carried out at 1:50,000 scale using LISS III- High Resoultion Satellite Data. The mapping was completed at the Remote Sensing Cell and the GIS data base was created at SAC Ahmedabad. The data base has been compiled in the form of an Atlas which covers information mainly about the Chenab basin in Himachal Pradesh. The preliminary interpretation of the maps pertaining to Ravi basin has also been completed except the digitization of the maps. With this the database pertaining to the snow and glaciers in all the basins in Himachal Pradesh is complete except for the Ravi basin.

The results obtained from the investigation suggest the presence of 457 glaciers in the Chenab basin having total aerial extent of 1055.27 km2. The total number of permanent snowfields in this basin is 732 having total area of 245.0 km2. This makes the total number of glaciers and snowfields in Chenab basin 1189 having an aerial extent of 1300.27 km2. The permanent snowfields and glaciers are covered in 55 sub-basins. The total glacial and permanent snow-cover stored water in Chenab basin is estimated at 93.033979 cu km. Most of the glaciers of Chenab basin have an area less than 1 km2. There are 165 glaciers in the basins which have the aerial range between 1-5 km2. There are 34 glaciers which have an area of between 5 to 10 km2. Only 14 glaciers with areas more than 10 km2 have been mapped in the basin. Analysing the distribution of permanent snowfields in various ranges of aerial extent it has been observed that most of the permanent snowfields have an area of less than 1 km2

Besides this, an inventory of moraine dammed lakes has also been prepared in the basin. The investigation suggests the presence of 50 moraine dammed lakes and five supra glacier lakes. Largest lake has an area of about 1.053 km2. This lake is formed in the glacier no. 52H11001 in 12448 sub-basin. Smallest lake has an area of about 0.002 km2 and has been observed near 52C12S52 in 12200 sub-basin. In addition to moraine dammed lakes 301 deglaciated valleys were also mapped. Deglaciated valleys covered an area of 269.013 km2.

Distribution of Glaciers in different ranges of Aerial Extent

Glacier area (km2)	No. of glaciers	Total area (km2)
<1	244	113.832
1-5	165	394.599
5-10	34	211.284
>10	14	335.612

[Source: State of Environment Report]

These glaciers not only provide water for irrigation, drinking and electricity generation but also give an assurance that our border areas are naturally protected by them.

12.4.6. Climate Change and Water Resources in Himalayan Region

The substantial component of precipitation in Himalayas is snow. In higher reaches, snowfall builds-up from year to year to form glaciers that provide long-term reservoirs of water stored as ice. The Himalayan range has a total area of about 35.110 km^2 of glacier and ice cover, with a total ice reserve of 3,735 km^2. Monsoon rains are another significant source of water especially in southwest Himalayan region.

Snow and glacial melt water, and water from monsoons flow into rivers. The contribution of snow and glacial to the major rivers in Himalayan region varies between <5% and >45% of the average flow. Climate controls the river flow and glacier mass balance in the Himalayan region. The Himalayan region has shown consistent warming over the last 100 years, which is much greater than the global average of 0.74oC. With rising temperatures, areas covered by glaciers are decreasing in extent. Many Himalayan glaciers are retreating faster than the world average and are thinning by 0.3-1.0 m/yr. Further, in many areas rainfall is decreasing and becoming more erratic in amount, frequency and distribution. As a result, snowmelt begins earlier and winter is shorter. This affects river regimes, natural hazards (floods, droughts, landslides, etc.), water supplies, and peoples' livelihoods and infrastructure.

12.5 River Systems of Himachal Pradesh

There are a number of rivers in Himachal Pradesh among them five are the major rivers and has five major catchment areas. Satluj the largest among all constitutes 30.69 per cent followed by Beas 24.5 per cent, Chenab 14.2 per cent, Yamuna 10.6 per cent and Ravi 9.9 per cent. These catchment areas are further sub-divided into several river subsystems. The major rivers are snow fed and perennial in nature, and supplemented by seasonal rainfalls.

12.5.1 Satluj River Subsystem

Satluj River:Satluj rises from beyond Indian borders in the Southern slopes of the Kailash Mountain near M a n s a r o v e r L a k e f r o m R a k a s L a k e , a s LongcchenKhababriver (in Tibet). It is the largest among the five rivers of Himachal Pradesh. It enters Himachal at Shipki (altitude of 6,608 m) and flows in the south-westerly direction through Kinnaur, Shimla, Kullu, Solan, Mandi and Bilaspur districts. Its course in Himachal Pradesh is 320 km from Rakastal, with the Spiti, the Ropa, the Taiti, the Kashang, the Mulgaon, the Yula, the Wanger, the Throng and the Rupi as right bank tributaries, and the Tirung, the Gayathing, the Baspa, the Duling and the Soldang as left bank tributaries. It leaves Himachal Pradesh to enter the plains of Punjab at Bhakhra, where the world's highest gravity dam has been constructed on this river. Its total catchment area in Himachal Pradesh is 20,000 km2 The Satluj finally drains into the Indusriver in Pakistan. The catchment area of about 50,140 km2of Satluj River is located above the permanent snow-line at an altitude of 4,500 m. The upper tracts of the Satluj valley are under a permanent snow cover. Its total length is 1,448 km.

Important Tributaries of River Satluj

Baspa River: Baspa is an important tributary of the river Satluj in its upper courses. The Baspa is joined by many smaller channels draining snow melt waters. The Baspa river has cut across the main Himalayan range. Thereafter it empties itself into the river Satluj in district Kinnaur. Baspa originates from the Baspa hills, joins it from the left bank near Karcham (Kalpa). Satlujriver leaves Kinnaur district in the west near Chauhra and enters Shimla district.

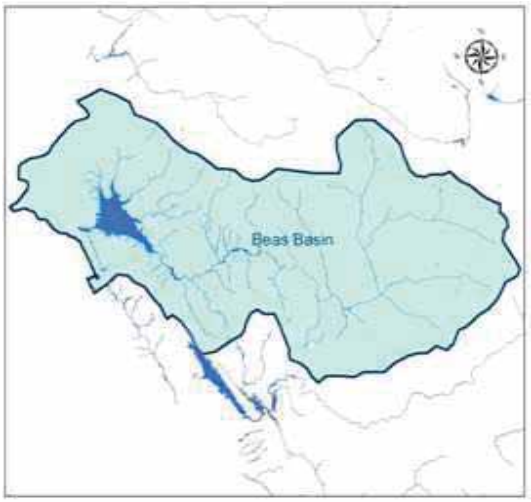
Spiti River: Spiti river originates from Kunzum range and Tegpo and Kabzian streams are its tributaries. Water draining the famous Pin valley area are also a part of the Spiti river system. Its position across the main Himalayan range deprives it from the benefit of the south-west monsoons that causes widespread rain in most parts of India from June to September. The river attains peak discharge in late summers due to glacier melting. After flowing through Spiti valley, the Spiti river meets Satluj at Namgia in Kinnaur district traversing a length of about 150 km from the north-west beyond that it flows in south-west direction in the Pradesh. Huge mountain rise to very high elevations on either sides of the Spiti river and its numerous tributaries. The mountains are barren and largely devoid of a vegetative cover. The main settlements along the Spiti river and its tributaries are Hansi and Dhankar Gompa.

NogliKhad: It joins Satluj just below Rampur Bushahar. It touches Kullu district in Nirmand tehsil opposite to Rampur tehsil of Shimla district. The river Satluj enters Mandi district near Firnu village in the Chawasigarh and passes through the areas of Mahunm, Bagra, Batwara, Derahat and Dehar. Practically, the whole of the ancient Suket state except Jaidevi and Balh circles drains into Satluj. The main tributaries of the Satluj in district Mandi are Siun, Bahlu, Kotlu, Behna, Siman, Bantrehr, Khadel and Bhagmati.

Soan River: The Soan river rises from the Southern slopes of the Shivalik range also known as Solasinghi range in the tract to the east of the Beas gap across the Southern periphery of the Kangra valley. It joins the boundary of Himachal Pradesh and Punjab. Its gradient is not very steep and the slopes of the Soan catchment vary from gentle to steep. In the summer the discharge drops drastically, while during monsoon it is in spate.

12.5.2 Beas River Subsystem

Beas River: The Rohtang pass at 4,350 m, 51 km north of Manali is the source of the river Beas. This river provides the water to the fields of Punjab and Pakistan before flowing into the Arabian Sea. On the south of the Rohtang pass lay the civilized state of Kullant (Kullu), while to the north lay the more desolate and barren areas of Lahaul& Spiti. There are two mountain streams that meet at Palachan village, 10 kmnorth of Manali to form the river Beas. The tourist resort of Manali is situated on the right banks of the river Beas. From Manali, this holly river after passing through dense evergreen forests reaches the town of Kullu. After covering hundreds of kilometres through the hills, the river at HariKaPatan in Ferozpore district of Punjab embraces the river Satluj before flowing into Pakistan. Its main tributaries are the Parbati, the Spin and Malananala in the east; and the Solang, the Manalsu, the Sujoin, the Phojal and the Sarvatistreams in the west. In



Beas Basin

Kangra, it is joined by Binwa, Neugal, Banganga, Gaj, Dehr and Chakki from north, and Kunah, Maseh, Khairan and Man from the south. The total length of this river is 460 km.

Important Tributaries of River Beas

Awa River: Rises from the Dhauladhar range in the Kangra valley of Himachal Pradesh. It flows in a south-westerly direction before joining the river Beas. It receives both snow as well as rainfall water from smaller channels.

Banner River: It is also known as Baner Khad. It is a tributary of the Beas river and drains the central part of the Kangra valley. The BanerKhad rises as a small snow fed channel on the southern slopes of the Dhauladhar range near Palampur. The general direction of flow of the Banner River is towards South-West.

Banganga River: It joins the Beas river in the Kangra valley. It rises from the southern slopes of the Dhauladhar range. This river is fed by snow melt waters and channels emanating from springs. Large fertile sediments have been formed all along the river near its mouth.

Chakki River: It drains the south-western part of Himachal Pradesh. The Chakki river rises as a small snow-fed and rain fed stream from the southern slopes of the Dhauladhar range. The river enters Punjab near Pathankot and joins the Beas River.

GajKhad: It rises as a small stream from the snows on the southern slopes of the Dhauladhar range in Kangra district. A number of small streams form the GajKhad. The GajRiver joins the Beas river a little upstream of the Pong dam lake (now known as MaharanaPratapSagar).

Harla River: Harlariver rises as a small channel from the snows in the depression of the North-Western plank of Kullu valley. It joins the river Beas near Bhuntar(Kullu airport). Numerous snow-fed streams join the river Harla.

Luni River: Luni rises from the south slopes of Dhauladhar in the Kangra valley. It merges with the river Beas in the central part of Kangra valley.

Manuni River: It rises from the southern slopes of the Dhauladhar range and joins the river Beas. Steep slopes form the upper catchment of the ManuniRiver. There is a sharp fall in its gradient, huge river terraces occur on the both sides of the river bed, which are used for cultivation extensively.

Parbati River: It rises in the snowy Wastes upstream of Manikaran on the foothills of the main Himalayan range in Kullu district. The glacier which feeds this river discends down from the steep southern slopes of the main Himalayas. It joins the river Beas at Shamshi in Kullu valley.

Patlikuhal River: This river is a tributary of the Beas river in the Mandi area of Kullu district. It rises from the snow on the southern slopes of the PirPanjal range and thereafter it flows into the Beas river upstream of Kullu.

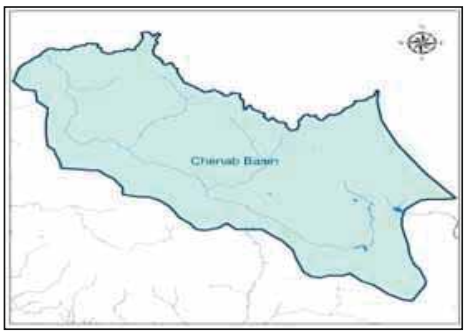
Sainj River: It rises from the water divide of the Beas and Satluj rivers in the lower ranges of the main Himalayas to the east of Kullu. Thereafter, it flows towards south-west to join the Beas Riverjust before it cuts across the Dhauladhar range near Larji. The Sainj valley is V-shaped and the river flows past a series of interlocking spurs. It has widened near the mouth of the river.

Suketi River: This river is a tributary of the Beas river in the Kangra valley. It rises from the south facing slopes of Dhauladhar range. A number of small channels join the Suketi river in its upper reaches. The river has formed huge terraces, most of which are under cultivation. The upper catchment of the river consists of steep

slopes.

Tirthan River: It is a tributary of the Beas river. It rises from the base of an o□shoot of the great or main Himalayan range to the south-east of Kullu. Thereafter, it follows a south-westerly course and flows into the Beas at Larji just before it cuts across the Dhauladhar range. Lower down, the valley opens up and it is fairly wide near its confluence with the Beas river.

Uhl River: It is another tributary of the Beas river which rises as two feeder channels in the area to the north of the Dhauladhar range in Himachal Pradesh. Thereafter, the two channels cross this gigantic mountain barrier and merge at the base of the southern slopes to form the main channel of the Uhlriver in Kangra area. It flows for a considerable distance along the base of the Dhauladhar range. Then turns towards the south-east to merge with the Beas near the town of Mandi.



Chenab Basin

12.5.3 Ravi River Subsystem

Ravi River: Ravi river rises from the Bara Banghal (a branch of Dhauladhar) as a joint stream formed by the glacier-fed Badal and TantGari. The right bank tributaries of the Ravi are the Budhil, TundahanBeljedi, Saho and Siul; and its left bank tributary worth mentioning is ChirchindNala. Town Chamba is situated on the right bank of the river Ravi. The river with its length of about 158 km in Himachal has a catchment area of about 5,451 km2 It carries away even sturdy trees. The Ravi river first flows westward through a trough separating the PirPanjal from Dhauladhar range and then turns southward, cutting the deep gorge through the Dhauladhar range. It flows nearly 130 km in Chamba region, before leaving it finally at Kheri. The Ravi river forms the biggest sub-micro region of Chamba district. From Bara Bangal of Kangra district, it flows through Bara Bansu, Tretha, Chanota and Ulhansa. Its total length is 720 km.

Important Tributaries of River Ravi

Bhadal River: It rises from the snowy range of the area lying between the PirPanjal and Dhauladhar ranges in the Bara Banghal area of the Central Himachal Pradesh. It flows in a westerly direction before merging with the Tant Gari river to form the mainstream of the Ravi. Bhadalriver's catchment is made up of U shaped valleys, waterfalls, moraines, cirques and towering peaks.

Siul River: It is the tributary of the Ravi river. It rises from the tract between the Dhauladhar and PirPanjal ranges near Jammu and Kashmir and Himachal Pradesh border. Thereafter, this river flows towards east, takes a U turn and attains a south-westerly course before flowing into the Ravi river downstream of Chamba. River Baira is the prominent tributary of the Siulriver. This river is fed by both snow melt waters and spring waters.

Baira River: It rises from the snows on southern slopes of the Pir Panjal range in Himachal Pradesh. Numerous tributaries of the Baira River are also fed by the snow and so make it a perennial river before it joins the Siulriver, which is a tributary of the Ravi river. Its catchment consists of steep slopes, deep valleys and terraces that have been laid down by the river since a long time.

Tant Gari River: It is a tributary of the Ravi River and rises as a small stream from the slopes of an o□-shoot of the Pir Panjal range in the area East of Bharmaur in Chamba district. The TantGari valley is U shaped. Its bottom is strewn with boulders and morainic deposits laid down by the glaciers in the past.

12.5.4 Chenab River Subsystem Chenab Basin

Chenab River: Two streams namely Chandra and Bhaga rise on the opposite sides of the Baralacha pass at an elevation of 4,891 m and meet at Tandi at an elevation of 2,286 m to form the river Chenab. The Chenab rises from the south-east and Bhaga from the north-west of the Baralacha pass. It enters Pangi valley of Chamba district near Bhujind and leaves the district at SansariNala to enter Podar valley of Kashmir. It flows in Himachal for 122 km. With its total length of 1,200 km, it has a catchment area of 61,000 km2, out of which 7,500 km2 lie in Himachal Pradesh. It is the largest river of Himachal Pradesh in terms of volume of waters. The Chenab valley is a structural trough formed by the great Himalayan and PirPanjal ranges.

Chenab Basin

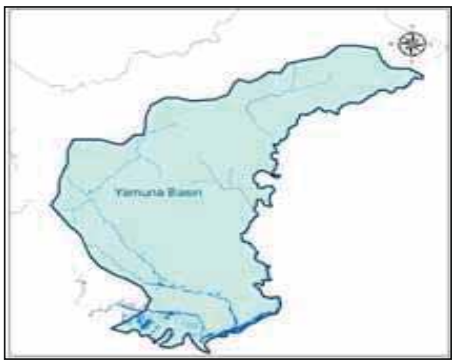
Important Tributaries of River Chenab

Bhaga River: This river originates from the Lahaul valley. A number of snowfed rivers join it during its course, before it joins the Chandra stream at Tandi. From its origin it flows in South-South-Westerly direction as a raging torrent before joining the river Chandra. U shaped valleys, waterfalls, glaciers and moraines characterises the upper catchment of the Bhagariver. The entire tract is devoid of a vegetative cover. The discharge of this river increases during the summer months, when the snow on the high mountains starts melting.

flows for a considerable distance along the base of thin range in the South-East direction, before making a 180° turn and taking a South-West course in Spiti valley. the entire area is a vast cold desert that receives little or no rain as it lies in the rain shadow of the PirPanjal range lying towards South. The important human settlement along the river is Koksar.

12.5.5 Yamuna River Subsystem

Yamuna River: It enters Himachal Pradesh at KhadarMajri in Sirmaur district. Yamuna River is the largest tributary of the Ganga. It rises from Yamunotri in Gharwal hills and forms the eastern boundary with Uttar Pradesh. The Yamuna is the eastern-most river of Himachal Pradesh.



Yamuna Basin

Important Tributaries of River Yamuna

Jalal River: Small tributary of theGiriRiver in Himachal Pradesh and rises from Dharti ranges adjoining Pachhad and joins Yamuna at Dadahu from the right side. It also joins the river Giriganga at Dadahu. The origin and entire course of this river lies in the lower Himalayas. This is the rainfed river and has abrupt flow during the rainy season. A number of human settlements have come up along the Jalal River. These include Bagthan and Dadhau.

Markanda River: Small river of Nahan area of the Sirmaur district and rises from the Southern face of the lower Himalayas on the western extremity of the Kiardadun (Paonta) valley. The lower Himalayan hills of Nahan occur on the right flank of the Markanda valley while the low rolling Shivalik hills are on its left flank. It is a rainfed river and has very low flow in the winter and summer months, but rises abruptly in the monsoon.

Andhra River: This is a tributary of the Pabbar river which in turn drains into the Tons river. This river rises from a small glacier tenanted in a cirque of the lower hills of the main Himalayas in the area to the North-West of Chirgaon in Shimla district. Thereafter it flows in a general direction towards South-East and merges with the PabbarRiver at Chigaon.

Giri River: Important tributary of the Yamuna river and it drains a part of south-eastern Himachal Pradesh. The Giri or Giriganga is famous in the Jubbal, Rohru hills that rises from Kupar peak just above Jubbal town after flowing through the heart of Shimla hills, flows down in the south-eastern direction and divides the Sirmaur district into equal parts that are known as Cis-Giri and Trans-Giri region and joins Yamuna upstream of Paonta below Mokkampur. The river Ashni joins Giri near Sadhupul (Chail) while river Jalal which originates from Dharthi ranges adjoining Pachhad joins it at Dadahu from the right side. The water from the GiriRiver is led through a tunnel to the power house of Girinagar and after that it is led into the Bata river.

Asni River: Tributary of the Giri river which in turn drains into the Yamuna river. This river flows along a deep V-shaped valley whose side slopes vary from steep to precipitous. It has carved a steep gorge across the o□-shoots of the Nag Tibba ridge. Numerous small spring fed tributaries join the AshniRiver at various places along its course.

Bata River: This river originates in the boulders below the Nahan ridge in the South-Western corner of Himachal Pradesh as the Jalmusa-Ka-Khala. It is mainly fed by the rain water that is cycled as underground water before finally coming up on the surface as a spring. The river flows below the surface for a part of its length in its upper reaches, thereafter the water flows on the surface. Large and wide terraces have been formed by it. The small tributaries which join the Bata River in the Paonta valley are Khara-Ka-Khala flowing in a Southerly direction from the Nahan ridge, and Kanser-Khala originating from the Southern slopes of the Nahan.

Pabbar River: The Pabbar river is a tributary of the Tons river, which in turn drains into the river Yamuna. This rises from the Dhauladhar range (South facing slopes) near the border of UP and Himachal Pradesh and the extreme North- Eastern of Shimla district. The main stream is fed by the Chandra Nahan glacier and springs originating from underground waters. It joins the Tons River at the base of the Chakrata massif near the border of Uttar Pradesh and Himachal Pradesh.

Patsari River: It is a small spring fed tributary of the Pabbar river. This river rises from the lower Himalayan hills near Kharapathar in Shimla district of Himachal Pradesh. This river joins the PabbarRiver near the mountain hamlet of Patsari about 10 km upstream of Rohru. Its bed is strewn with boulders of various sizes. Small villages and hamlets have come up along this river.

Tons River: Important tributary of the Yamuna river and joins it at Kalsi in the north-western part of Dehradun valley (approximately 48 km away from Dehradun). It rises as the following two feeder streams - the Supinriver rises from the northern part of the Tons catchment near the Himachal Pradesh and Uttar Pradesh border and the Rupin river rises from a glacier at the head of the famous Har-Ki-Dun valley in the north-north eastern part of the Tons catchment. These two feeder streams merge near the mountain hamlet of Naitwar and the channel downstream of Naitwar is known as Tons river. The river flows along a V-shaped valley. A number of settlements have come up along the Tons river such as Tuni, Naitwar and Menus.

12.6. Lakes of Himachal Pradesh:

The State of Himachal Pradesh is dotted with dozens of large and small lakes on high mountain tops. Natural lakes are spread over an altitude range of 450 to 5093 metre and cover tropical, sub-tropical, temperate and alpine regions of the state. The majority of lakes are part of the culture ethos of the local inhabitants and religious sanctity is given to them.

Some of these may date back millions of years and are held sacred and are the venue of many religious fairs. The Streams of pure snowmelt feed these lakes or by ground water springs and some of these are sources of the rivers. The crystal clear water of these lakes reflects the glorious scenery of the Himachal' varied landscape. Several of these lakes also home to a variety of resident and migratory birds.

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Location of lakes in Himachal Pradesh

Sr. No	Name of Lakes	District	Sheet No.	Quadrant No.	Longitude (E)	Latitude (N)	Altitude (Meters)	Area (hectare)
1	Bhrigu	Kullu	52H/3	C3	77o14' 41"	32o17' 37"	4240	3
2	Dashair	Kullu	52H/3	C2	77o13' 28"	32o22' 24"	4200	4
3	Mantalai	Kullu	53E/13	A2	77o47' 08"	31o51' 44"	4160	3
4	Seruvalsar	Kullu	53E/6	B3	77o23' 07"	31o32' 16"	3301	0.5
5	Prashar	Mandi	53E/1	B3	77o06' 05"	31o45' 18"	2600	1
6	Rewalsar	Mandi	53A/14	B2	76o50' 03"	31o38' 03"	1320	3
7	Nako	Kinnaur	53J/9	B2	78o37' 01"	31o52' 01"	3604	1
8	Chandertal	Lahul-Spiti	52H/11	B1	77o37' 00"	32o28' 52"	4280	49

Sr. No	Name of Lakes	District	Sheet No.	Quadrant No.	Longitude (E)	Latitude (N)	Altitude (Meters)	Area (hectare)
9	Surajtal	Lahul-Spiti	52H/5	B3	77o23' 53"	32o45' 47"	4800	3
10	Chandernauan	Shimla	53 I/3	B2	78o06' 08"	31o22' 38"	3960	1
11	Dal	Kangra	52D/8	A1	76o18' 42"	32o14' 50"	1840	2
12	Kareri	Kangra	52D/7	A3	76o16' 33"	32o19' 26"	2960	3.5
13	Pong Dam	Kangra	53A/1	A1	76o03' 33"	31o58' 57"	430	21712
14	ManiMahesh	Chamba	52D/11	B2	76o38' 12"	32o23' 42"	4200	2
15	GauriKund Lake	Chamba	52D/11	B2	76o38' 14"	32o24' 06"	4000	0.5
16	Khajjiar	Chamba	52D/2	A3	76o03' 32"	32o32' 47"	1920	5
17	Lam Dal Lake (Combination of 8 lakes) Lakes located in B2 and B3 are known as Nag Dal or Nag Chattri Dal	Chamba	52D/ 7	A2 A2 A2 B2 B3 B2 B2 B2	76o18' 03" 76o18' 44" 76o19' 48" 76o20' 19" 76o21' 43" 76o20' 50" 76o21' 33" 76o21' 37"	32o20' 58" 32o20' 47" 32o20' 19" 32o20' 01" 32o19' 44" 32o20' 29" 32o20' 34" 32o20' 10"	3640 3880 4080 4120 4120 4080 3920 4160	5 13 3 3 2 4 1 1
18	Gadasaru	Chamba	52D/1	C1	76o14' 31"	32o58' 58"	4280	1
19	Mahakali	Chamba	52D/5	A1	76o15' 35"	32o58' 39"	4355	2
20	Khundi Maral	Chamba	52D/6	B2	76o24' 20"	32o37' 16"	3750	3
21	Renuka	Sirmaur	53F/6	C2	77o27' 30"	30o36' 38"	660	15
22	Govind Sagar	Bilaspur & Una						

[Source: Topo sheets (Scale 1:50,000) Survey of India, Govt. of India, Dehradun and area has been calculated from toposheet]

Though there are more than 27 natural lakes (wetlands), yet 22 of these lakes identified being as tabulated held sacred by the people and are spread over 10 districts of Himachal Pradesh and Pong Dam is the largest manmade lake in Himachal Pradesh.

12.6.1. Location and Description of Lakes:

Bhrigu Rishi Lake: Bhrigu lake is located at an altitude of 4240 metre above mean sea level (msl) in Kullu district towards the east of Rohtang pass, 6 kilometre from Gulaba village. The depth of the lake is 3 metre as reported and is a clear water and there is no human habitation nearby. It is faith among peoples that 'Deotas' or 'Deities' take bath here once in a year and a holy bath of 20thBhado is

Bhrigu Rishi Lake, Kullu

organized here. The name Bhrigu of it is attributed to sage 'Bhrigu', who was a great seer and astrologer and in Hindu mythology the father of Venus known as Shukra. The shores of this clear water lake devoid of human habitation - it is visited by people regularly.

(ii) Dashair Lake: Dashair lake is located on the connecting district Kullu and Lahul & Spiti, at an altitude of about 4200 metres above msl at a distance of 3 kilometres near Manali. It is also known as 'Dashaur' and Sarkund. It has depth of 3 metres and held sacred. It is believed that all the diseases of skin is cured if one takes bath in the lake during mid-August and September and hence people visit to take holy bath generally during festive season.

Dashair Lake, Kullu

(iii) Mantalai Lake: Mantalai lake is located at the height of 4160 meter above msl at the base of Pin Parvati glaciers and is a source of the Parvati river, a tributary of the river Beas. It has an area of 3 hectares and is visited by both tourists, trekkers& religious pilgrims while passing through Khirganga. It involves a six days' trek to from Mani Karan to Mantalai via Khirganga. From Khir Ganga one needs to cross Tunda Bhuj, Thakur Kuna.

Mantalai Lake, Kullu

On third day one has to stay either at the confluence of Dibi or Parvati Rivers. The trek route from Manikaran (accessible by road) and Barshaini is about 14 kms on the reverse journey. This lake has the importance of religious sacredness. At Manikaran, there are also hot water springs. Manikaran also have Gurudwara but Manikaran, Khirganga and Mantalai are associated with the legends of Lord Shiva and Parvati. Manikaran means jewel (mani) from the ear (karan). A local legend describes that the Parvati while bathing lost a mani from her earrings. Fearing the wrath of the Lord Shiva- her consort-the serpent god, Sheshnag, angrily blew in back from underground and the hot springs spewed forth and the place came to be known as Manikaran. The place is sacred to Hindus and Sikhs. Another important Gurudwara at Manikaran commemorates the visit by Guru Nanak, the first Sikh Guru, who meditated here.

(iv)Seruvalsar Lake: It is located at the height of 3300 metre above msl, 20 kilometer from Banjar town towardsAni in district Kullu. It is a clear lake surrounded by mixed forest of Q. incana, Q. latifolia, P.Wallichiana, roxburghi and C. deodara. It is spread over one kilometre circumference. It is a belief among people that if a person takes a round by the lake and side by side pour "ghee" around it, ones all desires are fulfilled.

Seruvalsar Lake, Kullu

It is associated with a local goddess namely 'old nagin' by local people. 'Saruval' is actually "Saraal" which means 'a big python or serpent'. 'Old nagin was also 'Saraal' and so this lake is named after 'old nagin.' It has been observed that sparrows (Ambhispecies), which are found in the area pick up the fallen leaves from the surface water of the lake instantaneously when leaves fall, and help in keeping the wonderful lake clean. This lake has the importance of local deities' sacredness.

(V) Prashar Lake: Prashar lake is also located in Mandi district about 40 Kilometre from Mandi town. The lake is located at an altitude of 2600 metre and is held sacred to the sage Prashar. Parashar has a picturesque lake and an ancient wooden temple in Pahari style of architecture. There is a circular lake with crystal clear water with greenish hue. The water turns muddy during the rainy seasons.

Prashar Lake, Mandi

Also according to the elders of the place the water has been made muddy after an attempt to make use of the lake for rearing fish. Once there was a floating island which has now permanently stuck at its eastern end and is not moving.

(vi) Rewalsar Lake: Rewalsar Lake is located in Mandi district at a distance of 24 kilometre from Mandi town at 1320 metre above msl. Hindus, Sikhs andBuddhists hold the place sacred and there are three temples, a Gurudwaraand a Buddhistmonastery at Rewalsar. Hindus believe Rewalsar is supposed to have originated when Arjun struck an arrow to sprout water to quench mother Kunti's thirst during Mahabharata time.

Rewalsar Lake, Mandi

The lake is sacred to the Hindus, and the Sikhs for various religious reasons. Rewalsar is also known as'Padmacan' to the Buddhist which means 'Lotus possessing' and is considered the place where the spirit of Padmasambhava rests. Rewalsar lake is also associated with the Nag cult or serpent worshipping.

(vii) Nako Lake: Nako Lake is situated on the western declivity of the large mountain of Reo Purgyal about 1.6 kilometre above the left bank of the Spiti river at an altitude of 3604 metre in District Kinnaur. The village of Nako in Kinnaur is located near a emerald lake. Nako, the awesome magnificence of Reo Purgyal, marked on the map simply as point 6816 m, is revered on both sides of the IndoChinese (Tibetan) border as the abode of the god Purgyal,

Nako Lake, Kinnaur

It is situated in village Nako, township Yangthang, near Maling nala on Ambala- Kaurik Highway, 350 km from Shimla Pooh sub-division in the last corner at the end of the Kinnaur.

(viii) Chandertal: Chander Tal lake is 4280 metre above msl and it is 13 km from Kunzam Pass that connects Spiti and Lahaul. Surrounded by snows and acres of scree, this deep blue-water lake hasa circumference of 2.5 km. This is the sourceof the river Chandra. In Lahaul and Spiti, Chandertal is revered and so is the river Chandrabhaga. According to a story Chandra, the daughter of Moon and 'Bhaga', the son of the god fell in love.

Chandertal Lake, Lahaul & Spiti

But the Gods were illdisposed towards their union so the loversdecided to flee and descend to the earth. 'Chandra' landed at Chandratal and Bhaga landed in a gorge called 'Baralacha', and started running as a river. Later, Chandra too started from Chandertal to meet her lover. They met at place called Tandi and merged in each other, to become Chandrabhaga river. These and many other culture manipulations of natural phenomena provide as animistic view of life and give devotional meaning to ordinary abstract notions. The various stories and rituals, and the deep faith of the people have in them mirrored a fundamental set of values that are deep rooted and basic to human nature.

(ix) Surajtal Lake: Suraj Tal lake is 4800 m above msl and below the summit of the Baralacha Pass in the Lahaul division of district Lahaul & Spiti; it is located between rocks below the summit of Baralacha pass on Manali Leh road, 250 km from Manali. It is a centre of tourist attraction with its beautiful location especially during the summer season. It is a main source of water for Bhaga and Chandra.

Surajtal Lake, Lahaul & Spiti

Tandi is a confluence of Chandra and Bhaga and later known as Chanderbhagas,which is known as Chenab on the border ofJammu and Kashmir. The Baralacha connectsManali and Lahaul to Ladakh, and the lake, i.e.Surajtal, which draws a considerable number of visitors - especially in the summer - lies at its head.

(x) Chandra Naun Lake: This is a glacial lake at 3960 m above msl at Chansel range, in the main Himalayas to the northwest of Rohru in Himachal Pradesh in Shimla district. It lies at the origin of the Pabar river which is a tributary of the Tons river emerging in Yamuna river. The Chandra Naun Lake lies in a depression formed by the glacier that feeds the Pabar river. High snow clad peaks surround this lake. It is fed by snowmelt waters. Alpine meadows grow on the banks of this lake in summer. Its water is crystal clear and unpolluted. Chander Naun lake is also called as Chander Naun. It is accessible to experienced trekkers and fed by a series of springs, the name signifies 'Naun' for bathing. Generally local Gods visit the lake during the year or at an interval for the baths of Gods accompanied by devotees and office bearers of traditional Deity system prevailing in Himachal Himalayas.

(xi) Dal Lake: It is situated at 30o 17'' N and 77o 14'' E, 1840 m above msl in Kangra district. It has a Shiva temple on northern bank. It has importance of religious sacredness mainly associated with Shiva cult as Chamba district is on the other side of Kangra valley, so it has largely influence of Shiva cult and visited by devotees for pilgrimage and also by many trekkers.

Dal Lake, Kangra

Since the access is through Macloadganj in Dharamshala districtheadquarter of Kangra district which is also the residence of His holiness the Dalai Lama. A fair is also held during month of June.

(xii) Kareri Lake: The Kareri lake is located at district Kangra with an altitude of 2960 above msl with an area of 3.5 hectares approximately and having thick vegetation around the catchment. Kareri lake falls on latitude 32º 19' 26" N and longitude 76º 16' 33"E. On the north bank of the lake there is a Shiva temple. It is 22 km away from Kotwali bazaar and 28 km from Dharamshala. This lake is held sacred and has been a□ected due to the accumulation of silt.

(xiii) Pong Dam: Pong Dam is situated at district Kangra and the bank of the Beas river along boundary of Himachal Pradesh and Punjab states. Pong Dam is famous as a tourist place. It is situated at 31º 58' 57" N and 76º 03' 33" E, 430 m above msl in Kangra district with an area of 21712 hectares. It is a water storage reservoir. At high water level maximum depth exceeds 59 metres and low water level a muddy shore line up to 100 metres. The reservoir contains several large islands

Pong Dam, Kangra

(xiv) Manimahesh Lake: Manimahesh lake is located at an altitude of 4200 metres at the foot of the Manimahesh Kailash peak in Chamba district, 32 km from Bharmaur. The lake is held sacred to Lord Shiva and the lake is the venue of the annual Manimahesh yatra. Dal is local dialect fo lake, the Manimahesh Dal is situated on a snowfield a the foot of Manimahesh Kailash and is called Siva ra Chaugan (playground of Siva).

Manimahesh Lake, Chamba

Manimaheshlakeis sacred and the most famous lake of the Dhauladhar mountain ranges. The bath in the Dal is believed to cure diseases and wash sins. Stella Kramrisch writes: "Rudra heals the ills of mortals with the remedies that he himself created in the waters into which he plunged when Brahma had asked him to create mortals." The waters themselves have healing power; they were irradiated by his presence. It was in the water of the Dal that Siva had immersed in yogic trance after all the pain he had endured following Daksha yajna. The water flowing from the glacier to the Dal brings with it the essence of the medicinal herbs that grow in the course of the stream. This water also has curative e□ect on the devotees who take a bath in the Dal.

(xv) Gauri Kund: Gauri Kund, a water body that is otherwise called the Lake of Compassion. It is situated in in district Chamba and has an area of 0.5 hectares. According to Hindu mythology, there is a captivating story about Gauri Kund and has been depicted in legend "Shiva Purana".

Gauri Kund Lake, Chamba

(xvi) Khajiar Lake: This lake is situated at an altitude of 1920 metre from sea level in district Chamba. That has luxuriant vegetation cover in its catchment. Khajiar lake located on the way of Chamba – Dalhousie main road. It is 22 km away from Chamba towards Dalhousie. The location of this lake in toposheet is 32º 32' 47" N latitude and 76º 03' 32" E longitude with an area of 5 hectares approximately. This lake surrounding has thick forest and it is also a famous and religious place.

Khajiar Lake, Chamba

This place is also known as Mini Switzerland of India because its topography resembles Switzerland. There has been great concern about the ecological deterioration, habitat degradation and eutrophication of the wetland due to silting, high levels of organic pollution, dumping of non-biodegradable materials by pilgrims and and tourists. This has not only resulted in habitat deterioration, shrinkage of the aquatic life, but also the terrestrial fauna of Renuka Sanctuary as this is the only perennial source of water for wild animals

(xvii) Lama Dal Lake: Lama Dal is in district Chamba is situated at the height of 3,640 metre above msl main sea level, 45 km from Chamba town. Held sacred to Lord Shiva, this lake lies amidst bare rock, 'Lama dal' means a long lake. The lake is spread over two kilometres in the boulders surrounding on Dhauladhar range. It is as the name suggests oblong in shape. It lies in the vicinity of trek routes between Chambaand Dharamsala over Gag, Minkiani and Bleni passes.

Lama Dal Lake, Chamba

On the day of Manimahesh festival yatra is held for Lama Dal also via Dunali and Drakund. Like Manimahesh, Lama dal is also held sacred to Lord Shiva. About 200 mts shorts of Lama Dal are located Kali kund, shaped like a well and is enclosed by rising hills

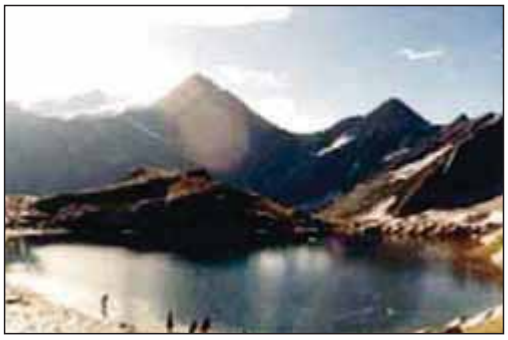
(xviii) Gadasaru Mahadev Dal: Gadasaru Lake is in district Chamba is situated at the height of 4280 metre above msl. This lies in the Churah tehsil of Chamba and is 24 km from Tissa. This lake is also held sacred and has a circumference of about a kilometre and near its banks it is very deep.It is situated on the extreme end of Nosaradhar amidst high mountains. Big mountain on the southof the lake, which is said to be the abode of Rudra Mahadev, induces godly presence.

Gadasaru Mahadev Dal

The lake and its surrounding possess mysterious ambivalence; a primitive shrine made of stone walls and roof is dedicated to Lord Shiva. Yatra is held for Gadasaru Mahadev annually at par with Manimahesh yatra on the same date.

(xix) Mahakali Lake: Mahakali Lake 4355 m above msl. This lies between mountain ranges in district Chamba. This middle-sized lake is held sacred to the goddess Maha Kali. This lake is associated with 'Shakti' cult being dedicated to 'Mahakali'.

(xx) Khundi Maral Lake: Khundi Maral Lake is located at an altitude of 3750 metres in Churah Tehsil of Chamba district and has an area of 3.0 hectares. Khundi Maral has three approaches, first from Chamba via Saho, second via Chanju from Churah and the third via Lith from Bharmour. The lake is situated on a green saucer at the mountain juncture in the inner folds of Chamba.



Khundi Maral Lake, Chamba

Pilgrims in their colourful best descend on Khundi Maral from three different directions of the surrounding hills onyatra days, i.e. first Tuesday of the Bhadrapada (September) these pilgrims come from Saho Gudiyal, Lilh Belj and Chanju Loh – tikki. The lake is sacred to Goddess Maha Kali who, it is believed, emerged splitting a hard rock at this place. The goddess owns a large flock of sheep which can be seen grazing on the

(xxi) Renuka Lake: It is located 173 km Southwest of Shimla in Sirmour District at an altitude of 660 m above msl. Due to its biological richness, the National Wetland Management Committee has designated it a wetland of national importance. The picturesque Renuka Lake is one of the several natural Lakes of Himachal Pradesh and is regarded as one of the most sacred places in northern India.

Renuka Lake, Sirmour

It is named after the Goddess Renuka, the mother of Lord Parshuram. The lake is also one of the famous tourist places of the state. Renuka Lake lies in Sirmour district and is the largest natural lake in the state. It is shaped like the profile of a reclining woman that is regarded as the embodiment of the goddess Renuka. There has been great concern about the ecological deterioration, habitat degradation and eutrophication of the

wetland due to silting, high levels of organic pollution, habitat degradation, dumping of non-biodegradable materials by pilgrims and tourists. This has not only resulted in habitat deterioration, shrinkage of the aquatic life, but also the terrestrial fauna of Renuka Sanctuary as this is the only perennial source of water for wild animals.

(xxii) Gobind Sagar Lake: Gobind Sagar Lake is alargest man-made reservoir (Bhakra Dam) situated in BilaspurandUnadistricts of Himachal Pradesh at an elevation of 650 m.The Bhakra dam which rises nearly 225.5 m above its lowest foundations. It is situated 31°25□N 76°30□E and 31°25□N 76°30□E longitude and has 56 km length and nearly 3 km breadth. To maintain the level of water, the flow of river Beaswas channelized to Gobind Sagar by the Beas-Sutlej link which was accomplished in 1976.

Govind Sagar, Bilaspur

Maximum depth of the lake is 163.07 m (535.0 ft). It has primary inflow of 4.4- 8.0 million cusecs and primary outflow 4.9- 7.0 million cusecs.

12.6.2 Issues Associated with the Lakes:

- Eutrophication of wetlands due to silting and high levels of organic pollution.
- Dumping of non- biodegradable materials by pilgrims and tourists.
- Habitat degradation.
- Shrinkage of the aquatic life.
- Weed infestation.

With the efforts of the State Govt. Renuka lake and Pong Dam have been declared lakes of International Importance (Ramsar sites) and Rewalsar lake and, Chandertal lake have been declared as the lakes of National Importance.

12.7. Waterfalls of Himachal Pradesh

i. Satdhara waterfall near Panjpulla is in district Chamba
ii. Rahalla waterfall is in district Kullu
iii. Chadwick waterfall is in district Shimla (Summer Hill)
iv. Kalika waterfall is in district Chamba
v. Dhanchho waterfall is in district Chamba(Bharmour)
vi. Bhagsunath waterfall is in Dharmashala (McLeodganj)
vii. Sissu waterfall is in Lahaul
viii. Bundla waterfall is in district Kangra (Palampur)
ix. Palani waterfall is in district Kullu
x. Jogini waterfall is in district Mandi
xi. Chobuwaterfall is in district Kangra (Baijnath)

12.8.Kundsof Himachal Pradesh

I. VyasKund,Nehru Kund (Manali) (named so because JawaharLal Nehru used to love it), VashishtaKund(Manali) Kullu
ii. AchharKundKangra (Bhawan)
iii. KurukshetraKund, Chakra Kund, Rama Kund, SitaKund,RukmaniKundBilaspur
iv. KopraKund (Nadaun) Hamirpur
v. KalikaKund , GauriKundMehal Nag (Churah valley),Dain Kund, Chamba
vi. Lunani and SalolKund(discovered by Capt. A.Coleman),BaijnathKund(Palam valley) Kangra
vii. Guru Kund (Nalagarh) Solan
viii. SarKund is located near RohtangPass

ix. GauriKund near Mani Mahesh where women take a holy dip. it is said that Goddess Parvati used to bath in this Kund
x. Dain Kund affords a beautiful view of the three rivers Ravi, Beas,Chenab on a clear day

12.9 Hot Water Springs:

There are plenty of resources of hot water springs in Himachal Pradesh.

1. Kullu District:
- Manikarn Spring
- Kasol Spring
- PulgaSpring
- Khirganga Spring
- Vashisht Spring
- Kalath Spring

2. Shimla District: Jeori Spring
3. Mandi District: Tattapani Spring
4. Kangra District:

- Salol Spring
- Tira Spring

5. Solan District: Jaoni Spring
6. Kinnaur District: Changrizang Spring
7. Sirmaur District: Shivapuri Spring
8. Chamba District:
- Nagini Spring
- TilmiliSpring

I. Manikaran located in Parvati valley and bath in the water of this spring is considered to be useful for curing pneumonia, gout, rheumatism, muscular pains and bronchitis quite rapidly.

ii. According to a legend, Tattapani hot water springs came into being as saintissuesJamdagini dug them out to entertain his guest King.

iii. Tilmili is the name of that large natural spring at village Dharwas 9 km. from Pangi, from where water used to be sent to the Raja of Chamba.

12.10 Ground Water Resources:

Groundwater is a priceless resource lying in the widest range of hydrogeologic settings beneath most of the Earth's land surface. Substantial/many fold increase in groundwater withdrawals have led to water scarcity in almost every country of the world. Groundwater resource, although replenishable, is not inexhaustible. The vulnerability of groundwater resource to overuse and water quality degradation was not widely understood until recently. In future much attention needs to be paid to water quality preservation and conservation of the resource as its development. Groundwater resources can be developed economically without damage to aquifers through either over pumping or contamination.

In India, groundwater is a major source of water and more than 85 per cent water supply for domestic use in rural area, 50 per cent water for urban and industrial areas and 55 per cent irrigation water requirement are being met from groundwater. During the past two decades the water level in several part of the country has been falling rapidly due to increasing demand placed on it and resulted in over exploitation of this resource. There are areas where groundwater development has reached to over exploited and critical stages in the

country as per Dynamic Ground Water Resource Estimation (DGWRE) carried out jointly by Central Ground Water Board (CGWB) and respective State Ground Water Departments, based on the methodology recommended by Ground Water Estimation Committee-1997 (GEC-97) which is now updated/modified as GEC-2015. The estimation of ground water resources of the state as on March 2017 based on GEC-2015 guidelines is under process.

In India about 250 km3 of ground water is extracted against replacement of only 150 km3. This has resulted in sharp decline of water table. If this trend is not arrested through controlled withdrawal in harmony with annual recharge, backed by strict regulatory mechanism, groundwater pumping will become costly and there will be deterioration of earth's environment.

The unconsolidated sediments, occurring in the inter-montane valleys and in the sub-montane tracts in Himachal Pradesh constitute the principal ground water reservoirs. The annual replenishable ground-water resource is estimated as 0.43 BCM, while the net annual ground-water availability as 0.39 BCM. Around 1,200 km2 valley areas in the state (Una, Paonta, Nalagarh, Nurpur and Indora, and Balh valley) have ground-water potential for irrigation, with average annual recharge of around 360 million m3. According to Ground Water Board Report, ground-water level has shown decline in parts of Kangra, Kullu, Mandi, Sirmaur, Solan, Una by more than 20 cm per year (1995-2004).

The State has a total replenishable groundwater reserve of 0.0366 hectare metres (ha m) per year and a net draft of 0.0053 ha m per year. In an effort to provide safe drinking water, a total of 37265hand pumps has been installed in the State.

District-wise water sources

District	Ground water	Surface water	Rain water	Traditional source	Other conventional sources	Total
Bilaspur	827	786	0	461	0	2074
Chamba	1717	2433	3	2598	836	7587
Hamirpur	1057	485	0	231	1	1774
Kangra	1602	1317	11	1369	466	4765
Kinnaur	76	217	0	24	2	319
Kullu	0	3392	0	0	0	3392
Lahaul & Spiti	1	290	0	57	0	348
Mandi	833	3924	0	1483	840	7080
Shimla	233	3917	5	2518	9	6682
Sirmour	644	2249	0	535	9	3437
Solan	344	1090	0	1215	316	2965
Una	832	123	1	21	116	1093
Himachal Pradesh	8186	20,223	20	10,512	2595	41536

[Source: Directory of Water Resources in Himachal Pradesh, State Centre on Climate Change. H.P. State Council for Science Technology and Environment, Shimla (HP)]

12.11 Ground Water Availability

1. Total replenishable ground water sources 0.03660 ha m yr. 2.Provision for domestic, industrial and other areas 0.00731 ha m yr. 3.Available groundwater resources for irrigation in net terms 0.02929 ha m yr. 4.Balance groundwater resources for future use in net terms 0.02399 ha m yr. 5.Level of groundwater development18.1%

12.12 Issues:

(i) **Problems with Existing Rural Water Supply Schemes in H.P.:**
Spring sources often have insufficient yield or are contaminated. Since the sub-surface water movement is rather fast in hill areas, it is common for springs originating in the upper slopes to disappear and then reappear as down slope springs. Perennial springs are not found in the Shivalik due to the low water-holding capacity of rock formations. Considerable numbers of Shivalik villages are fed by a pumped system which could provide water up to 100 villages. Many schemes were commissioned without sufficient investigation regarding source sustainability. Available sources were used with little planning regarding the possible growth of upstream water demand. Many irrigation schemes (diversion channel) have been commissioned in H.P. which reduce the downstream flows, especially during the lean season. Most HP village comprise several habitations often with distances of more than 2 kms from each other. In most cases, only the main habitation, is provisioned – the rest manage with little supply or depend on limited traditional sources.

People report a requirement of about 150-200 litres per family. If a reliable supply is assured many households are willing to pay for water. Exposure to urban life style and the convenience of household piped water supply has led to increased aspirations for private water connections in many of the villages.
n is reported in about 10-15% hand pumps of the state (Kangra, Hamirpur, Bilaspur and Sarkaghat area).

(ii) **Wastage and Shortage:**
Vegetable patch near public tap and household holding irrigates it with tap water supply , whereas the next downstream village remains starved of even their basic requirement.

(iii) **Condition of Infrastructure:**
Dedicated electricity line for distributed pumping stations does not exist. At places with high head, 2-3 stages pumping required. Failure of any of them cripples the system. Pipe breakage is quite common during the rainy season.

(iv) **Supply Augmentation Arrangements:**
Many sources have not been able to supply sufficient water due to:
- Competing upstream use for agriculture
- Drying up of source
- Catchment degradation (especially in the Shivalik region) Lack of funds for source augmentation is a major constraint. Demand side management has not been attempted so far.

(v) **Water Quality:**
Nearly all traditional sources are contaminated due to unhygienic methods of handling water. Slaked lime is used to settle water in Khatris, but its efficiency in dealing with pathogens is limited due to continuous infiltration of contaminated water. Khatris water has very low turbidity due to long residence time (often up to 6 months) without any light (hence no algal growth) and it is cool. Rural residents often consider clean and cool water safe and vouch for the purity of Khatris water which is used for almost all domestic purposes. Excess iron is reported in about 10-15% hand pumps of the state (Kangra, Hamirpur, Bilaspur and Sarkaghat area).

(vi) **Implementation and Operational Modalities:**
Survey and design of small and medium RWS is taken up by IPH itself and actual work is done often by subcontracting.

(vii) **Vulnerable Section:**
The limited prosperity of the region is based on its labour market linkage with the outside world. A large proportion of the men folk, especially in Shivaliks, either work in the armed forces or are employed outside. Households that do not have a working member outside tend to be poorer.

(viii) **Situation of Women:**
The brunt of water scarcity is borne by the poorer households, especially by women. In many areas of lesser and Shivalik Himalayas, the men migrate to the plains in search of jobs and women are the de facto heads of the households. The entire burden of maintaining the house, agriculture, livestock rearing, fetching water and fuel, and other domestic responsibilities lie with the women. Though women perform most domestic and agricultural functions, especially in families with high male migration, traditional barriers in their work sphere remain high, enforcing their lower status and dependence on the men folk. A typical example is restriction on ploughing the land, forcing women agriculturists to pay men. In the dispersed nature of the settlements, community structure is weak. The task of collection and transportation of water is left entirely to women.

(ix) **Sanitation:**
In small dispersed settlements sanitation problems are not severe. Furthermore, with the fairly rapid movement of groundwater in the hill terrains, many of the traditional sources especially downstream of the settlement are likely to get contaminated by the soak pits. Lack of land in the dense settlements especially in the hands of the poor, is another constraint for sanitary provision. There is thus a desperate need for an integrated approach to water supply and sanitation.

(x) **Irrigation Water Supply Measurement:**
The distribution of water for irrigation schemes such as kuhals, small canals should be done on a volumetric basis instead of surface area method through water users committees/associations.

(xi) **Judicious Use of Potable Water:**
Treated potable water may not be allowed to be used either in the construction activity, sanitary applications, irrigation and other such purposes as the cost of treatment is very high.

(xii) **Neglect of Traditional Water Resources:**

Although there are many traditional water resources in the state but they are neglected because of the govt. supply schemes, if they are properly managed on one hand they will help in augmenting the water supply schemes and on other hand they will remain in healthy condition.

(xiii) **Community Participation in Local Infrastructural Development:**

IPH is the sole agency for commissioning and maintaining rural water supply systems throughout the state. There are district level programmes like Vikas Mein Jan Sahayog (people's contribution towards development) in which communities or individuals contribute about 25 percent of the amount for infrastructure and rest is contributed by the government. However, the programme has not elicited a favourable response from communities.

(xiv) **Community Participation in Rural Water Supply and Sanitation:**
The PRIs are now provided with some funds for local works, but they are yet to get funds for the management

of water supply schemes. The PRIs receive funds under various centrally assisted schemes such as the Jawahar Rozgar Yojana (JRY). Since the settlements are dispersed in many areas, each settlement considers itself a community. Except in representation in the panchayat, there are very few activities that create strong community bonds. Activities like agriculture that need collective labour, have declined. These villages are like urban areas with each household having its own priority and very little participation in the programme. Mahila Mandal is present in most of villages but they are not formed by the initiatives of the community. Instead, the DRDA and other government department for delivery of their scheme constitute them. There are few NGOs working especially for women issues or water supply and sanitation. Rural people in Himachal are fairly individualistic. Khatris, for instance, are almost always owned by the individual households and investments at community level are limited

(xv) **Community Priorities:**

Roads and water supply are reported as the most common priorities. Traditional mountain agriculture is unable to provide sufficient incomes for the rural youth, except in areas where the cash crop has become popular. Education is another major concern but is accorded lower priority in cases where water scarcity is an issue. Since the government has the responsibility for providing water supply, community initiatives are absent, even in the areas of severe scarcity. People mostly try to provide for their household needs rather than rejuvenating their traditional sources.

(xvi) **Sector Specific Policy Environment:**

Under difficult terrain and dispersed habitation, managing a water supply can become very expensive if sufficient social development input is not provided. This is one of the main problems now facing the rural water supply scheme in the state. With current level of reliability in water supply it may be difficult to realize the full tari□s. Government has so far not taken up any demand side management or refurbishing of traditional systems. It is advisable to delink village level distribution from IPH and hand over distribution from sectoral tank/village tank onwards to village Panchayats. It would be a radical shift in policy from the current reliance on IPH alone to enabling the PRIs. Revenue collection can also be left to PRI. Large RWS systems serving many villages currently su□er from high differential availability across villages. This can be dealt with by creating multilevel management systems with user group/village representatives in decision making bodies regarding water sharing arrangement.

(xvii) **Maintenance of Installed Structures:**

Generally, it has been observed that many of the irrigation/drinking water supply schemes where huge investment had been made go defunct because of many reasons and thereafter no e□ort is made for their repair and maintenance.

(xviii) **Water-Related Constraints:**

Shortage, waste and over-consumption of water resources exist simultaneously. Some water-related constraints are listed below:

- Natural water resources are shrinking. Precipitation (snow and rainfall) due to climate change (global warming) is becoming erratic. Glaciers are melting. Rainfall patterns (extent, frequency and intensity) are changing. While annual rainfall may be as high as 2000 or 2500 mm, water availability can be a major problem soon after the monsoons for sowing of crops.
- Traditional wisdom of water management is dying. Before colonial rule in India, water resources were developed and managed either by the regional rulers or by village communities. Their wisdom and

experience generated site-specific water harvesting technologies (ITK), several of which are still in use. However, British took over the water resources probably for increasing their revenues, and the legacy continued after independence. Due to lack of involvement of local communities and stakeholders, the indigenous system of collecting rainwater is getting obsolete.

- Perennial water springs are drying; they have become victims of deforestation, mining, road construction, building construction etc., and any technology to harvest water from these springs fails to provide water during spring and summer months.
- Demand for water is increasing due to increasing population and changing life styles.
- Pollution of water bodies is increasing due to increased human activities
- Development in industrial sector is giving increased competition to agriculture sector for fresh water resources.
- Easily available sources of water have already been tapped.
- Kuhls (gravity streams), the main source of irrigation, are not optimally maintained. They are prone to damage by landslides, construction work, house-hold e□uents including polythene bags and negligence.
- Majority of agriculture is rainfed. The gross irrigation potential of the State is estimated to be 3.35 lakh ha. The topography and geo-hydrological conditions in the state prohibit canal and tube-well irrigation. Rains are concentrated in three months only (July-September). On the other hand, heavy rains during rainy season regularly cause havoc due to floods. Thus, water management in hills has to simultaneously address issues of strengthening water resources, drought management and flood control.
- The scope of expanding water supplies in hills through development of new water resources is limited, as suitable sites are not many, developmental costs are prohibitive, environmental concerns are too strong, and social problems are disturbing.

(xix) Other Unattended Issues:

- There is a growing perception that water cannot be indefinitely provided as a service however there is still no clear-cut pricing option available.
- Differences over modalities of fixing the price of water arise because water is both treated as basic need or service and a commodity.
- Besides PRI, water committees are an alternative institutional mechanism being suggested though relationship between them and PRI bodies is not yet clearly articulated.
- Participation of NGOs might be limited on account of their technical deficiencies while large-scale private participation is unlikely until new policies are firmly in place.

(xx) **Conclusion and Suggestion:**

1. Water storage at house level to be increased as hills hydrogeological system has very little capacity to store water.
2. Delivery of water sources should be based on the felt need of the people and their willingness to operate and maintain the system by paying water charges.
3. Formation of separate user group for each source is more e□ective
4. Awareness generation programme for making judicious use of water is essential before executing water related activities and should be linked with incentive – disincentive schemes to practise water conservation.
5. Local institutions - PRIs, Mahila Mandals (Women's group), Yuvak Mandal (youth club) have to be enabled to manage water equitably.
6. Local village level animator to be developed for future management.

12.13. Pressures: Increasing demand for quality potable water, irrigation, industrial & other household uses.

(I) Water Demand

Water demand in urban areas is generally the double the requirement of rural populace. The per capita requirement for rural area is projected at 70 lpcdwhereas for urban area 140 lpcd. By 2021, the urban areas of the State will require 150.49 mld of water out of which over 1/3 will be required by Shimla alone. The demand for the water in rural areas is much higher than in urban areas as majority of population lives in rural areas.

Water Demand in Himachal Pradesh (mld)

District/State	1999	2001	2011	2021				
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Bilaspur	2.69	22.84	2.90	23.76	4.18	28.90	6.04	35.06
Chamba	4.70	30.18	5.03	31.5	7.06	38.96	9.92	48.12
Hamirpur	3.63	27.39	3.90	28.23	5.58	32.75	7.99	37.85
Kangra	8.30	90.9	8.63	94.44	10.46	114.43	12.67	138.37
Kinnaur	-	5.75	-	5.96	-	7.13	-	8.53
Kullu	2.99	23.61	3.13	24.71	3.88	31	4.82	38.89
Lahaul&Spiti	-	2.47	-	2.55	-	2.96	-	3.46
Mandi	7.64	59.57	7.89	62.1	9.31	76.45	10.98	94.12
Shimla	21.75	37.7	23.81	38.47	37.45	41.6	58.91	42.52
Sirmaur	6.05	28.14	6.48	29.3	9.20	35.81	13.06	43.65
Solan	7.63	27.19	8.22	29.15	11.92	36.12	17.27	44.57
Una	4.83	27.86	5.10	28.84	7.71	34.33	8.83	40.82
Himachal Pradesh	**70.21**	**384.32**	**75.04**	**399.01**	**105.76**	**480.44**	**150.49**	**575.97**

Source: Himachal Pradesh Human Development Report

(ii) Drinking

Needs: The drinking water needs of the people and livestock have so far been suitably met. However, added provisions are to be planned so that the domestic population growth and the tourist influx could be provided safe and adequate drinking water. Demand of water for industrial use has so far largely been concentrated in or near the towns. However, the domestic and industrial water demand in rural areas is expected to increase sharply as the development programmes improve economic conditions and influence shift in consumption patterns. With the coming in force of National Rural Drinking Water Supply guidelines w.e.f. 1.4.2009 and subsequent realignment /mapping of habitations there are 53604 habitations in the State. The criteria of coverage of habitations have been changed to population coverage to ensure water security at house-hold level. During the year 2013-14 the Government of India

has increased the rate of water supply level for fully covered habitations from 40 lpcd to 55 lpcd and there were total 53604 habitations. As on 01.04.2018 out of total 53604 habitations, 35193 are fully covered and 18411 habitations have inadequate drinking water.

(iii) **Agro-Hort Requirements:**

Developmental activities in the State have inevitably led to increase in demand for water for diverse purposes: domestic, commercial and industrial, irrigation, hydro-power generation, recreation, etc. So far, the major consumptive use of water in the State has been for irrigation. The gross irrigation potential of the State is estimated to be 3.35 lakh ha. While the irrigation potential created has reached 2.72 lakh ha. by March, 2018. Production of food grains in H.P. has increased from around 0.7 million tonnes in the year 1966-67 to about 1.53 million tonnes in the year 2017-18. The irrigation needs to be expanded to achieve targeted food grain yield of around 2.4 million tonnes by the year 2025 to feed the projected population of 92.25 lakh. The production of fruits andvegetables has increased from 0.05 million tonnes (1966-67) each to 0.56and 1.69milliontonnes, respectively (2017-18). There is an apparent need to cover the balance area of 1.25 lakh ha., through irrigation schemes so that the productivity of the land area of the State improves, food grain output increases to ultimately reflect on the economic prosperity of the State.

(iv) **Hydro Power Generation**

The preliminary hydrological, topographical and geological investigations indicate that Himachal has a potential of 27436 MW hydropower potentials, the basin wise estimates of which are as under:

Name of the River Basin	Assessed Potential (MW)
Yamuna	840
Satluj	13,332
Beas	5,995
Ravi	3,237
Chenab	4032
Total	27,436

Since 6,672 MW of the total assessed hydro-power potentials has already been achieved and another 5,986 MW is under execution, allotment of about 7,735 MW has also been done.

(v) **Sewage Discharges to the Rivers and Streams:**

It is a well-known fact that sewage discharges are being dumped in to the nearby rivers or streams in the absence of sewage treatment plants. It is, therefore, pertinent to look into this problem quantitatively as well as qualitatively.

(vi) **Over Exploitation of Tapped Water Sources:**

The resource potential of tae exiting supply schemesremains the same, but the demands have increased manifold and there are very few alternative arrangements.

(vii) **Non - Revival of Defunct Supply Systems:**

There are reports that many supply schemes have become defunct due to various causes and there are no financial provisions for their revival.

(viii) **Non - Realistic Vision for Project Demands:**

On many occasions it has been observed that the projected demands were not based on the actual data and hence they become non-functional because of the inadequacy.

(ix) **Leakages in the Public Distribution System:**

There has been a general consensus that there are huge leakages in the installed systems.

(x) Misuse of Community Water Supplies and Infrastructures in Efficient Use of the Irrigation Water Supplies:

(xi) Poor Monitoring of Industrial Supplies/Applications There is no monitoring system for the monitoring of the water intake and use in industrial applications.

(xii) Resource use without defining carrying capacity/potential

12.14. Impacts:

(I) **Shortages of Potable Water:**
There is a need to assess the available water resources and their exploitation on a sustainable basis as this has direct correlation with the growth rate of the population. The demands for water, especially for drinking purposes have a significant impact and this is likely to strain available water resources. The demand for urban areas of the state up to 2021 AD is projected at 150.49 million litres/day. The demand for water in the rural areas is much higher, i.e. 575.97 million litres/day by 2021 AD which is 3.8 times the demand in the urban areas.

(ii) **Non Judicious Use of Treated Water:**
The treated water being costlier, should not be allowed for other uses such as watering the kitchen gardens, sanitary purposes and for the construction activities.

(iii) **Melting of Glaciers**
Glaciers in the Himalaya have been reported to be in the retreating phase. Melting of Himalayan glaciers has doubled since the start of the 21st century due to rising temperatures, losing over a vertical foot and half of ice each year and potentially threatening water supply for hundreds of millions of people in countries including India. The climate change is eating the Himalayan glaciers. Retreating glaciers, depleting snow cover and Glacial Lake Outburst Floods (GLOFs) are of immediate concern in the mountain environment as GLOFs can have a devastating impact on the hydro power, water sources, people, livestock, forests, farms and infrastructure. Decreases in snow accumulation and glacial retreat might lead to acute water shortages in the future. Some of the important research findings related to impact of climate change on glaciers are as under:

- An overall reduction in glacier area from 2077 km2 to 1628 km2 from 1962-2001 in Chenab, Parbati and Baspa Basins. An overall deglaciation of 21 per cent of total area in these basins

- About 10 per cent deglaciation is observed in Spiti Basin between 2001-2007
- Prominent glaciers as studied by Geological Survey of India (GSI) in Himachal Pradesh showed:

- ChotaSigri 6.81 m/y retreat between 1962-95
- Bara Sigri 29.78 m/y between 1906-1957
- Trilokinathas 17.86 m/y between 1968-1996
- Beas Kund as 18.8 m/y between 1963-2003
- Manimahesh as 29.1 m/y between 1968-2005

(iv) **Degradation in the Water Quality:**

Surface and sub-surface water pollution is on the rise and can become a source of conflict between the upstream and downstream users. Pollution has an inverse relationship with the water quantity available for specific uses and with the rise in the pollution levels, water loses its economic value. Good quality water (Class A) that is used directly for drinking purposes loses its value once it becomes polluted, similarly water used for bathing cannot be used after a certain level of pollution contaminates it. Industrial and sewage e□uents can be a great hazard. The treatment process for making water pollution free is rather costly which adds to the cost.

(v) **Depletion of Groundwater Table:**
In the lower regions of the state depletion in the groundwater table has been reported.

(vi) **Progressive Decrease in Potential Flow to Hydro-power Generation:**
Progressive decrease in the flow to the hydro-power has been noticed in the recent years and due to this

factor uneven generation of power has been noticed.

(vii) **Impact on Agriculture and Horticulture:**

About 22.6 per cent of the agriculture and horticulture in the state is irrigated and rest of the area is mainly dependent on the rains which in recent years are abnormal.

12.15 Responses:

Himachal Pradesh is endowed with a rich and vast diversity of natural resources, water being one of them. Its development and management plays a vital role in agricultural production. Irrigation and Public Health department envisages Integrated Water Management for poverty reduction, environmental sustenance and sustainable economic development. Water is the elixir of life. As a scarce and precious resource, its usage has to be planned along with conservation and management measures on an integrated and environmentally sound basis. Keeping this in view and the socio-economic needs of the State, a water policy is being drafted so that safe and portable drinking water supply to all and community participation in conservation of water resources is ensured.

(a) **Drinking Water**

Water management is an important issue. Provision of safe drinking water has been the priority of the State Government. All the census villages in the state have been provided with drinking water facilities by March 1994. During the year 2013-14 the government of India has increased the rate of water supply level for fully covered habitations from 40 lpcd to 55 lpcd and there were total 53,604 habitations. As on 31.03.2018 out of total 53,604 habitations, 35,193 habitations have 100 per cent population coverage and 18,411 habitations with population coverage >0 and <100 are identified having inadequate drinking water.

During the year 2017-18, against the target of covering 730 habitations in which 363 habitations under state sector and 367 habitations under central sector with an outlay of Rs. 226.10 crores and Rs. 101.86 crores, respectively. Up to 31.03.2018, total 873 habitations (859 under Center sector + 14 habitations under state sector) have been covered.

(I) **Hand Pump Programme:**

Hand pumps usually do not provide coverage of a habitation, (due to limitation of rigs operating along road-sides only) they are supplementing the existing piped water supply and have been installed in drought prone areas, areas of acute water scarcity and other problematic areas and the areas where tankers have been deployed in recent years at huge financial cost. Hand pump programme has been great success in mitigating the people's misery due to shortage of drinking water in di□erent pockets of drought prone and acute water scarcity areas. The programme was started during 1991-92 and during the year 2017-18, 1,233 hand pumps have been installed upto December, 2017. A total of 37265 hand pumps have been installed in the Pradesh upto March-2019.

District-wise Status of Installation of Tube Wells and Hand Pumps in the State

Sr. No.	Name of District	No. of tube wells constructed	No. of hand pumps installed	Total
1	Kangra	624	10306	10930
2	Mandi	123	4643	4766
3	Sirmour	172	3400	3572
4	Solan	286	3254	3540
5	Una	827	2602	3429
6	Hamirpur	04	3735	3739
7	Kullu	09	1295	1304
8	Bilaspur	08	2974	2982
9	Chamba	--	1996	1996
10	Shimla	12	2398	2410
11	Kinnaur	--	207	207
12	Lahual&Spiti	--	455	455
Total		**2065**	**37265**	**39330**

[Source: Irrigation and Public Health Department(HP),htp://iph.hp.gov.in]

(ii) **Urban Water Supply schemes:**

Water Supply system of towns in H.P. is quite old and there is an urgent need to carry out the rehabilitation/augmentation of these old schemes. There are total 54 Urban Local Bodies in Himachal Pradesh; the Water Supply Schemes for these ULBs are under IPH Department. The Water Supply Schemes for 6 Cantonment areas (Yol, Bakloh, Kasauli, Sabhatu, Dagshai and Dalhousie) are maintained by Cantonment Boards, in Parwanoo by H.P. Housing Board and in Palampur by Municipal Committee, Palampur. It is important to mention that in Shimla and Solan

the distribution system is being maintained by the respective Urban Local Bodies.

The Water Supply Schemes for 38 Town/ULBs are completed and the work for Augmentation of WSS in 11 Towns/ULBs is in propgress and DPR for WSS of five ULBs namly Karsog, Nerchowk, Baijnath , Jwali, & Taliwal is under process.

Augmentation of water supply schemes of 40 towns have been completed. These towns are Shree Naina Devi Jee, Nadaun, Una, Chowari, Kangra, Jawalamukhi, Rohru, Santokhgarh, Mehatpur, Dehra, Chamba, Rewalsar, Arki, Daulatpur, Jogindernagar, , Kotkhai, Ghumarwin, Chopal, Suni, Palampur, Gagret, Nagrota, Nalagarh, Narkanda,Nurpur, Paonta,Theog, Dalhousie, Talai, Rajgarh, Bhota,Solan,Bhunter,Jubbal and Dharamshala,Bilaspur, Shimla, Baddi,Sundernagar.

(iii) Water Supply Scheme for Shimla Town

Water supply scheme for Shimla town was constructed in the year 1875. Thereafter, its augmentation was

done in 1889, 1914, 1923, 1974,1982,1992 and 2008. On an average 55 MLD Water is supplied to Shimla town.

(b) **Rural Water Supply:**

Social Accountability Mechanism (SAM) in Rural Water Supply has been pilot tested in the 27 panchayats of Narkanda block and Lambagoan block of Shimla and Kangra districts respectively by Irrigation and Public Health Department (IPH). Under Rural Water Supply provision of safe drinking water has been the top priority of the State Government. As per status of March 2018, there are total 53604 habitations in the State out of which 35193 habitations have been fully covered and balance 18411 habitations have been partially covered with safe drinking water facility. Also, the Government has an ongoing programme of providing hand pumps with focus on regions facing scarcity of water during summer season. Overall, 37,265 hand pumps have been installed up to March, 2019. About 9516Water Supply Schemes under Rural Water Supply have been completed in the State. Out of these, 2391 are lift, 404 tube wells and 6,721 are gravity schemes.

(c) **Irrigation Sector:**

Out of the total geographical area of 55.67 lakh hectare of State, only 5.83 lakh hectare is the net area sown. It is estimated that ultimate irrigation potential of the State is approximately 3.35 lakh hectare. Out of this, 0.50 lakh hectare can be brought under irrigation through major and medium irrigation projects and balance 2.85 lakh hectare of area can be provided irrigation through minor irrigation schemes of di□erent agencies. About 2, 72,077 hectares has been brought under irrigation till 31.03.2019. Financial provision has been made for minor irrigation schemes under major and medium irrigation projects. There are 2669 completed irrigation schemes in the State out of which medium irrigation 5, FIS 1163, LIS 664 and tubewell 837.

Completed Irrigation Schemes

District	Circle	Medium	FIS	LIS	Tubewell	Total
Chamba	Chamba	0	160	19	9	**188**
Kangra	Dharamsala	0	60	104	0	**164**
	Nurpur	0	2	33	225	**260**
Una	Una	2	0	59	459	**520**
Hamirpur	Hamirpur	0	2	64	0	**66**
Bilaspur	Bilaspur	1	11	72	0	**84**
Mandi	Sundernagar	1	156	80	19	**256**
	Hamirpur	0	65	16	1	**82**
Kullu	Kullu	0	48	19	0	**67**
LahaulSpiti	Kullu	0	83	2	0	**85**
	ReckongPeo	0	97	2	0	**99**
Shimla	Shimla9	0	71	34	0	**105**
	Rohroo	0	88	14	0	**102**
	ReckongPeo	0	25	3	0	**28**
	WS&SShimla3	0	0	0	0	**0**
Solan	Shimla9	0	45	8	0	**53**
	Nahan	0	39	60	105	**204**
Sirmour	Nahan	1	116	75	19	**211**
Kinnaur	ReckongPeo	0	95	0	0	**95**
Total		**5**	**1163**	**664**	**837**	**2669**

[Source: Irrigation and Public Health Department (HP),htp://iph.hp.gov.in]

Major and Medium Irrigation Projects:

The only major irrigation project in the State is Shahnehar Project in Kangra District. The project has been completed and irrigation facility to 15,287 hectare land is being provided. The Command Area Development (CAD) work is in progress and out of 15,287 hectare, 9,933.50 hectare land has been brought under CAD activities upto November, 2018. Under Medium Irrigation Projects, Changer area Bilaspur 2,350 hectare, Sidhatha Kangra, 3,150 hectare and Balh Valley Left Bank 2,780 hectare has been completed. The work of CAD Sidhatha is in progress and 2,635.10 hectare land has been brought under CAD activities upto November, 2018. At present work of Medium Irrigation Project Phinna Singh (CCA 4,025 hectare) and the Nadaun area in District Hamirpur (CCA 2,980 hectare) is in progress. There is a target of 1000 hectare area for the year 2018-19 under major and medium irrigation against which 300 hectare achievement reported upto November, 2018 and an amount of Rs 25.67 crore has been incurred out of due provision of Rs 127.00 crore.

Minor Irrigation Projects:

During the year 2018-19, there was a budget provision of Rs. 250.36 crore in the State sector to provide irrigation facilities to an area of 3,000 hectare against which upto November, 2018 an area of 1,880.18 hectare has been covered with an expenditure of Rs. 58.31 crore.

Command Area Development.

During the year 2018-19, a provision of Rs 130.00 crore has been provided by the Government of Himachal Pradesh which includes Rs 32.00 crore for HIMCAD activities in completed minor irrigation schemes to bridge the gap of potential created and utilized and rest of amount is for major/medium irrigation and minor irrigation schemes ongoing in the State including Central share. There is a physical target of 3000 hectare CCA for providing CAD activities, out of which 983.60 hectare has been achieved up to November, 2018 with an expenditure of Rs 11.18 crore. CAD to major irrigation Shahnehar and medium irrigation Sidhatha projects were included for funding under Command Area Development Water Management (CADWM)programme of Government of India. The Government of India has launched the ISBIG scheme for providing CAD activities in the completed/ongoing irrigation projects during 2016-17 and accordingly the 6 projects (Shahnehar major irrigation project, Sidhatha Changer, Nadaun Area, Ballah valley left bank medium irrigation projects, and 23 minor irrigation schemes) of CADWM have been considered.

Completed Major and Medium Irrigation Projects

Sr. No.	Name of Project	CCA(ha)
A	**Major Irrigation Project**	
1.	Shahnehar Project	15287
B	**Medium Irrigation Project**	
1.	Giri Medium irrigation Project district Sirmour	5362
2.	Lift Irrigation Project (Phase-I) Bhabour Sahib in district Una	923
3.	Balh Valley Medium Irrigation Project district Mandi	2410
4.	Lift Irrigation Project (Ph-II) Bhabour Sahib district Una	2640
5.	Anandpur Hydel Channel Project (Changer Area) in district Bilaspur	2350
6.	MIP Sidhata in district Kangra	3150
7.	MIP Balh Valley (Left bank) in district Mandi	2780

Ongoing Medium Irrigation Projects

Sr. No.	Name of Project	CCA (ha)
1.	MIP Phina Singh in Nurpur, district Kangra	4025
2.	MIP Nadaun in district Hamirpur	2980
	Total	**7005**

(d) E-Flows: Himachal Pradesh is the only state to have mandated the release and maintenance of 15 per cent minimum lean flows downstream of diversion structure to maintain riverine ecology.

(e) Disposal of Sewage-Adopting environmental friendly options: As many as 51 sewage treatment plants with cumulative treatment capacity of 100.03 mld have been commissioned and provided. In all, 10 municipal solid waste processing facilities are being set up at di□erent towns for better disposal and management of sewage and municipal solid wastes in the State.

(f) Monitoring of Water Quality: Surface water quality monitoring is conducted four times a year for 189 locations selected on major rivers viz. Satluj, Beas, Ravi, Yamuna, Parvati, Sirsa, Markanda & Sukhna and their tributaries in the State. These locations include 116 points on major rivers and its tributaries, 18 locations in major industrial towns for the monitoring of ground water and 55 locations on hydel projects.

(g) Rain Water Harvesting: Provision of rain water harvesting structure has been made mandatory as per provision in Section 107 of H.P. Municipal Act, 1994 in all the new buildings constructed within the jurisdiction of MCs/Nagar Panchayats. All commercial and institutional buildings, tourist and industrial complexes, hotels, etc. existing or coming up are being pursued to have rain water storage facilities commensurate with the size of roof area. No objection certificates, required under di□erent statutes, will not be issued to the owners of the buildings- unless they produce satisfactory proof of compliance of the new law. Toilet flush systems will have to be connected with the rainwater storage tank.

(h) Flood Protection: The flood prone area in the State is 2.31 lakh ha. The government is making strenuous e□orts to protect private properties and culturable land by providing emergent flood protection measures in the shape of embankments, spurs and wire crates. During the year 2017-18 a sum of 63.58 crore has been provided to protect 2,500 hectare of land. An amount of Rs 10.98 crore upto December, 2017 has been spent to protect an area of 159.21 hectare. Upto march 2019, the department of IP&H was able to protect an area of 24920.2. ha from the fury of floods. The works for Swan Phase-IV and Channelization of Chhochh Khad is in progress.

(I) Efforts in Rainwater Conservation by Irrigation and Public Health Department
Conservation and Management of water resources with rising population and rapidly expanding demand of water is top priority issue for the state. The excessive use of ground water is reducing both the availability as well as quality of the water. To tackle this issue it needs a holistic thinking and that is where the role of Rain Water Harvesting comes in to play. The government of Himachal Pradesh in line with the provisions of National Water Policy has framed a State Water Policy in the year 2013 to provide adequate and safe drinking water to the entire population of the State and assured irrigation

to maximum feasible cultivated area with people's participation in managing and conserving this critical natural resource.

The State has promoted water conservation initiatives at village level with community participation to adopt practices of rainwater harvesting and artificial recharge. The details of the outcomes of some of the measures are as under:

(I) Check dam on Salasi Khad, district Hamirpur:

- Dam constructed for sustaining Lift Water Supply Scheme (LWSS) Chowki Chhabot with storage capacity of 10000 cum
- Lean period water availability increased from 3,00,000 lpd to 7,00,000 lpd

(ii) Check dam on Sukrala Nallah, district Hamirpur

- Check dam constructed to sustain LWSS Sai Matwar throughout the year with storage capacity of 700 cum
- Lean period discharge has increased from 1,00,000 lpd to 3,00,000 lpd

(iii) Check dam on Dug Nallah

- Check dam constructed for augmentation of LWSSHathol and LIS Pansai by diversion of water with storage capacity of 200 cum
- Lean period availability of water for schemes increased by 20 lps
- The structure helped in maintaining the bed level of khad which was earlier getting eroded

(iv) Check dam on Tahal Khad

- Check dam constructed across Tahal khad to recharge percolation well of LWSS Dal Daloh with storage capacity 15000cum.
- Lean period discharge of this percolation well increased from 1.5 lps to more than 25 lps

(v) Check dam at Charamboo across Drug Khad

- Check dam constructed to recharge the existing percolation well with storage capacity of 700cum
- The discharge in the percolation well increased from 1.1 lps to 4.5 lps
- LWSS Charamboo is now not a□ected by extreme droughts

(vi) Check dam at LWSS Bhota

- Check dam constructed to recharge the source of water supply scheme to the town Bhota with storage capacity of 2500cum
- 6, 61,440 lpd water regularly available throughout the year to operate LWSS Bhota town and LWSS Bhota Roperi Ujhain.

(vii) Check dam at intake of LWSS Jubble Kherian

- Check dam constructed to recharge the source of water supply scheme with storage capacity of 3000cum.
- Lean period discharge increased from 13, 16,800lpd to 25,90,000 lpd during dry season

(viii) Check dam in Gowald Khad for Lift Irrigation Scheme (LIS) Maharal Baragaon

- Dam constructed to check the bed erosion and maintaining the supply level for LIS Maharal with storage capacity of 500 cum
- The dam increased availability of water for two WSS existing downstream

(ix) Check dam in Samoor Khad, district Una

- Check dam constructed for LIS for village Samoor and Sanhal from Samoor Khad (RWHS-III) in Kutlehar constituency in district Una
- Dam height-16 m, Storage capacity-0.767 MCM

(X) Check dam in Takoli Khad, district Una

- Check dam constructed for LIS for village Sohari, Barota Bhaloun, Jol, Chowki from Takoli Khad (RWHS-I & II) in Chintpurni constituency district Una
- Dam height- 11 m, Storage capacity- 0.430 MCM

(xi) Check dam in Ragehar Nallah, GP Kudail, district Kangra, capacity: 10,000 cum

(xii) Water bodies created in district Solan

(j) Sewerage Sector:

As towns in the state mostly serve as health resorts, environment improvements assume special significance particularly to avoid pollution of the rivers and other water bodies of the State. Secondly, to abolish carrying of night soil on head load and scavenging system in the country/ states, the government has given top priority to connect dry latrine system into water pour system. Hence, the sewage programme has assumed immense importance. Under this programme sewerage facilities are proposed to be provided in all towns of the state.

Ten sewerage schemes have been completed (Shimla, Palampur, Mandi, Jawalamukhi, Shri Naina

Devi Ji, Chamba, Bilaspur, Rohroo, Ghumarwin, Manali and two rural schemes (Reckong-Peo and Sarahan). The work on 20 schemes is in progress (Rampur Phase-II, Una, Solan, Sundernagar, Paonta, Sarkaghat, Kullu, Mehatpur, Santokhgarh, Arki, Dalhousie, Chowari, Jogindernagar, Bhuntar, Dharamsala, Hamirpur, Kangra, Nagrota, Jubbal and Sujanpur).

Shimla Sewerage Project- Shimla Sewerage Scheme from OPEC (10 Million Dollars)

Shimla sewerage project is being implemented with the aid of OPEC Fund for International Development Vienna. The estimated cost of the project is Rs.54.80 crore. The ratio of OPEC Fund and State Share is as under:

OPEC loan (73%)	Rs. 40 crore (10 million dollars)
State share (27%)	Rs. 14.80 crore
Total	Rs. 54.80 crore

The Shimla sewerage project was started in November, 1997and sewage treatment plants at six places are almost completed as per details given below:

Dhalli (0.76 MLD)	Completed & commissioned
North Disposal (5.80 MLD)	-do-
Summer Hill (3.93 MLD)	-do-
Sanjauli/Malyana (4.44 MLD)	-do-
Snowdon (1.35 MLD)	Completed and tested
Lalpani (19.35 MLD)	Completed and commissioning started from 26.7.04

Out of 179 kms sewer lines, 179.352 kms sewer lines have been laid in different zones of the Shimla town.

Executive Engineer, Sewerage Network, Construction Division, Shimla-5 has been authorized to sanction the sewerage connections to the buildings situated outside the Municipal Corporation limits.

Sewage Treatment Plant at Lalpani, ShimlaSewage Treatment Plant at Summer Hill, Shimla
[Source: Irrigation and Public Health Department (HP)]

12.17 Water Resource Development

It is very important to increase the efficiency of water use, explore options to augment water supply in critical areas, and ensure more effective management of water resources. Water conservation practices like in situ(through micro catchment) and ex situ(storing water in ponds, tanks, check dams and reservoirs)rainwater harvesting, including roof-top rainwater harvesting, is being practiced to increase the utilizable water resources in the State.

Appropriate Technologies for Water Resource Development and Management in Hills

Purpose	Technologies
In-situ soil moisture conservation	• Bund and terrace renovation for *in situ* soil moisture conservation on farmland • Biological barriers for *in situ* soil conservation for agricultural land • Construction low density polyethylene (LDPE) farm ponds
Provision of drinking water for humans and catle	• Spring development with improved design. (Use of moist clay with sufficient compaction as core wall has been very successful and low cost). • Construction of spring fed small storage tank. • Construction of unlined tank with good design consideration has been found more effective. • Roof-top rainwater harvesting • Lift/gravity water supply scheme • Hand pumps in lower Shiwaliks • Tube well
Provision of water for irrigation	• Construction and repair of diversion weirs with irrigation canal *(Kuhal)* along with construction of storage distribution tank wherever necessary. • Construction of sub-surface dams. • Construction of small lift irrigation scheme. • Development of mobile irrigation systems. • Installation of Hydram

12.18.Some Tips for Water Conservation:

- Dispel the conception that water is a "Free Gift of Mother Nature"
- "Water is Life" and there is no substitute of water. "Use it Wisely".
- "World Water Day" is celebrated every year on 22nd March throughout the world.Those who are born on this date should celebrate their birth day as "Water Day"to increase the awareness of people towards the importance of water in various fields of life including the environment, health, agriculture and trade.
- Try to use the concept of "Virtual Water" for determining agricultural & industrial strategies.
- Collect and use rain water for watering gardens, lawns, washing cars, etc.
- Toilets require 7 to 10 litters of water for flushing every time. Use flushing systems that allow you to control the amount of water you flush
- Every time 50-100 litters of water is needed for washing your car. Avoid doing so every day. Use bucket instead of hose pipe to wash it.
- Plant a tree. Trees help to conserve water
- Do not leave the taps running while brushing your teeth, washing dishes & clothes.
- See that there are no leaking taps. Leaking of one drop by another will fill one bucket during the night. Close the taps well after use. Close any tap you find open, even though it might be road side one.
- Take a bucket bath instead of shower bath.
- Direct the downspouts or gutters towards shrubs or trees.

- Never put the water down the drain. There may be another use for it such as watering a plant or garden.
- When you plan to clean storage tank, use water you have drained for irrigating plants.

Be aware and care for the environment. The problem is ours and not of someone else.

INDUSTRIES & ENVIRONMENT

CHAPTER-13

Industrialization plays a very important role in economic development of a nation, augmentation of the economy, balancing trade deficit and in wealth creation. Value addition through upstream and downstream integration creates direct & indirect job opportunities resulting in equitable growth and livelihood generation.

The State of Himachal Pradesh started its journey as a predominantly agrarian economy. Topographical conditions, lack of adequate connectivity and infrastructure constraints coupled with the soil and weather conditions resulted in the initial focus being on the agrarian economy. To boost Economy of the State and create adequate job opportunities are the major twin objectives of the Industrial Policy of the State. Manufacturing though has been predominant as a cottage industry, primarily for development of agrarian tools. Cottage Industries like Water Mills, Handloom, Poultry, Bamboo based home made products, tea processing have an old legacy in the State. The progressive policy driven approach of the State Government, availability of qualified labour and abundance of power availability has resulted in emergence of a number of sectors such as Pharma, Textile and Cement. Share of secondary sector in the State GDP has been increased from 7% in 1950-51 to 43% in 2018-19.

The State Government recognized the importance of Industrial Policy as an e□ective instrument to boost the confidence of investors and catalyze industrial development. Incentives to Industries were notified initially during 1971 and were revised in the year 1980, 1984, 1991, 1996, 1999 and 2004, which were amended in the year 2009, 2015 and 2017 in response to the changing scenario.

In Ease of Doing Business (EODB) ranking, the State has improved its implementation score from 65.48% to 94.13% in 2017-18 and also emerged as the fastest growing State in the EODB. In Start-up ranking 2018, the State has emerged as the leading Hill State and aspiring leader and also recognized as leader for regulatory change.

As Himachal Pradesh Industrial Investment Policy, 2019 to ensure balanced development of Industrial & Service Sector throughout the State, the State has been categorized into three categories of Areas as "A", "B" & "C". This classification has been done depending upon the location, distance from border of adjoining state, extent of industrial development and overall backwardness; resource availability and potential for employment generation. In Category "A" Areas industrially developed areas and Category “B” industrially developing Page 6 of 56 areas and in Category “C” Tribal Areas, industrially backward developmental blocks & backward panchayats are included.

13.1 Trends in Industrial Sector (Source: Economic Survey of Himachal Pradesh 19-20)

Industrial sector performance in terms of its contribution in Gross State Value Added (GVA) has slightly decreased in 2018-19 over 2017-18. The contribution of Manufacturing Sector in Gross State Value Addition (GSVA) at Current Prices is increasing every year, as it has increased from 26.69 percent in the year 2014-15 to 29.79 percent in the year 2018-19, due to State Government's initiatives such as Proactive Industrial policy, Incentives to investors, enabling Ease of Doing Business to attract Investment etc. The contribution of Mining & Quarrying Sector in Gross State value addition (GSVA) at Current Prices has increased marginally, as it has increased from 0.33 percent in the year 2014-15 to
0.53 percent in the year 2018-19, due to the reason that other sectors of the economy have been contributing more and also due to stringent action to check illegal mining by the State Govt.

To ensure sustainable industrialization in the State, highly polluting Industries are discouraged in the policy and emphasis is laid on supporting establishment on CETPs, ETPs, Hazardous Waste Treatment Plants and Green Technology in Industrial Clusters.

Approximately 49700 enterprises are operational in the State with an approx investment of 35000 cr. and gives employment to about 4,11000 people.

Our existing Industrial Policy has a provision to promote environment friendly "Thrust Sector" enterprises. The list of Thrust Sector Industries is as under:-

1. Units based directly on horticulture produce including hops and tea.
2. Mineral water botling.
3. Automobile manufacturing units including assembly units which have a minimum of 5 ancillary units substantially dependent on it.
4. Cold storage units/ chain.
5. Fruit, vegetable/ herbs/honey/spices based wineries.
6. Production of Ciders/ale/liqueurs.
7. Sericulture/Handlooms/Khadi Industry related manufacturing Industrial activities.
8. Electronic units including computer software and information technology except assembling units where value addition is less than 15%.
9. Floriculture.
10. Medicinal herbs and aromatic herbs etc. processing.
11. Horticulture, Maize based industries, herbal based industries and Agro Based Industries excluding those included in the negative list.
12. Food Processing Industry excluding those included in the negative list.
13. Sugar and its by-products.
14. Silk and silk products.
15. Wool and wool products.
16. Woven fabrics (Excisable garments)
17. Sports goods and articles and equipment for general physical exercise and equipment for adventure sports/activities, tourism.
18. Paper & Paper products excluding those in negative list (as per excise classification).
19. Pharma products.
20. Information & Communication Technology Industry, Computer hardware, Call Centres, I.T. Software and services.
21. Eco-tourism-Hotels, resorts in locations other than those located in the Muncipal limits/NAC/Nagar Panchayats/ Special Area Development Authority limits, as the case may be of Shimla, Dalhousie, Macleodganj and Manali.
22. Spa, entertainment/amusement parks ropeways etc.
23. Industrial gases (based on atmospheric fraction).
24. Handicrafts
25. Non-timber forest product based industries.
26. Precision Industries.

After giving a due thought and in consultation with various stake holders, the revised list of negative industries is as under:-

Negative list

1. Tobacco and tobacco products including Cigaretes and pan masala.
2. Thermal Power Plant (Coal/oil based).
3. Coal washeries/dry coal processing.
4. Tanning and dyeing extracts, tannins and their derivative, dyes, colors, paints and varnished, puty,

fillers and other mastics, inks.

5. Foundries using coal.
6. Minerals fuels, mineral oils and products of their distillation; Bituminous substances, mineral waxes.
7. Cement, clinker and Asbestos raw including fiber.
8. Explosive (including industrial explosives, detonators & fuses, fireworks, matches, propellant powders etc.).
9. Mineral of Chemical fertilizers.
10. Insecticides, fungicides, herbicides & pesticides (basic manufacture and formulation).
11. Paper made of wood pulp.
12. Manufacture of pulp-wood pulp, mechanical or chemical (including dissolving pulp).
13. Plastics and articles which only include coloured polythene carry bags made of non-biodegradable material listed in the schedule to H.P. Non-Biodegradable Garbage (Control) Act, 1995, having thickness less than 70 microns and size less than 12"x18".
14. Production of firewood and charcoal.

Baddi, Barotiwala, Nalagarh Industrial Area in Himachal Pradesh is the biggest industrial hub of the State. More than 2400 Industrial Enterprises are located in this area.

Reputed Industrial Houses like Johnson & Johnson (3 units), Cadbury, Wrigley India Ltd., Vardhman Group (10 units), Colgate, Timex, Procter & Gamble Home Products Ltd. (2 units), Wipro (3 units), Godrej, Gillette, Sun Pharma Ltd., Nector Life Sciences Ltd., Coca Cola, L'Oreal India Pvt. Ltd., Steel-bird, Woodland Shoes, Action Shoes (3 units), Lee- Cooper, Hindustan Uni-lever Ltd., Wep Solutions Ltd., Torrent Pharma Ltd., Dr. Reddy's Labs Ltd., Venus Remedies Ltd., Sri Ram Cylinders (2 units), Gopal Cylinders (3 units), Su-Kam, Microtech, Faiveley, Bajaj Home Appliances, Havell's, Abbot Healthcare Ltd. Unichem Labs Ltd., Micro Labs Ltd., Indoco Remedies Ltd., Jupiter Solar Power Ltd., Charak Pharma Ltd., Ayurvet Ltd., Cipla Ltd., Dabur India Ltd. etc. are operational in BBN Area.

13.2 MAIN HIGHLIGHTS OF BBN AREA:

1. BBN Area accounts for 90% of the total Investment in the State in Medium & Large Sector.
2. BBN Area accounts for 70.50% of the total Investment in the State in Micro & Small Sector.
3. BBN Area accounts for 30% of the total Employment in the State in Micro, Small, Medium & Large Sector.
4. BBN Area accounts for 42% of the Medium & Large and 4% of SSI Units of the total Units in the State.
5. BBN Area's share in total Revenue from Industries Sector is about 50%.

BBN Area has been emerged as "Asia's Largest Pharma Hub" having about 35% production of Asia Region.

For the treatment of the effluents, a Common Effluent Plant is functional in this area. The details of this plant are as under:-

1. Common Effiuent Treatment Plant (CETP):

Location : Village Kenduwal (Baddi)
Land Area : 96-17 Bighas
Total Cost : Rs. 58.43 Cr.
Capacity : 25 MLD
Life of Project : 25 years

Common Effluent Treatment Plant at Baddi

The Department is serious to establish CETPs in other major Industrial Areas. In this process a CETP is coming up at Industrial Area Kala Amb.

- A Committee has been constituted for analyzing technical and financial aspects for construction of CETP at Kala Amb, Distt. Sirmaur, H.P. under the Chairmanship of Deputy Commissioner, Sirmaur at Nahan.
- The private land for said project measuring 19-13 Bighas has been identified by the aforesaid Committee.
- M/s Shiwalik Solid Waste Management has been entrusted the work of preparing Detailed Project Report to Baddi and the same has been prepared with estimated cost of Rs. 20.00 crore covering the Municipal Waste of neibouring Panchayats.

AN OVERVIEW OF STATE INDUSTRIALIZATION:
Details of total Number of Industrial Enterprises Established in the State since inception to 31.12.2018:

Sr. No.	Category	Number of Units	Investment (Rs. In Cr.)
1.	Small Scale Enterprises	48768	20117.47
2.	Medium Scale Enterprises	527	7578.22
3.	Large Scale Enterprises	140	6957.50
4.	**Grand Total**	**49435**	**34653.20**

13.3 Sericulture Industry

Sericulture is one of the important agro-based rural cottage industries of the Pradesh that is providing gainful employment to about 10,485 rural families for supplementing their income by producing Silk Cocoons. 14 silk yarn reeling units have been set up in private sector i.e. district Kangra and Bilaspur five each, in Hamirpur, Mandi, Una and Sirmaur one each with the assistance of Government. Upto December, 2019, 228.00 MT Silk Cocoons were produced that was converted into raw silk of 31.00 MT providing an income of about `6.20 crore by sale of silk products in the State.

The Department has focus to achieve the following objectives:

i) To generate self-employment in rural areas by enhancing human skills, capabilities and to ensure sustainability of sericulture & silk sector.
ii) To develop an integrated and collaborative structure by involving farmers, entrepreneurs, self help groups, Community based organizations, NGOs and other stakeholders for promotion of sericulture in the State.
iii) To strengthen the value chain in sericulture within the State for better livelihood and higher earnings for the people.
iv) To adopt improved technology in sericulture.

13.4 Art and Exhibitions

With a view to promote the products being manufactured by various industrial units in the state, the Pradesh has been participating in various fairs, festivals and exhibitions organized at State, National and International level.

13.5 Handlooms and Handicrafts

Under "Cluster Approach" component of integrated handloom development scheme, 3rd phase of implementation of Gohar and Kangra Handloom cluster has completed and 1,127 weavers have been covered, 3rd phase for development

Reckong Peo and Rampur clusters and 2nd phase of Jawali, Janjehli and Tissa handdloom clusters are being undertaken by Himachal Pradesh Handicrafts and Handloom Corporation and HIMBUNKAR, Kullu. An amount of ` 7.80 lakh for 3rd phase handloom clusters and ` 30.99 lakh for 2nd phase clusters have been released to the implementing agencies for undertaking developmental activities viz; base line survey, formation of consortium, training for skill upgradation, design development, product diversification, publicity and exhibition activities, 647of 3rd phase clusters, and 800 weavers of 2nd phase handloom clusters have been benefitted.

Under "Group Approach" component, 2nd phase of implementation/development of 17 small weavers groups is going on to benefitted 325 weavers of Shimla, Kangra and Kullu districts. An amount of Rs. 20.29 lakh has been sanctioned and released by Government of India. Under "Marketing Incentive" component, the Government of India has sanctioned matching grant of Rs 113.86 lakh in favour of 58 handloom agencies in respect of their claims.

13.6 Mining Sector.

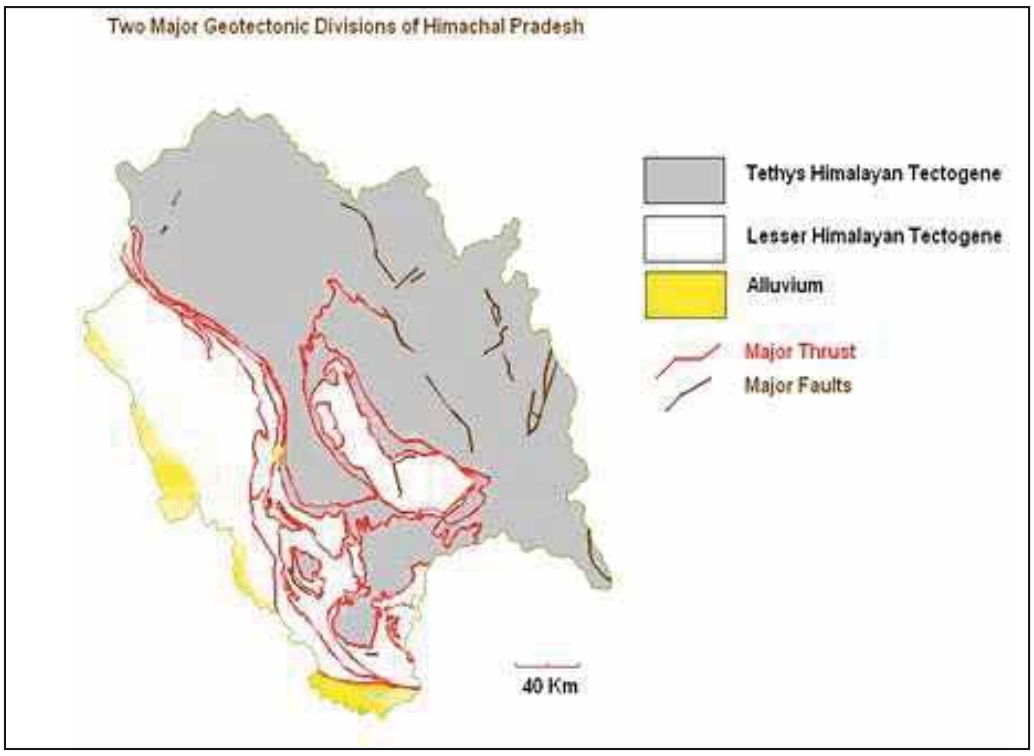
The Himalayas and its foothills is a treasure house of the minerals being exploited by human beings since time immemorial. With the advent of society, the method of the extractions of the minerals became more and more mechanized which resulted in extraction of the minerals at a pace much faster than the pace at which the nature could meet itself. It brought into sharp focus the conflict between development and conservation, which served to emphasize the need for reconciling the two into the larger interest of the society.

Stone, gravel and sand are one of the largest non-fuel mineral commodities by tonnage produced in Himachal Pradesh, supplying some of the most important construction materials. These minerals co-exist in the river beds flowing through Himachal Pradesh. The average unit value of Stone, Sand and Gravel is one of the lowest of all mineral commodities. The production of aggregate in a particular area is a function of the availability of natural resources, the size of population, the economy of the area and various developmental and infrastructural works being undertaken in the area.

13.7 Geology of Himachal Pradesh

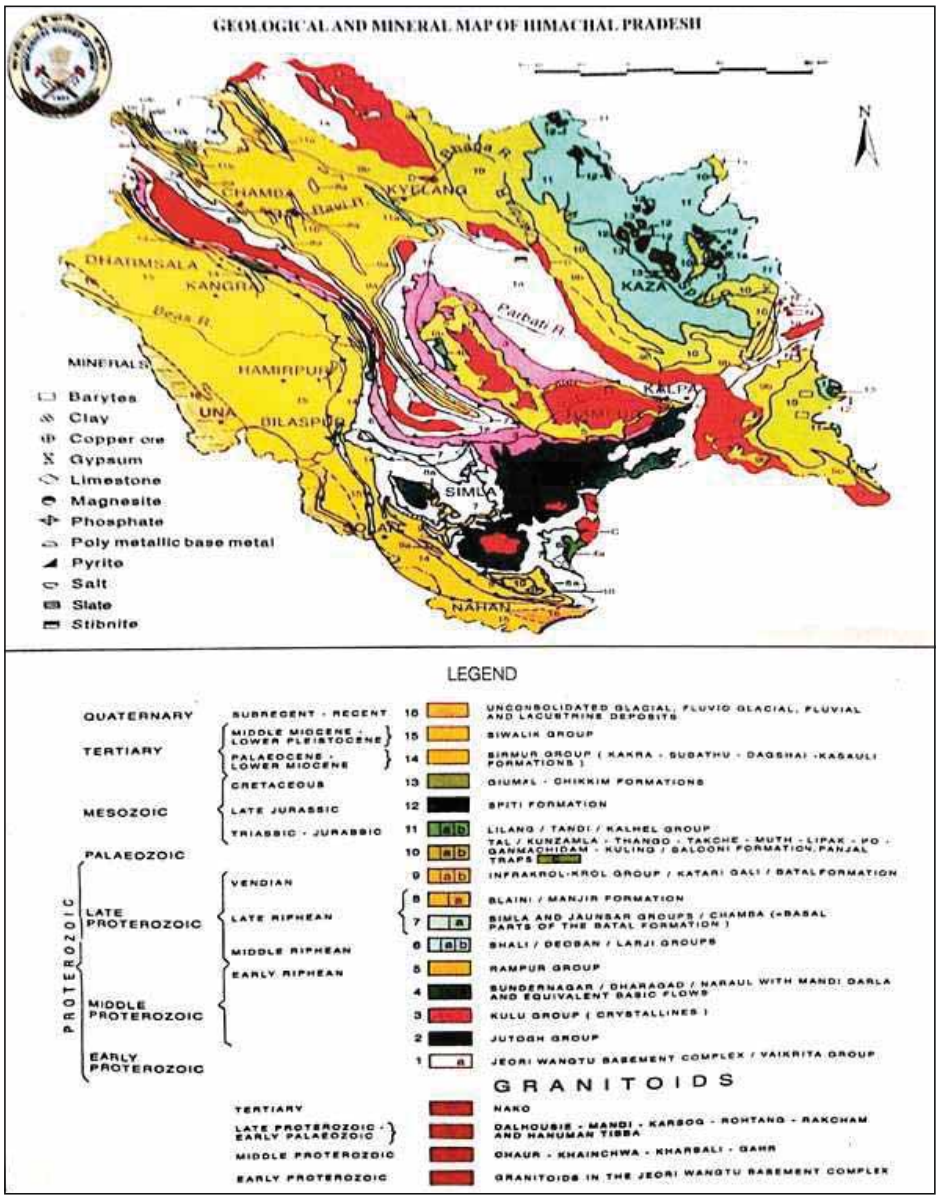
The geological history of Himachal Pradesh goes back to the Archaean – Proterozoic transition although Himalayan mountain building took place only during Cenozoic era. The Himalaya is a classic example of continent to continent collision due to convergent movement of Indian plate towards the Eurasian Plate. It comprise two contrasting tectogene with their own distinctive geological history. The dividing line between these two tectogenes represents a major tectonic discontinuity and is designated by several names. However, it can be collectively called as the Main Central Thrust (MCT), and on either side of this thrust the tectogene display contrasting stratigraphy and tectonic indicating the convergence of two alien blocks. These are the Lesser Himalyan Tectongen and the Tethys Himalayas, Tectogene.

Figure : Geological Division of the Himachal Pradesh in two tectogen of Tethys and the Lesser Himalaya tectogene



Palaeomagnetic data indicate that India, after the separation from other parts of Gondwana super-continent some 130 million years (Ma) ago moved north-eastwards at a velocity of 18-19 cm per year and additionally rotated more than 30° counter clockwise (Molnar & Tapponier, 1975). During this movement oceanic crust of the Tethys Ocean was sub ducted beneath the Asian southern continental margin, melted at depth and the ascending melts formed the granites of the Trans Himalaya plutonic belt. The actual collision of India and Asia is considered to start between 65-55 Ma ago (Klootwijk et al., 1992; Klootwijk et al., 1994). Based on isotope dating and sediment logical constraints Gullet et al. (2003) estimate the beginning of the collision at 55 ±2 Ma. After the collision Indian continental crust started to sub duct below Asia and the northward movement of India slowed down to some 5 cm per year, a velocity that continues up to present. The still ongoing collision causes deformation, crustal thickening and surface uplift. The upper continental crust of India is sheared o and thrust in south-westward direction along major, several hundreds of meters thick thrust zones propagating in sequence from north to south, thus becoming increasingly younger towards the south. Based on the classic book by Gansser (1964) these tectonic zones divide the organ into five tectonic units (Medlicott and Blanford, 1879/1887), which on the whole correspond with the geomorphologic divisions (Srikantia and Bhargava, 1998). The tectonic units from south to north are:-

(I) Sub-Himalaya,
(ii) Lesser Himalaya (LH),
(iii) Higher Himalaya (HH),
(iv) Indus Yarlung Suture Zone (IYSZ),
(v) Trans Himalaya



13.8 Mineral Wealth of Himachal Pradesh

Mineral Wealth of Himachal Pradesh Himachal Pradesh, with an area of 55,673 Sq km, has the potential for the occurrence of economic minerals but has not brought to light any worthwhile metallic 32 Mineral Resource Himachal Pradesh mineral deposits so far. Though there are old workings of metallic mineral but, there is no major metal mine in the whole State. The situation however, is di□erent in respect of non-metallic minerals having abundant reserves of cement to chemical grade limestone, dolomite, and also small reserves of barytes and gypsum. Himachal Pradesh is the only State in the Indian Union to have a working rock salt mine. The slate and building materials are also important minerals of the state. In the foot hill areas, despite having natural gas in Palaeogene -Neogene strata, exploration by drilling has not so far brought out encouraging results. In the Tethys Himalayan zone problems are much more severe due to poor logistics, inaccessibility and limited period of working owing to adverse climatic conditions. About 37 minerals are reported in Himachal Pradesh and except for limestone, barite, shale, rock salt, silica sand, magnesite, gypsum, quartzite, slate, building stone, bajri & sand, other minerals have only academic importance.

The Geological Wing was set up in the Department of Industries, H.P. in the year 1964-65. Primarily, work entrusted to the Geological Wing was to explore the mineral wealth of the State for their scientific and economical exploitation and setting up of mineral based industries. With the passage of time, the nature of work and responsibilities of the Geological Wing have increased manifold. With the Changing scenario, the Mining industry in Himachal has emerged as a major economic activity, which is contributing significantly to the economy of the State and Mining sector has become a new thrust area focusing Development and regulation, resulting into creation of various other allied issued pertaining to Mining. The Geological Wing is part and parcel of the Industries Department, consisting of 353 Officers/employees against the sanctioned strength.

With the vision that the natural resources must be utilized in environmental friendly manner in scientific and systematic way and with the objective of sustainable development, the State of Himachal Pradesh notified its first River/Stream Bed Mining Policy Guidelines for the State of H.P.-2004 containing various provisions for protection of environment & ecology. The river/stream bed mining is allowed to be carried out strictly according to the Working- cum-Environment Management Plan of sanctioned mining lease area. These plans are prepared after exhaustive and elaborated studies of the mining lease areas by the Registered Qualified Person and approved by the Competent Authority authorized under Rule 22(4A) of Mineral Concession Rules, 1960.

The said River/Stream Bed Mining Policy Guidelines for the State of H.P.-2004 has further been amended and incorporated as Annexure-1 in the Himachal Pradesh Mineral Policy, 2013. The clause 7 of the River/Stream Bed Mining Policy Guidelines for the State of H.P. provides for preparation of Action Plan for each District.

The survey documents prepared by the Department are based on direct and indirect benefits of mining and identification of the potential threats to the river/stream beds in the State. Besides, calculating the carrying capacity of the river/stream beds to find out maximum quantity available to be allowed to remove each year from the river/stream beds, it also provide various measures to regulate river bed mining in a systematic way.

There is also a restriction on the removal of river borne sediments beyond the depth of on meter, besides provisions to safeguard the banks of the river/stream beds by prohibiting mining within 5 meters of either side of the bank or within one tenth of the width of river/stream beds from either side of the bank, whichever are higher.

To ensure the systematic & scientific mining in the interest of environment, detailed provisions of Mining Plan, Progressive Mine Closure Plan and Final Mine Closure Plan in consonance with the draft rules circulated by the Ministry of Mines has been incorporated. For protection of environment, reclamation and rehabilitation measures suggested in the Mining Plan, the financial insurance shall be furnished by the every mineral concession holders for due observance of the provisions of the Mining Plan.

Status of Mineral Concession, and its Regulation and Royalty in Himachal Pradesh As on January 2020

- Mining leases (Major and Minor Mineral): -

Total Mining Leases -----

State	Free Sale of River Borne Material	Stone Crusher	Lime Stone/Salt	Slate Stone/Clay	Total
HP	112	292	44	17	**465**
	River Bed		**Hill Slope**		
HP	220		245		**465**

- Operational- 376
- Not in Operation - 89 (Due to Codal Formalities)

Total Auctioned Quarries - 221
- Total Amount shall beReceived per Annum 100.32 Crores
- Total Area Auctioned 1830-05-16Hect.
- Auctioned Quarries in Operation 14 (1 Sirmaur, 4 Una, 4 Hamirpur, kangra5)

Total Mining Quarries (Mining Lease + Auction) 686 (465+221)
- Total Mining Concession Area 4823-72-00Hect. (2993-66-84+1830-05-16Hect.) (Mining Lease + Auctioned (including hill Slope)
- Total Mining Concession in River Bed 3099-88-64Hect. (1270-75-49+1829-13-15Hect.) (Mining Lease + Auction)
- Total Mineral Concession in Hill Slope 1723-83-36Hect. (1722-91-35+00-92-01Hect) (Mining Lease + Auction)

Stone crusher Units: -
- Total stone crusher units 363
- Running on Mining leases and Other Sources- 267
- Not in operation- 96

Royalty
- 2015-16 - 155.08Cr.
- 2016-17 - 176.22 Cr.
- 2017-18 - 441.46 Cr (194 Cr. Upfront Premium from Ultra Tech)
- 2018-19- 173.21 Cr.
- 2019-20(up to January 2020)- 174 Cr.

13.9 MEASURES FOR CHECKING ILLEGAL MINING:

- Penalty provisions made more stringent, in new rules notified on 6th April 2018.
- Constituted a Sub Divisional Level Flying Squad under the Chairmanship of concerned Sub Divisional Officer (C) with Assistant Conservator of Forest and Deputy Superintendent of Police as its member.
- Constituted Head Office level Flying squad.
- Delegated powers to 39No's of officers/officials of various categories of different Departments like, Industries, Revenue, Police, Forest, Public Works Department, I&PH Department to check the illegal mining.
- Delegated powers to 20 No's of Officers/officials of various departments to seize any mineral or tool, equipment, vehicle or any other thing used for illegal mining.
- Delegated power to Regional Transport Officers in their respective jurisdiction vide notification dated 19.9.2012.
- Illegal mining mostly takes place on Government lands, mainly belonging to Revenue & Forest Departments, Henceforth, if, public property is damaged due to illegal mining, the custodian Department has to lodge First Information report (FIR) with Police for damaging public property.
- Transportation of raw material for stone crusher between 8-00 PM to 6-00 AM in the border areas has been stopped
- Printing of transit Pass through online web portal.

Paucity of Staff in the Department:

Vacant Post

- 2 post of Mining Officer
- 10 Posts of Mining Inspector
- 12 Posts of Assistant Mining Inspector
- 20 Posts of Mining Guards
- 4 posts of Steno Typist
- 5 Posts of Clerks
- 7 Posts of Senior Assistant
- 7 Posts of Surveyor
- 2 Posts of Technical Assistant (Geology)

Name of Post	Sanctioned Posts	Vacant Posts
Mining Officer	12	2
Mining Inspector	15	10
AMI	42	12
Mining Guard	115	20
Steno Typist	4	4
Clerks/Jr Assistant	8	5
Senior Assistant	8	7
Technical Assistant	2	2

Comparative detail of illegal Mining:

During Year 2016-17

Illegal Mining cases detected	=	9907
Fine realized from the defaulters	=	Rs 4.30cr.

During Year 2017-18

Illegal Mining cases detected	=	6974
Fine realized from the defaulters	=	Rs 3.35cr.

During Year 2018-19

Illegal Mining cases detected	=	9804
Fine realized from the defaulters	=	Rs 4.79Cr.

During Year 2019-20 up to January 2020

Illegal Mining cases detected	=	8360
Fine realized from the defaulters	=	Rs 4.20Cr.

Minor Mineral Quarries auctioned up to 05/03/20

Auction of minor mineral Quarries: -

- The State Government is auctioning the river bed and hill slope quarries falling in all the 12 districts.
- Enhanced, contract period of auction/tender from 5 years to 10 years in case of non-forest area and up to 15 years in case of forest land

- The auction of river beds of districts Kangra, Sirmour, Hamirpur, Una, Bilaspur, Chamba, Mandi, Kullu and Shimla have been conducted and new auctions in the districts are being carried out as all the codal formalities are completed.

Minor Mineral Quarries auctioned up to 05/03/20

District	Number of Quarries Auctioned	Date of Auction	Amount of Auction (Cr.)
Bilaspur	4	29-01-2018	1.83
	3	07-01-2020	0.54
Chamba	2	21-12-2018	1.15
	6	03-03-2020	1.2
Kangra	13	25-04-2016	2.21
	17	31-01-2018	6.63
	12	09-01-2020	7.78
Kullu	10	03-08-2018	2.16
	9	15-11-2018	1.56
Mandi	3	02-08-2017	0.24
	26	30-01-2018	1.51
	16	13-11-2019	2.88
Shimla	9	25-09-2018	3.87
	4	28-12-2019	1.82
Sirmaur	20	06-05-2016	30.15
	1	23-11-2016	0.9
	2	09-02-2018	1.5
	17	10-01-2020	15.5
Una	6	20-06-2018	3.48
Hamirpur	14	21-04-2016	3.53
	14	12-12=2018	5.29
	13	05-05-2020	4.59
Total	221		100.32

Total 221 quarries of an area measuring 1830-05-16 hectares auctioned for the amount of 100.32Crores.

The main provisions of Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of Illegal Mining, Transportation and Storage) Rules, 2015 on dated 6, April 2018: -

Restriction for Mining:

- No mining lease shall be granted within a distance of two kms. from the limit of Municipal Corporation/Committee, one kilometre for Nagar Panchayat, without obtaining consent of concerned authority.
- No mining lease shall be granted within 100 meters from National Highway/ Express Way, 25 meters from State Highway and 10 meters from other roads.
- No mining leases shall be granted within 200 meters from Water Supply & Irrigation Scheme and within 200 to 500 meters upstream and downstream of bridge.

Penalty Provisions for Illegal Mining:

- Fine for illegal mining has been enhanced upto Rs. 5 lakh and also added provision of imprisonment upto two years or both vide amendments in Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of Illegal Mining, Transportation and Storage) Rules, 2018.
- The penalty of illegal mining has been linked with quantity of the mineral extracted. If the quantity of the mineral is upto 25 MT, compounding fee will be Rs. 10000. vide amendments in Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of Illegal Mining, Transportation and Storage) Rules, 2018.
- If the quantity of the mineral exceeds 25 M.T. Additional fines to the tune of Rs.500 per M.T. on pro rata basis will be realized from the offenders vide amendments in Himachal Pradesh Minor Minerals (Concession) and Minerals (Prevention of Illegal Mining, Transportation and Storage) Rules, 2018.
- The minimum penalty in case of illegal transportation shall be:

Vehicle	Capacity (in Metric Tonne)	Compounding fee (Amount in Rs.)
Tractor	4	4,500
Truck/Tipper	7	7,000
Truck	10	15,000
Truck	> 10	25,000

- The minimum amount of penalty of illegal storage of mineral has been fixed at Rs. 50000 plus market sale price of the total material stored illegally at the spot.
- Provision made for short term auction of seized material to prevent illegal mining.

Penalty Provisions for JCBs

- The minimum compounding amount of Rs.50000 has been fixed for illegal extraction of mineral mechanically.

The Detail of Vehicles Impounded during 1st January 2018 to January 2020 is as follows: -

Detail of Vehicles Impounded, Cases of Illegal Mining Detected by JCB, Material Seized along with fine Imposed in each case if any During Present Government.							
Dist.	Vehicle Impounded				Material Seized (MT)	Compounding Fee	Total Fine Imposed
	JCB	Truck/Tipper	Tractor	Without PMT/Unscien1ic Mining			
Bilaspur	0	0	0	0	0	0	0
Chamba	0	0	0	0	0	0	0
Hamirpur	1	0	0	0	0	59000	109000
Kangra	0	0	0	0	2100	505000	505000
Nurpur	24	54	37	19	0	3065000	3065000
Kinnaur	1	0	0	0	0	0	0
Kullu	0	0	0	0	0	0	0
L & Spiti	1	0	0	0	0	0	0
Mandi	4	1	0	0	0	0	94500
Shimla	0	5	0	0	3211	1572800	1572800
Sirmaur	1	11	28	17	0	0	300000
Solan	2	1	2	0	0	0	58000
Una	29	28	14	0	0	2121650	2121650
Total	**63**	**100**	**81**	**36**	**5311**	**7323450**	**7825950**

Quarterly Meetings to prevent illegal mining under the Chairmanship of District Magistrate

- Various steps have been taken to curb the illegal mining by the concerned DCs in the districts. And to review the actions taken by the departments, quarterly meetings under the chairmanship of concerned DCs are being done and one of the important actions initiated is to plug the unauthorized illegal mining roads. The detail of unauthorized illegal mining roads plugged is as follows:

Sr. No.	District	Number of Unauthorised roads plugged
1	Bilaspur	20
2	Chamba	9
3	Hamirpur	32
4	Kangra	26
5	Kinnaur	6
6	Kullu	4
7	L &Spiti	0
8	Mandi	11
9	Shimla	27
10	Sirmaur	6
11	Solan	18
12	Una	15
13	Nurpur	34
Total	**208**	

Systematic and Scientific Mining:

- For systematic and scientific mining, Mining Plan is mandatory for working in the mining lease auction/permit area.
- Mineral Concession Holder has to furnish financial assurance for compliance of Mining Plan; in case of any violation security will be forfeited.

Procedure simplified for Mineral Concession:

- Letter of Intent shall be issued for obtaining environment clearance.
- Enhanced, contract period of auction/tender enhanced from 5 years to 10 years in case of non-forest area and upto 15 years in case of forest land.
- Provision made in the new rules for lifting/transportation of mineral generated due to land slide, road construction, tunnel excavation desilting of reservoirs etc.
- Simplified the constitution of Joint Inspection Committee in case of brick earth and ordinary clay in private lands having area less than 5 hectares.

Initiative to start the online system in the mining sector:

- Immediately after the formation the present Government, the online portal has been launched for the simplification of the process of mining lease applications. All the applications for grant of mining leases now are being received through online portal. Further, the printing of W and X forms is directly being done by the lessee through his web portal linked with Departmental website.

Penalty Provisions for stone crusher units/lease deed violation:

- Provision made for registration and working of stone crusher units.
- The stone crusher operating illegally i.e. without registration will be punished with imprisonment upto one year or with fine upto Rs. 50,000/-.
- The violation of terms & conditions of lease deed or agreement deed or mining plan, punished with imprisonment for a term which may extend to one year or with fine which may extend to Rs. 50,000/- or with both.

To Check illegal mining following directions have been issued to all the Mining Officers vide OM No. Ind-II (F) 10-7/2019 dated 25-02-2020 ed)

- Dumps of Mining Material to be atleast at a distance of 1 KM away from the mining lease sites.
- To lodge FIR against JCB and mechanical excavator owners involved in illegal mining.
- Suspension/Cancellation of mining leases of lessees engaged in unauthorised/illegal/unscientific mining or using mechanical excavators without permission for mining.

- Cancellation of registration of vehicles engaged in illegal mining.
- Action against overloaded vehicles and vehicles plying without number plates, RCs, Driving License etc.
- Fixing of Roster of Mining Guards/ Astt. Mining Inspector.
- To ensure the proper erection of boundary pillars in all the mining leases.
- Identification of points for erecting barriers and weigh bridges.

13.10 Environment Impact Assessment:

- Ministry of Environment & Forest, Government of India on 14.09.2006 issued a Notification making Environment Clearance mandatory for lease areas above 5 hectares.
- The Hon'ble Apex Court dated 27.02.2012 directed to procure Environment Clearance for mining lease areas less than five hectares.
- Accordingly, SEIAA (State Level Environment Impact Assessment Authority) has been notified by the State.
- Further, as per order passed by Hon'ble NGT (National Green Tribunal) on dated 13.09.2018, the mining cases of Environment Clearance of less than 5 hectares are being directed to SEIAA and environment clearance is accordingly being granted.

District Mineral Foundation Trust:

- The State of Himachal Pradesh as per the directions of Government of India, notified the Himachal Pradesh District Mineral Foundation Trust Rule, 2016 on dated 22nd August 2016 and constituted the Trust and managing committee in the 12 districts of Himachal Pradesh. The lessee of Himachal Pradesh depositing the DMFT fund as per section 13 of HP DMFT rule 2015.
- **The Total Accrual of DMFT Fund in the State up to the month of March 2020 is as follows: -**

DMFT Accrual up to March 2020

District	In case of Minor Mineral (Rs.)	In case of Major Mineral other than coal and Lignite (Rs.)	Amount Allocated for Schemes as per PMKKKY (Rs.)	Total Number of Schems	Amount used for COVID-19 Containment Measures (Rs.)
Bilaspur	Rs. 10,00,114.00	Rs. 37,99,61,682.00	Rs. 1,08,02,772.00	8	
Chamba	Rs. 7,33,260.00	Rs. -	Rs. -		
Hamirpur	Rs. 1,69,46,015.00	Rs. -	Rs. -		
Kangra	Rs. 2,59,70,193.00	Rs. -	Rs. -		
Kinnaur	Rs. -	Rs. -	Rs. -		
Kullu	Rs. 34,03,982.00	Rs. -	Rs. -		

District	In case of Minor Mineral (Rs.)	In case of Major Mineral other than coal and Lignite (Rs.)	Amount Allocated for Schemes as per PMKKKY (Rs.)	Total Number of Schemes	Amount used for COVID-19 Containment Measures (Rs.)
L & Spiti	Rs. 27,75,547.00	Rs. -	Rs. 16,000.00	1	
Mandi	Rs. 13,99,514.00	Rs. -	Rs. -		
Shimla	Rs. 14,14,260.00	Rs. -	Rs. -		
Sirmour	Rs. 3,92,13,525.00	Rs. 11,36,92,158.00	Rs. 98,80,000.00	25	
Solan	Rs. 46,10,265.00	Rs. 82,30,05,466.00	Rs. 12,32,03,719.00	27	Rs. 43,00,000.00
Una	Rs. 6,64,91,421.00	Rs. -	Rs. 42,50,000.00	5	
Total	Rs. 16,39,58,106.90	Rs. 1,31,66,59,306.00	Rs. 14,76,52,491.00	66	Rs. 43,00,000.00
Grand Total:-	Rs. 1,48,06,17,412.90				

Note:- Data for the Months of January, February and March 2020 in case of district Sirmaur is combined (Major and Minor Minerals).

Out of 148 crores 15 crores have been allocated to facilitate the mine affected people in districts Solan, Sirmaur and Bilaspur.

Detail of Leases in Himachal Pradesh

	Total Leases Granted								
	Free Sale of River Borne Material		Stone Crusher		Limestone/Silica/Sand/Rock Salt		Cut Stone/ Slate/ Shale/ Baryte/ Clay		Total Leases
Districts	Working	Non Working	Working	Non Working	Working	Non Working	Working	Non Working	
Bilaspur	0	2	4	1	1	0	0	0	8
Chamba	1	1	4	0	0	0	7	0	13
Hamirpur	9	0	25	6	0	0	0	0	40
Kangra	2	20	1	0	0	0	0	0	23
Kinnaur	0	0	0	0	0	0	0	0	0
Kullu	0	0	11	7	0	0	1	1	20
L & Spiti	0	0	4	2	0	0	0	0	6
Mandi	11	0	12	2	1	0	6	0	32
Shimla	3	1	30	6	0	0	0	0	40

	Total Leases Granted								
	Free Sale of River Borne Material		Stone Crusher		Limestone/Silica/Sand/Rock Salt		Cut Stone/ Slate/ Shale/ Baryte/ Clay		Total Leases
Districts	Working	Non Working	Working	Non Working	Working	Non Working	Working	Non Working	
Sirmaur	10	0	26	8	22	6	0	1	73
Solan	11	2	31	12	2	1	0	0	59
Nurpur	1	0	47	4	8	0	0	0	60
Una	37	1	44	5	3	0	1	0	91
Sub-Total	85	27	239	53	37	7	15	2	465
Grand Total	112		292		44		17		465

District wise Detail of Leases in Himachal Pradesh.

Out of 465 granted leases 376 mining leases are operational and 89 numbers of leases are non-operational due to various incomplete codal formalities

District wise Detail of Stone Crusher in Himachal Pradesh.

Detail of Stone Crushers in H.P.			
	Stone Crushers in Operation		Stone Crushers not in Operation due to Codal Formalities
Total Number of Stone Crushers	Stone Crusher Working on Leases	Stone Crushers Working on other Sources	
6	5	0	1
6	3	3	0
22	16	0	6
25	18	2	5
6	0	2	4
16	7	7	2
8	3	5	0
29	21	7	1
41	27	0	14
28	27	0	1
65	32	1	32

Detail of Stone Crushers in H.P.			
	Stone Crushers in Operation		Stone Crushers not in Operation due to Codal Formalities
Total Number of Stone Crushers	Stone Crusher Working on Leases	Stone Crushers Working on other Sources	
68	42	5	21
43	34	0	9
363	235	32	96
363	**267**		**96**

Out of 363 numbers of stone crushers 267 are operational and 96 are non-operational.

Detail of Illegal Data (2018-19 and 2019-20) Year 2018-19....

Detail of illegal cases detecting by Various Department during April 2018 to March 2019 (FY 2018-19)

Departments	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Mining Department	2631	1583	12083388	632	314	2160800	541	14244188
Revenue (SDM)	38	38	201000	0	0	0	0	201000
Forest Department	176	172	1368954	0	0	0	0	1368954
Police Department	6958	5878	31773210	1025	70	340000	0	32113210
BDO (JE)	0	0	0	0	0	0	0	0
HPPWD	0	0	0	0	0	0	0	0
G.M. DIC	1	1	4500	0	0	0	0	4500
I & PH	0	0	0	0	0	0	0	0
Total	**9804**	**7672**	**45431052**	**1657**	**384**	**2500800**	**541**	**47931852**

District wise Detail of illegal cases detecting by Various Department during April 2018 to March 2019 (FY 2018- 19)

Districts	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Bilaspur	680	661	3270570	4	2	20000	15	3290570
Chamba	510	226	233120	351	49	262400	47	495520
Hamirpur	849	729	3795700	77	20	122000	43	3917700
Kangra	2204	2033	13073830	166	18	99600	11	13173430
Kinnaur	159	90	435500	70	67	316000	0	751500
Kullu	650	295	1683100	255	83	517500	123	2200600
L &Spiti	101	100	646400	1	1	5000	0	651400
Mandi	2348	1598	6408610	499	33	302300	251	6710910
Shimla	394	314	2369600	134	47	316000	32	2685600
Sirmaur	1033	835	5228334	31	0	0	0	5228334
Solan	503	453	4347600	44	41	219500	9	4567100
Una	373	338	3938688	25	23	320500	10	4259188
Total	**9804**	**7672**	**45431052**	**1657**	**384**	**2500800**	**541**	**47931852**

District wise detail of illegal cases detecting by Mining Department during April 2018 to March 2019 (FY 2018- 19)

Districts	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Bilaspur	144	125	681700	4	2	20000	15	701700
Chamba	101	44	131080	124	49	262400	47	393480
Hamirpur	263	143	739200	77	20	122000	43	861200
Kangra	454	366	3119430	83	18	99600	11	3219030
Kinnaur	27	31	152000	0	0	0	0	152000
Kullu	217	53	296000	115	81	503500	123	799500
L &Spiti	6	5	25000	1	1	5000	0	30000
Mandi	548	241	1235000	56	33	302300	251	1537300
Shimla	147	92	837300	108	47	316000	32	1153300

District wise detail of illegal cases detecting by Mining Department during April 2018 to March 2019 (FY 2018-19)

Districts	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Sirmaur	328	138	860600	27	0	0	0	860600
Solan	208	192	1951500	12	40	209500	9	2161000
Una	188	153	2054578	25	23	320500	10	2375078
Total	**2631**	**1583**	**12083388**	**632**	**314**	**2160800**	**541**	**14244188**

Year 2019-20 (up to January 2020) ....

Detail of illegal cases detecting by Various Department during April 2019 to January 2020 (FY 2019-20)

Departments	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Mining Department	2096	1203	9066886	344	203	1402600	549	10469486
Revenue (SDM)	12	9	51500	0	0	19500	3	71000
Forest Department	169	169	1636434	0	0	191620	0	1828054
Police Department	6079	5062	28020980	991	127	1645600	0	29666580
BDO (JE)	3	1	10000	0	0	0	0	10000
HPPWD	0	0	0	0	0	0	0	0
G.M. DIC	1	0	0	0	0	0	0	0
I & PH	0	0	0	0	0	0	0	0
Total	**8360**	**6444**	**38785800**	**1335**	**330**	**3259320**	**552**	**42045120**

District wise detail of illegal cases detected by various Departments during 1st April, 2019 to 31st January, 2020 (Year 2019-20)

Districts	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Bilaspur	440	418	2035780	1	1	7000	21	2042780
Chamba	417	202	1154500	147	44	314600	27	1469100
Hamirpur	756	653	3482700	60	18	87000	43	3569700
Kangra	1773	1548	10049546	168	8	35000	57	10084546

District wise detail of illegal cases detected by various Departments during 1st April, 2019 to 31st January, 2020 (Year 2019-20)

Districts	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Kinnaur	130	108	507600	36	20	196500	0	704100
Kullu	608	288	1697000	310	132	772000	65	2469000
L &spiti	125	118	581000	0	0	0	0	581000
Mandi	1911	1444	4682750	346	14	82000	121	4764750
Shimla	395	280	1886200	59	3	17000	56	1903200
Nurpur	153	137	2632500	2	1	7000	14	2639500
Solan	205	134	1140900	24	19	250000	0	1390900
Sirmaur	788	647	4568664	26	3	37000	112	4605664
Una	659	467	4366660	156	67	1454220	36	5820880
Total	**8360**	**6444**	**38785800**	**1335**	**330**	**3259320**	**552**	**42045120**

District wise detail of illegal cases detected by Mining Department during 1st April, 2019 to 31st January, 2020 (Year 2019-20)

Districts	No. of Cases Detected	No. of Cases Compounded	Compounding Fee (Rs)	Cases lodged in the court	No. of cases decided by court	Fine Imposed by court (Rs)	Cases pending in the Office	Total fine (Rs)
Bilaspur	73	52	234900	0	0	0	21	234900
Chamba	120	44	207900	55	44	314600	27	522500
Hamirpur	275	172	904700	60	18	87000	43	991700
Kangra	320	230	746696	33	8	35000	57	781696
Kinnaur	7	5	44500	0	0	0	0	44500
Kullu	143	31	184700	97	93	520000	65	704700
L &spiti	24	17	92000	0	0	0	0	92000
Mandi	276	132	822200	23	14	82000	121	904200
Shimla	159	59	398900	44	3	17000	56	415900
Nurpur	153	137	2632500	2	1	7000	14	2639500
Solan	205	134	1140900	24	19	250000	0	1390900
Sirmaur	159	46	496700	1	1	25000	112	521700
Una	182	144	1160290	5	2	65000	33	1225290
Total	**2096**	**1203**	**9066886**	**344**	**203**	**1402600**	**549**	**10469486**

The environmental impact of mining includes erosion in the environment. formation of sinkholes. loss of biodiversity. and contamination of soil. groundwater. and surface water By replenishing the environment mining can become more environmentally sustainable. Mining companies sometimes overlook the importance of replenishing the environment. This simple act can go a long way towards increasing the environmental sustainability of mining. There are simple solutions that can be followed, such as replenishing native soils and grasses, cleaning excess waste and its management, proper waste removal, site inspections and replanting trees and natural forestry.

TOURISM, CULTURE AND ENVIRONMENT

CHAPTER-2

14. Introduction

Strategically placed in the Western Himalaya and bestowed with an abundance of natural beauty and considerable topographic variation in a relatively small geographic area, Himachal Pradesh has emerged as one of India's top leisure destinations. The state is eyeing other markets like MICE, and as a destination that offers filming, adventure and heritage.

Himachal Pradesh lies in the lap of Himalayas and is popularly known as the Devbhumi – 'Land of the Gods'. The state is endowed with natural resources in abundance such as forests, snowfed perennial rivers and rivulets, glaciers and lakes. There are vast tracts of high-altitude desert in the Trans Himalaya and dense green deodar forests; there are fruit orchards and cultivated terraces; there are snow capped mountain ranges and snow fed lakes.

14.1 PRESSURE

The world over, mountain areas are second only to coasts and islands as popular tourism destinations. These highland areas generate 15%to 20% of annual global tourism, which have a business value of USD 70.0 to 90.0 billion per year. Tourists are attracted to mountain destinations for many reasons, including the climate, clean air, unique landscapes and wildlife, scenic beauty, local culture, history and heritage, and the opportunity to experience snow and participate in snow-based or nature-related activities and sports.

About 12% of the world's human population live in the mountains, with another 14% living next to or very near mountain areas and substantially dependent on their resources. Of these people, about half are concentrated in the Andes, the Hengduan-Himalaya-Hindu Kush system and a variety of different African mountains. The biodiversity of mountain ecosystems and the uniqueness of many of their landscapes and animal and plant species represent important conservation values. Mountains also supply important resources and benefits to human society. They are the source of about 80% of global fresh water supplies and provide significant food, hydroelectricity, timber and mineral products to more than half of the world's population. In the Asian context, the Himalayan mountain system is called the 'water tower of Asia' and several rivers in India like the Indus, Ganges and the Brahmaputra have their source there.

14.2 STATE

As in other parts of the world, tourism has become an important industry in Himachal Pradesh and plays an important role in economic development and job creation. By creating jobs, enterprises, infrastructure and revenue earning mechanisms, tourism now plays a key role in the socio-economic progress of the state. Tourism has the potential to stimulate other economic sectors through its backward and forward linkages and cross-sectored synergies in fields like agriculture, horticulture, poultry, handicrafts, transport and construction. Expenditure on tourism induces a chain of transactions requiring a supply of goods and services from often unrelated sectors. The consumption demand, emanating from tourist expenditure, also induces more employment and generates a multiplier effect on the economy. Tourism development in an area depends on the resources provided. However, in recent years, the burden on the environmental resources has increased, which in turn has prompted efforts towards more environment-friendly tourism.

14.3 IMPACT

Himachal has long been a popular tourist destination and is famous nationally and internationally. Domestic tourists are attracted towards this hill state for many reasons – like the environment and landscapes, to escape the heat of the plains, the pollution of big cities, for holidays or for pilgrimages. International tourists are also attracted towards the historical importance of the hill state. New areas have also been identified such as adventure, trekking, camping and sport.

14.4 Response

As a business phenomenon, tourism has both positive and negative impacts. Positive impacts are reflected as economic development and employment generation, encouragement to the preservation of monuments and heritage properties and assistance in the survival of art forms, crafts and culture. Negative impacts are reflected as environmental degradation such as unregulated or insensitive building works, air pollution and noise pollution, water pollution and solid waste pollution due to littering of biodegradable and non biodegradable wastes and disposal of waste at eco-sensitive places leading to the erosion of biodiversity and pollution of water sources. Disturbed ecosystems are often coupled with unethical and insensitive attitude towards local people, and their customs and traditions.

14.5 PRESSURE

The tourism industry has been flourishing worldwide during the past decades on account of greater connectivity, awareness and disposable incomes. Tourism is overwhelmingly an industry of private sector service providers, although the public sector has a significant role to play in infrastructure areas either directly or through Public Private Partnership (PPP) mode. In Himachal, the state owned and state run, Himachal Pradesh Tourism Development Corporation (HPTDC) has 57 economy and high-end hotels across the state; this constitutes the single largest hospitality –provider in the state.

Tourism is characterized by multiple services provided by a range of suppliers. It is quite similar to manufacturing industry, where the supply chain is as important as the end product. Related sectors include airlines, surface transport, hotels, basic infrastructure and facilitation systems, etc. Thus, the growth of tourism cannot be attained unless the issues related to all the related sectors are addressed simultaneously.

The tourism industry has emerged as one of the most lucrative businesses in the world, and has a tremendous potential for earning foreign exchange, generating income and employment and to develop industrially backward regions through its various linkages. According to the UNWTO (2017), tourism contributes to 10% of the world's GDP. It accounts for 7% of the world's exports, services being the third largest export sector after fuels, chemicals and ahead of automotive products. Tourism is responsible for 235 million jobs, one in every 10 jobs, worldwide.

According to the UN World Tourism Organization (UNWTO), worldwide, in 2018 international tourist arrivals crossed 1,407.1 million and the receipts crossed USD 1458.4 billion. In India, 2018 saw the arrival of 17.4 million tourists from overseas and this reflects a decadal growth of 13%. The total international tourism receipts in India stood at USD 28.6 billion and reflected a 9% change in real terms. Tourism accounts for 5% of India's exports; this may be compared with Europe with the figure is 6% and Africa and the Middle East where this is 9%. India's share in international tourist arrivals is 1.24%

The World Travel and Tourism Council has calculated that tourism generated Rs. 16.91 lakh crore (USD 240 billion) or 9.2% of India's GDP in 2018 and supported 42.673 million jobs which is 8.1% of its total employment. The sector is predicted to grow at an annual rate of 6.9% to Rs. 32.05 lakh crore (USD 460 billion) by 2028 and will comprise 9.9% of the GDP.

As per the data made available by the Ministry of Tourism, between 2015 and 2019, in national terms, there has been a perceptible shift in the percentage of tourists coming from different countries.

In 2018, Bangladesh topped the list with 27.35% of arrivals. From the developed nations, earlier it was the United Kingdom that topped the list of the 'source of origin' of visitors. This position has now been taken by the United States.

Source Countries for Foreign Tourist Arrivals (FTAs) in India in 2018 (P):

Serial No.	Source Country	FTAs	Percentage Share %
1	Bangladesh	2256675	21.37
2	United States	1456678	13.80
3	United Kingdom	1029758	9.75
4	Sri Lanka	353684	3.35
5	Canada	351040	3.32
6	Australia	346486	3.28
7	Malaysia	319172	3.02
8	China	281768	2.67
9	Germany	274087	2.60
10	Russian Fed	262309	2.48
	Total top 10 Countries	6931657	65.65
	Others	3626272	34.35
	G.Total	10557929	100.00

Source: Bureau of Immigration, Govt. of India (P- Provisional)

However, in the case of Himachal Pradesh, as far as foreign tourists go, the primary country of origin remains the United Kingdom.

Country	Year 2013	Year 2014	Year 2015	Year 2016				
	No. of visitors	Bed nights spent.	No. of visitors	Bed nights spent.	No. of visitors	Bed nights spent.	No. of visitors	Bed nights spent.
U.K.	72530	93604	70826	90332	75024	108855	83680	121677
France	22030	28256	21253	27787	20481	31360	18248	27205
Italy	7663	10816	7867	10507	5251	7917	6629	9794
Canada	11017	15174	10387	14732	11663	18195	13609	21104
UAE	1858	2692	2160	2701	1318	1881	3310	4602
Pakistan	617	827	1445	1833	905	1446	580	1265
USA	34768	45598	29068	38103	37892	56953	37057	54359
Germany	20925	26664	16140	21912	15629	24892	14517	22399
Malaysia	5409	7539	8166	11018	8497	12666	11354	17341
Australia	19048	25171	17428	22273	16458	26422	17724	26427
Switzerland	5344	7489	4665	6379	4427	7039	4525	7345
Bangladesh	9941	13060	9563	12565	11830	15926	16374	22702
Sri Lanka	2413	3320	1974	2502	3339	4736	4048	6271
Japan	7791	10980	6178	8660	5426	8233	5990	9648
Saudi Arabia	765	1250	2598	3346	2105	3226	1915	2836
Singapore	2892	4301	3588	5107	4764	7584	7492	11178
Iran	316	433	358	494	352	578	524	809
Others	189178	259593	176684	270021	181667	348618	205624	357254
Total	414249	556227	389699	549508	406108	685048	452770	723556

Source – Department of Tourism and Civil Aviation, Himachal Pradesh.

However, domestic tourists continue to dominate the market as is apparent from the table below which also has the district-wise break-up.

Table Break-up by District and Year of Domestic and Foreign Tourists in Himachal Pradesh.

Year	Tourists	Bilaspur	Chamba	Hamirpur	Kangra	Kinnaur	Kullu	L&S	Mandi	Shimla	Sirmour	Solan	Una	Total
2002	Indian	477201	357060	21786	828653	9629	1072695	28175	2244554	1227710	346321	236715	128418	4958917
	Foreigners	166	1211	54	29060	3439	48352	20130	2240	37860	676	1164	31	144383
2003	Indian	518299	404609	36190	891516	12109	1290438	35411	220202	1373635	354128	263499	144378	5544414
	Foreigners	220	1177	75	32146	3751	57833	23585	3052	44400	544	1102	17	167902
2004	Indian	584706	450803	41532	1012567	14219	1477324	40897	269479	1597246	393596	288546	174154	6345069
	Foreigners	87	1466	92	38713	4609	69649	28615	3581	55382	726	1424	0	204344
2005	Indian	634781	448473	42670	1080520	10098	1641007	44148	337105	1757307	428859	314595	188179	6927742
	Foreigners	128	1617	0	40923	2059	67933	22997	5122	64752	779	1480	0	207790
2006	Indian	682353	493567	47454	1133314	23128	1867984	52107	375438	1971417	470926	346856	207358	7671902
	Foreigners	126	1952	28	47412	12212	89751	31525	5417	90407	750	1947	42	281569
2007	Indian	728666	559831	124244	1245088	55158	1962424	85749	465137	2095946	514752	373447	271546	8481988
	Foreigners	325	2504	41	60377	24258	102654	40080	6815	98839	1048	2419	49	339409
2008	Indian	683761	644309	279745	1275155	147754	2001674	172931	603086	2061539	575798	480125	446820	9372697
	Foreigners	190	3953	53	70819	20733	112910	41398	9154	112917	1785	2693	91	376736
2009	Indian	886495	686136	432433	1403963	271287	2224649	251415	869904	2175314	653668	586388	594920	11036572
	Foreigners	170	3353	34	75549	13811	119514	65101	8070	108981	2090	3811	99	400583
2010	Indian	962061	786163	554970	1631232	384936	2395990	362660	1006418	2485564	748599	673932	819461	12811986
	Foreigners	86	3253	12	91709	18742	133707	59125	10485	127737	2712	5780	268	453616
2011	Indian	1093317	817477	630108	1813686	467186	2659527	470815	1184335	2818270	872597	801234	976336	14604888
	Foreigners	104	2191	4	98962	17860	138488	73040	9813	134167	3142	6464	283	484518
2012	Indian	977502	954518	683202	2190302	445334	3082545	396662	798461	3195332	948654	867890	1105646	15646048
	Foreigners	134	974	3	115109	14860	143900	47413	9068	158671	3088	6818	246	500284
2013	Indian	1145212	994023	729178	2098028	123178	2766709	114726	874139	2992991	840634	850825	1185943	14715586
	Foreigners	172	663	4	102595	3282	119341	4897	9663	164006	3009	6476	141	414249
2014	Indian	1241267	1090874	753185	2230888	26497	3187436	85282	936532	3193637	899226	913732	1366145	15924701
	Foreigners	156	970	8	102479	2084	104309	5111	9189	156235	3112	5766	280	389699
2015	Indian	1368807	1122894	855263	2396970	117216	3314463	86591	1086231	3261152	1016060	1072486	1426912	17125045
	Foreigners	350	1197	4	112843	2695	109468	4612	10478	154155	3377	6692	237	406108
2016	Indian	1431831	1162267	906914	2528837	97864	3515169	100759	1152614	3416629	1059618	1117837	1507411	17997750
	Foreigners	440	823	12	123895	2863	122064	15278	11181	165476	3558	6973	207	452770
2017	Indian	1616925	1180949	980611	2684948	463771	3732044	104645	1231968	3318829	992352	1225105	1598394	19130541
	Foreigners	446	828	2	138341	2609	133057	14275	10072	162168	2522	6454	218	470992

Figures include religious tourists.

Source: – Department of Tourism and Civil Aviation, Himachal Pradesh.

Indian	19130541
Foreigner	470992
Total	19601533

Total increase 6.24%.

Note:- The above estimates are inclusive of religious tourists.

As can be derived from the above table, from a figure of 161.45 lakhs tourists in 2012-2013, the number of tourists visiting the State went to 196.02 lakhs in 2017-2018.

However, there has been a decline in the number of tourists who visited Himachal between 2017 and 2018. In 2017, a total of 1,96,01,533 tourists (including 4,70,992 foreigners) visited Himachal. In 2018, this figure dropped to 1,64,50,503 (including 3,56,558 foreigners).

As per data collected by The Tribune for an article published on 28 December 2019, this decline is attributed to the short stay of tourists, tardy implementation of projects, erosion of sports like skiing and ice-skating, the mushrooming of illegal homestays and inadequate parking.

As is also apparent, there are certain areas of Himachal that attract far greater numbers of tourists than others – and there are certain areas that attract foreigners, like Lahaul-Spiti where, in comparison to other districts, there is almost a parity of numbers between foreigners and domestic visitors. Other areas attract primarily domestic tourists – and the districts of Una, Hamirpur and Sirmaur get hardly any foreigners, however the number of tourists have increased from the year 2002 to 2016. As regards the profile of visitors from within the country, this continues to follow a traditional pattern with visitors from certain areas and states continuing to dominate the market.

Apart from the brief decline in the latest numbers, what is also indicated in the above tables is the rise in both domestic and foreign visitors as well as the number of bed nights spent in the State.

Apart from the tables, in 1990, the State had 440 registered guest houses and hotels and the number of visitors (foreign and domestic) was 19.42 lakhs. In 2004, the number of hotels and guest houses had risen to 1,710 with a bed capacity of 37,948 and as the table shows, the number of visitors in 2004 are over 65.49 lakhs. In, 2010, the number of hotels and guest houses had risen to 2,150 with a bed capacity of 56,023 and the number of visitors is now over 1.61 Crores, which is showing an increasing trend in subsequent years. In 2016, the number of hotels, guest houses & home stays have increased to 3660 with a bed capacity 80,243 and the number of visitors is now over 1.84 Crores.

In December, 2019 the total number of registered homestays in Himachal had risen to 1,656 units with a bed-capacity of 9,144. The number of registered hotels stood at 3,382 with 44,552 rooms and a bed-capacity of 91,223.

It may be noted that these figures do not represent the substantial number of tourists who visit the State and stay with friends and relatives or of the numbers who stay at dharamshalas and other religious or charitable establishments

STATISTICS RELATING TO NO. OF HOME STAY UNITS AS ON 31.12.2017

Sl. No.	DISTRICT	NO. OF HOME	NO. OF ROOMS	TOTAL	BED				
		STAY UNITS	SBR	DBR	DOR	FS	TBR	ROOMS	CAPACITY
1.	Bilaspur	14	2	37	0	0	0	39	76
2.	Chamba	73	12	186	0	3	0	201	396
3.	Hamirpur	2	0	5	0	0	0	5	10
4.	Kangra	176	7	442	0	3	0	452	903
5.	Kinnaur	47	0	141	0	0	0	141	282
6.	Kullu	303	11	785	0	35	0	831	1720
7.	Lahaul & Spiti	127	0	377	0	0	0	377	752
8.	Mandi	87	7	230	0	10	1	248	510
9.	Shimla	273	0	799	0	0	0	799	1638
10.	Sirmour	25	1	64	0	2	0	67	137
11.	Solan	84	4	236	0	25	0	265	576
12.	Una	9	0	20	0	1	0	21	44
	TOTAL	**1220**	**44**	**3322**	**0**	**79**	**1**	**3446**	**7044**

TOTAL TOURIST ARRIVAL TREND IN HIMACHAL PRADESH

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Bilaspur	477367	518519	584793	634909	682479	728991	683951	483539	789416
Chamba	358271	405786	452269	450090	495519	562335	648262	314252	962147
Hamirpur	21840	36265	41624	42670	47482	124285	279798	289309	554982
Kangra	857713	923662	1051280	11211443	1180726	1305465	1345974	827160	1722941
Kinnaur	13068	15860	18828	12157	35340	79416	168527	169388	403678
Kullu	1121047	1348271	1546973	1708940	1957735	2065078	2114584	1388025	2529697
Lahaul & Spiti	48305	58996	69512	67145	83632	125829	234329	161905	421785
Mandi	2246794	223254	273060	342227	380855	471952	612240	636774	1016903
Shimla	1265570	1418035	1652628	1822059	2061824	2194785	2174456	1408015	2613301
Sirmour	346997	354672	394322	429638	471676	515800	577583	378577	751311
Solan	237879	264601	289970	316075	348803	375866	482818	323664	679712
Una	128449	144395	174154	188179	207400	271595	446911	307022	819729
Total	**5103300**	**5712316**	**6549413**	**7135532**	**7953471**	**8821397**	**9769433**	**6687630**	**13265602**

Year	2011	2012	2013	2014	2015	2016	2017
Bilaspur	1093421	977636	1145384	1241423	1369157	1432271	1617371
Chamba	819668	955492	994686	1091844	1124091	1163090	1181777
Hamirpur	630112	683205	729182	753193	855267	906926	980613
Kangra	1912648	2305411	2200623	2333367	2509813	2652732	2823289
Kinnaur	485046	460194	126460	28581	119911	100727	466380
Kullu	2798015	3226445	2886050	3291745	3423931	3637233	3865101
Lahaul & Spiti	543855	444075	119623	90393	91203	116037	118920
Mandi	1194148	807529	883802	945721	1096709	1163795	1242040
Shimla	2952437	3354003	3156997	3349872	3415307	3582105	3480997
Sirmour	875739	951742	843643	902338	1019437	1063176	994874
Solan	807698	874708	857301	919498	1079178	1124810	1231559
Una	976619	1105892	1186084	1366425	1427149	1507618	1598612
Total	15089407	16146332	15129835	16314400	17531153	18450520	19601533

The numbers of people directly employed in the tourism industry (including employees of hotels, bars and restaurants, guides, travel agents and photographers) in 2004 stood at 15,418 – out of these 13,504 were Himachalis. In 2019, there were 899 registered photographers, 2,912 travel agencies and 1,314 guides.

The dynamic growth of this industry is evident from the fact that a new job is added to the sector every 2.5 second. These figures, however, do not represent the figure of those who are indirectly employed by the tourism industry like in transport, as porters or in handicrafts or souvenirs. It does not represent the persons who are suppliers to tourism based units – food, flowers, etc. The positive side of informal or unreported employment is that the money is returned to the local economy, and has a great multiplier effect as it is spent over and over again. The World Travel and Tourism Council estimates that tourism generates an indirect contribution equal to 100% of direct tourism expenditures.

At the same time there is the factor of seasonality to the work and the consequent fluctuation of employment. This is especially more so in the unorganised sector, for example, taxi driver-owners, guides and porters. It has been observed worldwide in the tourism industry that 'Problems that seasonal workers face include job (and therefore income) insecurity, usually with no guarantee of employment from one season to the next, difficulties in getting training, employment-related medical benefits, and recognition of their experience, and unsatisfactory housing and working conditions.'

This is becoming increasing apparent in the hill stations where the weekends show a spurt in activity and a lull during the rest of the week.

14.6 State

To accommodate the rising number of tourists in the state, infrastructure facilities are also increasing. There has been increase in the number of hotels and other commercial establishments in these years. Urbanisation has led to deforestation and congestion. Problem of air pollution due to heavy vehicular traffic, excess water consumption and solid waste pollution has also emerged as a negative consequence of tourism. Tourism activities following disturbance in sensitive high altitude areas negatively affects many species of sensitive flora and fauna and some are even in the verge of extinction. Pollution in these high altitude areas have a long term effect and pollutants flowing towards downstream areas of water bodies affect the overall ecology of the area.

In the global context, it is broadly accepted that the three prime movers of mountain economies are horticulture and select agriculture, hydro-electricity and tourism. At the moment, only 6.6% of the state's GDP comes from Tourism – as given by the IBEF (the Indian Brand Equity Foundation). Yet, it is estimated to be much higher as there is substantial income generation even in the non-organised sector. Job opportunities are limited since the economy is basically agrarian and the scope for industrialisation is limited due to geographical and ecological reasons. The Convention on Biological Diversity (CBD) has stated Tourism as one of the world's fastest growing industries as well as the major source of foreign exchange earning and employment for many developing countries, and it is increasingly focusing on natural environments. Biological and physical resources are in fact the assets that attract tourists.

However, the stress imposed by tourism activities on fragile ecosystems accelerates and aggravates their depletion. Paradoxically, the very success of tourism may lead to the degradation of the natural environment by depleting natural resources (and this) reduces the site attractiveness to tourists, the very commodity that tourism has to offer. To be sustainable, tourism should be managed within the carrying capacity and limits of acceptable change for ecosystem and sites, and to ensure that tourism activities contribute to the conservation of bio-diversity. Tourism should be restricted, and where necessary prevented, in ecologically sensitive areas."

India is a veritable shopper's paradise and the retail trade provides enormous forward and backward linkages throughout the economy. Recognizing shopping as an intrinsic part of the tourism experience and most valuable contributor to revenues, the strategy during the 10th plan was to encourage the development of dedicated shopping centers for traditional crafts, designed on the lines of ethnic village “Haat” such as Dilli Haat and Shilpagram. In Himachal local fairs and festivals are promoted and are main source of shopping for tourists and art & craft exhibitions, food fairs are also organized for tourism promotion. Certain self-groups are providing employment to women and other sections of society. These are engaged in making various handicrafts and other items. However, all these kind of tourism promotion activities are also creating pressure on the local natural resources. Therefore, the sustainable use of natural resources should be promoted with the theme for environment conservation.

Himachal is also famous for pilgrimage visits. A large number of tourists visit the state for pilgrimages and mostly are dominated by domestic tourists. In many of these places basic amenities are missing which ultimately leads to the environmental degradation. During the langars / bhandaras organised by the various pilgrim's centres, the waste is thrown indiscriminately which attracts animals and is a source of diseases. In these areas it should be

ensured that the pilgrims centres may be made responsible for the scientific disposal of waste generated by them.

Tourism has influenced our hill state in many ways, which have positive as well as negative effects. The most important element of tourism in hill areas includes:ensured that the pilgrims centres may be made responsible for the scientific disposal of waste generated by them.

Tourism has influenced our hill state in many ways, which have positive as well as negative effects. The most important element of tourism in hill areas includes:

a) Nature walks, hikes and treks
b) Land based adventure activities.
c) Air based adventure activities like para-sailing
d) Freshwater based recreational activities.
e) Snow dependent recreation activities.
f) Heritage based tourism activities

Today, tourists are increasingly interested in learning more about the different ecosystems, wildlife, cultures and communities that they will encounter during the course of their trip. Visitor education and Interpretation efforts can help communicate ideas and messages to travellers that increase their awareness, knowledge, understanding and appreciation of the natural and cultural environments of a destination. Interpretation may be incidental to a tour, or form a major focus of any mountain-based trip, and may include a variety of media, displays and interactive activities.

Many tourist places, due to heavy tourism pressure and inadequate maintenance, have become polluted and local people are facing the negative consequences of tourism. Litter is a common complaint even at places of pilgrimage or after local fairs and festivals. Water sources are often affected – and social media is rife with images of garbage.

14.7 Impact

The World Tourism Organization (WTO) defines sustainable tourism development as, "what meets the needs of the present tourists and host regions while protecting and enhancing the opportunity for the future. It is envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled, while maintaining cultural integrity, essential ecological processes, and biological diversity and life support systems." Due to tourism ecological and aesthetic damage are also done.

Tourism development has both positive and negative impacts. Environmental impact due to tourism has generally two main issues which are: (i) Resource depletion problem and, (ii) pollution.

With increasing tourist loads negative impact on the environment are visible. Due to environmental degradation future thrust of tourism such as adventure tourism, eco-tourism and heritage tourism are also in the danger of existence. The environment performs three functions with reference to tourism which are:

- Supplier of natural goods such as beautiful landscape, mountains, lakes, forming the core of the tourism product.
- Provider of natural resources used to create economic goods.
- The 'sink function', wherein unwanted by-products generated during the production and consumption process, are discarded.

Therefore, the quality of tourism is dependent upon the quality of environment to a large extent. Researches on tourist preferences have also revealed that the tourists regard high quality natural environment as the

primary condition for a successful vacation. Environment is also regarded as raw material for tourism. It is the reason for existence of tourism as well as its economic driving force. With ecological deterioration, destinations get categorised as 'down-market' ones in the public eye. And after all that, the quality of life is negatively impacted for the community. It would perhaps be appropriate that the industry creates an internal monitoring body that ensures that the intransigence of some does not affect the reputation and standing others – or of the destination. A comparison of case studies of success and failure of tourism, under similar geographic and ecological initial situations, is important in being able to understand the dynamics of the process of tourism development and its interaction with the local environment and the host culture.

Expectedly, tourism leaves both positive and negative impacts on the environment.

14.8 Positive impacts:

The most important factor in favour of tourism leaving positive impacts emanates from the very fact that the environment constitutes a very important part of tourism. It is therefore in the larger interest of the tourism industry to protect the environment. The situation of over-exploitation of this important resource by the tourism industry leads to the phenomena of 'tourism killing tourism'. The positive impacts can be summarised as given under:

- Economic benefits to the society flow in the form of foreign exchange earnings, direct and indirect employment opportunities created due to the development of tourism and the associated infrastructure, and the resultant income multiplier effects. It also leads to increased government revenue in the form of various kind of taxes levied on various tourism activities.
- Improvement and preservation of parks and cultural heritage properties. Natural parks of Kenya, Tanzania, Zambia and South Africa are good example of these.
- The tourism activities also lead to better resource availability for construction of infrastructure and maintenance of heritage properties and parks due to combined effect of three factors. First, as the historical monuments, natural parks and cultural traditions are projected to attract tourists, there is an increased allocation of resources for their maintenance and publicity from the government. Second, as the visiting tourists are generally made to pay for their visits for these monuments, the funds so received also add to the available pool. Finally, due to the combined effect of increased expenditure of the government on creation of infrastructure and publicity and increased tourist arrivals, the private investment also starts crowding in.
- Tourism also promotes cross-cultural exchanges with tourists and resident population learning more about each other's culture. In the multi-ethnic society such as India and Indonesia, domestic tourism can ideally help achieve cross-cultural understanding.
- It is generally seen that tourism infrastructure utilises the idle and wasteland in the area.

14.9 Negative Impacts:

Negative impacts on tourism can be identified as; on natural environment, built environment and cultural environment.

(1) Impacts on Natural Environment:

Impact of tourism in natural environment is divided into five parts viz. on flora and fauna, pollution, erosion, depletion of natural resources and visual effects.

Impacts on Flora and Fauna:

The most significant source of tourism induced impacts on ecosystem is the spread of tourism and recreation infrastructure. It not only puts strain on scarce land, but also, due to digging and increased extraction of local building materials, causes irreversible damages to the landscape. Creation of tourism infrastructure requires a lot of space, which is often provided at the expense of ecosystems. Both built infrastructure as well as tourist facilities and activities are created replacing the natural vegetation.

The intrusion of mass tourism is facilitated by the construction of paved roads that have the capacity to bring thousands of tourists. It is believed that this single factor has caused problems of air and noise pollution, traffic jams, dust and devastation of vegetative cover resulting in erosion. Road building also disturbs the slopes and changes local drainage pattern. It also involves construction of structures to protect travellers from falling rocks, soil erosion and avalanches, thereby impacting flora and fauna and ultimately impacting overall ecosystem of the area. The extent of damage and intensity of damage may depend upon several factors like nature of tourism activity and carrying capacity of the area. The vegetation cover is also damaged due to trampling by walkers or crushing by tourist vehicles. Hikers, trackers and mountaineering approach the areas left by roads and off road traffic. They can penetrate into the inaccessible by mechanical means. Impacts such as soil erosion due to trampling, deforestation due to fuel requirement, threat to wildlife and threat to cultures. With the development of tourist destination the construction activities like road & house construction, are increased in the area and emergence of small business houses crowd the area and disturb the ecological system.

A visible example of this impact is on the mass felling of trees that has taken place to build the four-lane highway between Kalka and Shimla.

Impacts due to Pollution:

Tourism industry is one of the major contributor of environmental pollution. Pollution caused by tourism activities is air, noise, water and solid waste pollution. Though the tourism industry is believed to be smokeless industry, air pollution can accompany tourism development in a number of ways which are; during the construction of buildings and other tourist facilities and associated infrastructure, from burning of fossil fuels for providing power and heating and from the forms of transportation used by tourists like road, railway and air. Noise pollution occurs mainly due to increased traffic, water sport activities and music in restaurants and discos. Instances of ecological stresses occurring in the form of pollution and destruction of natural vegetation across the Himalayan regions have been recorded. Problem of littering and solid waste disposal is also a major problem of tourist activity. The Everest region in the Nepal is the best example of such a case. Between 1979 and 1988 about 770 MT. of garbage is reported to have been disposed by about 840 mountaineering teams. This included 422 MT. of disposal garbage, 141 MT. of non-biodegradable garbage and about 207 tons of oxygen cylinders.

In some of the most pristine places of Himachal, non-biodegradable litter is present. Much of this is dumped by tourists and constitutes plastic water and soda bottles, liquor bottles, packets and packages of foo dstuff.

Impacts on natural environment due to erosion:

The most significant physical damage to soils in fragile environments such as drylands and mountains is caused mainly due construction of tourist infrastructure may involve deforestation, digging or cutting of earth causing soil erosion, tourist activities like camping, trekking and mountaineering causing trampling by human feet, horses and vehicles leading to soil erosion.

Impact on depletion of natural resources:

Increased activity and consumption may lead to rapid depletion of renewable and non-renewable resources like construction material, forests, water and animal life. Tourism led deforestation and degradation of forests are widely reported issues. The cases of tourism led scarcity of water are very common.

Impacts on visual effects:

The visual impacts are mainly caused due to three main reasons: littering, sewage and poorly sited and constructed buildings. Littering is one of the major causes of visual pollution at tourist destinations. Abandoned aluminium cans, bottles and foodstuff become a permanent kind of defacement.

(2) Impact of Tourism on Built Environment:

The impact of tourism on built environment mainly are: architectural façade, change of land use and burden on infrastructure. Mass tourism development is generally associated with poorly designed, sited and constructed buildings and other facilities. Large scale construction of infrastructure and tourist facilities lead to change of land use in the area, through direct loss as a result of urban expansion or indirectly as a consequence of changes in land values. This may be harmful for the local ecological balance. Forest land is converted to agricultural land, encroachment on public open spaces and tendency to leave land fallow for camping are the most visible impact of tourism on land use change. The agriculture land is being converted for infrastructure development for accommodating tourists in the state.

(3) Impact on Socio - Cultural Environnent:

The impact of tourism on socio-cultural environment is mainly on tourists and host population. The major impact on tourists that emerges is on the quality of recreational experience. Overcrowding may force some people to consider the experience no longer worth having, that is, the repeat visits will fall substantially. People who generally enjoy a relatively untouched and primitive environment value a wilderness area and not the man-made works. Intensity of satisfaction of tourists is also high for a lesser used area, which generally falls for the areas which are used more.

Impact of tourism on host population has positive as well as negative impacts. Although there is not much agreement among social scientists about the socio-cultural consequences of tourism, a majority of them seem to emphasis the negative impacts of tourism. Among the negative consequences of tourism are: decline in traditions, materialism, increase in crime rates, social conflicts, crowding and environmental deterioration. It is frequently stated that the local traditions are weakening under the influence of tourism. There is often a loss of identity of traditional cultures resulting in tourist facilities like accommodation loose their identity and similar cultures grow in different parts of the region. The loss on identity resulting from tourism often destroys intimate, personal and friendly relationship and leads to commercialising and materialism. This results in change of system based on social and moral values to a system based on money. Impersonality and commercialisation in human relations form one of the factors in increase in crime rates.

Similarly, increased population due to addition of floating population and increase in number of vehicles due to increase in demands leads to crowding. The environmental deterioration occurs as a result of littering, water and air pollution and destruction of natural beauty and architectural facade. So much so, evidence of tourism resulting

physical and mental diseases have also been found. In the community where there is widespread resistance against tourism, touristic developments may be blocked. However, if the place has strong touristic value, some

investor will still invest in tourism despite the resistance. With this the employment opportunities will be created and some segment of the population will benefit from it which will change its attitude from resistance to adoption. On the other hand, if the general reaction of the population will at a destination is that of adoption, the tourism developments will be fast. Soon the negative impacts of tourism development will start surfacing, and a significant portion of the population will start getting hostile towards tourism and tourists.

While no detailed studies are available, broad indicators point to low spending on part of the average tourist and also to insensitive behaviour on part of many. The losses often cannot be quantified, but are clearly visible in terms of expenditure required for law and order, pressure on civic amenities, roads and parking, and the visible degradation of the destination. In the aspect of 'regulation', a 'tourist police' wing within the police establishment has been created in Himachal and has the role, 'To assist, benefit and protect'. The presence of this force is expected to help both the tourists and the local people.

At the same time, with ecological deterioration, destinations get categorised as 'down-market' ones in the public eye. And after all that, the quality of life is negatively impacted for the community. It would perhaps be appropriate that the industry creates an internal monitoring body that ensures that the intransigence of some does not affect the reputation and standing others – or of the destination. A comparison of case studies of success and of failure of tourism, under similar geographic and ecological initial situations, is important in being able to understand the dynamics of the process of tourism development and its interaction with the local environment and the host culture.

While again, no conclusive studies are there, these indicators are often cited in the case of Shimla, Manali and Dharamsala where it is stated that the number of tourists that visit these places every year are up to ten times the local population – and those who are not stakeholders in the industry, often resent their presence as depriving them of basic civic amenities, the deterioration of the environment and the erosion of local culture. While no analysis, far less a carrying capacity report exists at the moment, it will be interesting to have a cost benefit analysis of tourism in the context of the primary destinations. For example, it can well be argued that the money earned from tourism in say, Shimla do not necessarily commensurate with the expenditure both in terms of money and in terms of deterioration in both physical and perceived terms of a destination. Shimla, at one time was likened in elegance to the finest cities of the world – Paris, St. Petersburg and London. While it may have had a colonial base, that base was substantial enough to sustain the tourism industry in the post-Independence years. It is unfortunate to have to make the admission that there has been no value addition at all – and only a chipping away at the base.

Response

Tourism development can bring a lot of economic benefits to the country, yet it is not without negative effects. The policy option therefore can be either to develop tourism and tolerate environmental degradation or to not to have tourism at all. Formulation of appropriate development strategy for achieving environmentally sustainable tourism obviously, is the right choice. With the advent of mass tourism, there is an increase in population due to addition of floating population. There is, therefore, a consequent increase in energy and water consumption, and a rapid increase in generation of wastes. The net outcome is rapid depletion of renewable and non-renewable sources of energy. The success of environmentally sustainable tourism strategy has to be evaluated with reference to its contribution in conservation of scarce and highly valuable resources, increasing afforestation and restoration of degraded land and increase in production per unit of natural resources consumed. The long term success of such a programme will, however, depend on its success in involving all concerned: tourists, tourism industry, host population and the governments. Tourism planning is done at various levels. Starting from national level, it is taken up at regional level, local level and ultimately even the site level.

Department of tourism, Himachal Pradesh is working with a mission to increase the contribution of the tourism sector in the State GDP from present level of 8% to 15% by 2020 by increasing tourist arrivals to 30 million domestic tourists and one million foreign tourists and has following objectives:

1. To position Himachal Pradesh as a leading tourist destination in the country and globally under the brand 'Unforgettable Himachal'.
2. To enhance the flow of domestic & foreign tourists to the State.
3. To create and maintain new and existing infrastructure for tourism in the State.
4. To encourage private sector investment in tourism sector including on PPP basis and employment generated.
5. To promote the state as a leading adventure tourism destination.
6. To promote rural tourism and encourage local community participation in tourism related activities.
7. To enhance air connectivity to and from the state and within the state – including helicopter services.
8. Use of IT in tourism sector.

14.10 Infrastructure Development Investment Program for Tourism (IDSIPT)

Government of Himachal Pradesh signed a loan agreement with Asian Development Bank in July 2011 for strengthening tourism infrastructure in the State under Infrastructure Development Investment Program for Tourism. The Investment Program will focus on:-
(i) Urban Infrastructure and Service Improvement;
(ii) Connectivity Improvement;
(iii) Quality Enhancement of Natural and Cultural Attractions;
(iv) Community-based Activities; and
(v) Capacity Development, Community Participation and Project Management.

As per the Economic Survey of Himachal for the year 2017-18, it was observed that to boost tourism in the State, the Asian Development Bank (ADB) approved loan assistance worth USD 95.16 million to Himachal Pradesh for development of tourist infrastructure in the State. Under Tranche-I, financial assistance of USD 33.00 million was approved. Community Based Tourism under Tranche-1 was implemented in 5 clusters of the State: Dhameta, Kangra-Paragpur, Chintpurni, Nainadevi and Shimla-Chail. Here, various types of skilled and livelihood-based trainings were provided and total 5,316 participants (Female 2,822 and Male 2,494) were trained.

Under Tranche-3 total finance of USD 62.16 million was approved on 28 September 2015. The completion period of Tranche-3 is June, 2020. Under this Tranche there are total 15 sub-projects of civil works out of which 9 sub-projects have been awarded. Under Tranche-3, 19 panchayats have been selected for the implementation of Community Based Tourism (CBT) projects, out of which initial training have been started in 7 panchayats where a total 673 participants participated. The Government of India, Ministry of Tourism has sanctioned the project Integrated Development of Himalyan Circuit in Himachal Pradesh worth Rs. 9,976.05 lakh under Swadesh Darshan Scheme. Under this project total 14 tourism development projects have been sanctioned for the State.

Himachal Pradesh is already a well established and recognized tourist destination. A Tourism Policy has been established by Department of Tourism and Civil Aviation, Himachal Pradesh in 2005. The policy has been revised and in the one issued in 2019 has a strong focus on sustainable development. UNESCO defines sustainable tourism as "tourism that respects both local people and the traveller, cultural heritage and the environment".
Sustainable Development Goals (SDGs) are a set of targets relating to future international development. They are created by the United Nations and promoted as Global Goals for Sustainable Development. There are 17

goals, including poverty alleviation, zero hunger, good health, gender equality, affordable and clean energy, decent jobs and economic growth, clear water and sanitation, and responsible consumption.

The vision statement of this policy is to 'Position Himachal Pradesh as a leading global sustainable tourism destination for inclusive economic growth.'

This is to be achieved by:
- Protection of state's natural and cultural heritage
- Improved quality of life and better employment opportunities
- Enhanced tourist experience
- Innovation through private sector participation

As a part of the policy, certain goals have been delineated in Himachal. Some prominent ones are:

Ecotourism: The advantages of promoting ecotourism include: benefits to local communities, generation of revenue, support to local economy and preservation of ecosystem and biodiversity.

Agro/Organic tourism: This tourism involves any agriculture-based operation or activity that brings visitors to a farm or orchard. Agro Tourism is undertaken to experience the real rural life, taste authentic local food and get familiar with various farming tasks.
Adventure tourism: Adventure tourism attracts high value customers who are passionate and prepared to take risks. This can be leveraged to support local economy with sustainable practices.
Pilgrimage Tourism: The State not only has Hindu temples, but it also houses many colonial churches, Sikh gurudwaras and centuries-old Buddhist monasteries. Several of them are important places of pilgrimage and each year attract thousands of devotees from all over the country.

Other categories that form a focus for the policy are: Cultural and Heritage Tourism, Snow Tourism, Lake Tourism, Health and Wellness Tourism, Film tourism and MICE Tourism.

The primary goal of the policy is to establish Himachal Pradesh as a leading global sustainable tourism destination.

Goals:
- Establish Himachal Pradesh tourism as an international brand in niche tourism
- Make tourism sustainable with prime focus on socio-economic growth and employment generation.
- Ensure quality experience of tourists.
- Encourage Private Sector Participation in tourism related investments & infrastructure

Policy Objectives are:
- To promote Tourism Diversification through theme based development
- To safeguard state's tourist destinations through sustainable interventions
- To ensure that sustainable tourism primarily benefits host communities
- To build capacity and develop quality human resource for the tourism industry
- To provide safe, secure and unique 'Tourism for all'
- To create an enabling environment for investments for sustainable tourism

The Government has also notified a Tourism Development Board that follows the pattern of other boards elsewhere in the world and is capable of cross-cutting management with multiple linkages. These are all indicators that there is a strong realisation in Government and among policy makers that tourism has to become sustainable – but this is not necessarily how it translating on the ground. Nor is this an indicator that the concept of sustainable tourism is currently at least, supported by the industry at large – and this may have something to do with the fact that a substantial number have already established a stake or are not professionals in the hospitality or tourism sector and treat the environment that sustains the industry, only as a source of revenue.

Main objectives of the Home Stay scheme are:

(a) Broaden the stake holder's base for tourism in the State;

(b) Take tourism to the rural and interior areas of the State;

(c) Decongest the Urban areas, which cannot support any further tourism load;

(d) Provide employment and economic values in the interior areas;

(e) The activity shall be ecologically sustainable.

Rain Water Harvesting has also become mandatory in all the tourism hotels in the State and the list of hotels having provision for Rain Water Harvesting has been provided in the department's web site.

There is considerable potential for attracting higher value added tourists in the State, with a unique combination of attractions that includes natural assets, historic architecture (Shimla) and cultural and religious attractions (notably Dharamshala, the residence of the Dalia Lama which is a magnet for international tourism). The tourism sector has shown remarkable resilience despite over-crowding in some areas and has the potential to become one of Himachal Pradesh's main drivers of economic growth. The tourism sector's potential growth is intricately linked with environmental quality. The State's unique and fragile hill ecosystem, including its protected areas, supports many of the State's most popular tourist activities, including trekking, skiing, angling, mountaineering, rafting, and watching of flora and fauna.

Some innovative concepts that protect and promote environmental concern and sensitivity to local culture that have been used are:-

1. The concept of 'grow your own tree' for residents – especially honeymooners where they plant a tree which is looked after by the management. This also makes sound business sense as they hope to encourage return visits – if only to see the tree planted by them.

2. Using the property as an 'art gallery' where exhibits on the walls are for sale. This gives local artists an opportunity to display their works, the property is able to change its décor at no extra cost and also cover administrative expenses incurred on this by a nominal gallery commission.

3. Empty milk pouches and cut bottles of mineral water are used to prepare the plant nursery.

4. Waste water from the kitchen and bathrooms is drained to the adjoining villages for irrigation purposes. Bio-waste from the kitchen is also taken by agriculturists for manure.

5. Local people come to sell handicrafts.

6. Water harvesting to supplement requirements. The use of this is further optimized by drip irrigation and sprinklers.

7. Bringing eco-sensitive tourists to the state for tree plantation as was done by a eco-stay unit near Rampur in 2019.

Value addition to the destination holds at least one of the keys in enhancing the tourism experience as well as in protecting or even improving, the environment. The concept of 'maximum value addition' places the highest possible value on culture and natural heritage while providing visitors with value for their money and

time. This strategy is arguably appropriate for Himachal's delicate fabric – and it is already the avowed policy of the Government to shift from number-driven tourism to a low-volume high-value one. There is however a transition that has to be made both by educating the players of the industry and by sensitising tourists that this idea for and not against tourism. Here, one basic concept has to be understood, is that when a tourist travels, he enters some else's home and that has to be respected. While this may sound unnecessarily rhetorical, killing the destination leaves nothing for anyone – not for the people who live there, not for the industry and certainly not for tourist.

A concept of codes for the principal players is often mooted. These are taken to address (i) the General tourist industry, (ii) specific sectors and activities,(iii) tourists and, (iv) the host populations. While legislation and law may be more valid for the first two sectors, it is education, information and informal actions like market positioning and promotion that seem more valid for the efficacy of the latter two.

14.11 World Heritage and Sustainable Tourism Programme:

For the past 40 years the UNESCO World Heritage Convention has conserved, protected and presented the Outstanding Universal Value of our shared heritage. World Heritage properties are important travel destinations, that if managed properly, have great potential impact for local economic development and long-term sustainability. The UNESCO World Heritage and Sustainable Tourism Programme represents a new approach based on dialogue and stakeholder cooperation where planning for tourism and heritage management is integrated at a destination level, the natural and cultural assets are valued and protected, and appropriate tourism developed.

14.12 The Five programme objectives:

- Integrate sustainable tourism principles into the mechanisms of the World Heritage Convention.
- Strengthen the enabling environment by advocating policies, strategies, frameworks and tools that support sustainable tourism as an important vehicle for protecting and managing cultural and natural heritage of Outstanding Universal Value.
- Promote broad stakeholder engagement in the planning, development and management of sustainable tourism that follows a destination approach to heritage conservation and focuses on empowering local communities.
- Provide World Heritage Stakeholders with the capacity and the tools to manage tourism efficiently, responsibly and sustainably based on local context and needs.
- Promote quality tourism products and services that encourage responsible behavior among all stakeholders and foster understanding and appreciation of the concept of Outstanding Universal Value and protection of world heritage.

14.13 Pressure

The requirement of tourism for enhanced revenues for both the state coffers and the people of Himachal means that a strong focus will remain on this activity and the structures that enable this.

14.14 State

An inventory of the Himachal's tourism assets would include the following:

Established Destinations:

- The lush Kangra valley and the towns of Dharamsala (1,380 m) and Palampur (1,220m). Dharamsala is the district headquarters and its twin town, McLeodganj (1,830m) is also the seat of His Holiness the Dalai Lama.

Palampur is surrounded by tea gardens and the terrain is criss-crossed by several streams and brooks.

- The Chamba valley that lies by the river Ravi and has the towns of Dalhousie (1,525 m to 2,378m) and Chamba (996m); this pocket also has the rather remote Pangi valley. Between Dalhousie and Chamba is the glade of Khajjiar.

- The river Beas creates the Kullu valley and this, along with the side valleys like the Parvati and Tirthan have some beautiful areas – apart from the main destinations of Kullu (1,220m) and Manali (2,050m).

- The arid Lahaul and Spiti valleys in the Trans Himalaya and the Kinnaur valley, are created by the rivers Chandrabhaga, the Spiti, the Satluj and the Baspa amongst others. The elevation of this area is over 2,500m.

- The rivers Giri and the Yamuna feed the towns of Nahan (932m) and Paonta Sahib (350m), while the Pabbar - valley has Rohru (1,550m) and Jubbal (1,892m) and the famous temples of Hatkoti (1,100m).

- The town of Shimla (1,900 to 2,200m) is the state capital and was the 'summer capital' of British India.

- These are the well-developed core-focus zones that draw the maximum number of visitors.

14.15 Flora and Fauna:

The outer fringe of Himachal is formed by the Shiwalik hills which are characterised by shallow dips and low dense scrub. As the hills climb higher, tropical vegetation gives way to woods of pine which merge into forests of oak and rhododendron. The mid-ranges have the majestic deodars and spruce. Close to the snowline, come stretches of fir, alder and birch. The chil pine which gives the tasty kernel – the 'chilgoza' or 'neoza' – and huge elms and horse-chestnuts appear in places. Wildflowers, a variety of ferns and grasses and rare medicinal herbs form the groundcover.

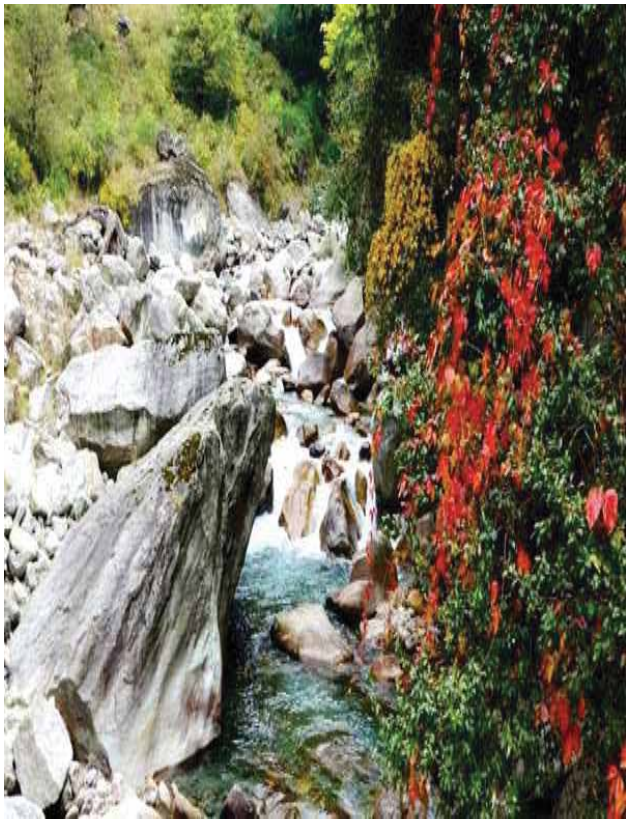
14.16 Sanctuaries:

Over seven thousand square kilometres of the state's territory are covered by sanctuaries and National Parks. The birds and animals whose home Himachal has been for countless centuries, include pheasants, partridges, kites, ibex, antelopes, deer – including the musk deer –bears, bharal, thar and the snow leopard.

14.17 History and Culture:

Pre-historic sites with stone-age tools have been located in the districts of Una, Bilaspur, Kangra and Sirmaur. The rise and fall of the great empires of northern India sent their own eddies into the hills and the Rajput states have left an indelible impression over Himachal. The mosaic of architecture is varied. Pastoral hamlets hold folk architecture at its finest. With the coming of the Europeans, Himachal added another dimension to its rich architectural heritage. Shimla, the state capital has some of the world's finest examples of British-colonial architecture. Apart from Shimla, colonial structures can be found all over the state – especially in the 'hill stations' of Kasauli and Dalhousie.

Culturally, south of the Greater Himalaya, the presence of Hinduism is strong. In the mid-hills, pastoral influences appear in the worship of numerous local 'devtas' and 'devis'. There are hundreds of large and small temples



Great Himalayan National Park

14.18 Fairs, Festivals and Celebrations:

Most of the fairs and festivals of Himachal are a celebration of life, or have religious or agrarian roots. Practically every major festival of north India is celebrated in Himachal – and has its own special touch. In addition, there are some two thousand deities worshipped in Himachal - and numerous fairs and festivals are held in their honour.One of the most spectacular festivals, with nuances that are special to Himachal is the Dussehra celebration at Kullu, in October. In the dance forms in the state, there is the warlike Thoda where archers aim at the padded legs of a dancer who leaps to avoid the arrows and then, there is timelessness in the Naati, where with arms interlocked, the dancers move with a steady rhythm. Folk theatre has the age-old Kariala performances.

Kullu Dusherra

14.19 Handicrafts and Shopping:

Himachal's diverse cultural and historical influences have produced a variety of handicrafts and arts. Some were created for household use – and then there were a few court crafts, like the fine miniature paintings and the Chamba 'rumal', handkerchief.
There are fine skills in the spinning and weaving of wool – the delicacy of the pashmina shawl and the thicker, more functional, brightly patterned woollen shawls. The vivid shawls of Kangra, Kullu and Kinnaur are famed the world over. The local tweeds, 'pattu', are rustic and warm. The need to keep the chill at bay has given rise to warm and wonderfully embroidered footwear and the distinctive caps of Himachal. The jewellery is ornate. The women of Himachal are often adorned by such a mass of exquisitely worked silver that their faces are barely visible. Perhaps the most unusual item of Himachal's metal ware lies in the 'moharas' or busts of deities and village or household gods. Then there is a range of statuettes, vessels, bells in brass or copper - and occasionally, silver. Wood makes its presence felt in carvings, walking sticks, furniture and bowls. Bamboo and grass mats, leather products and the little dolls of Himachal are both souvenirs and utility items.

14.20 Adventure and Activity

The varied terrain and climate of the state provides numerous options for outdoor activity and for soft and serious adventure. All across the state, there are hundreds of identified trek routes. Camping sites exist all over Himachal. Some popular treks are – from Shimla over the Jalori pass to the Kullu valley, numerous treks in the Great Himalayan National Park (GHNP), trek to the Shrikhand Mahadev, trek to Dodra Kwar, trek to Zanskar. Golf courses are located at Khajjiar; at Annandale, in Shimla; at YOL Camp and at Naldehra. Skiing (and ski courses) are available near Manali and at Narkanda. Ice skating is available at Shimla. Himachal has several places for trout and mahaseer (carp) and other fish.

Water and river sports include swimming, kayaking, canoeing, rowing and sailing. Bir-Billing in Kangra are considered to be among the world's best sites for para-sailing and para-gliding. Himachal has already hosted international competitions in the sport at this site. Mountaineering and rock climbing – The area around Manali and the Dhauladhar mountains currently form the core of this activity in Himachal. Courses are conducted by the Directorate of Mountaineering and Allied Sports.

14.21 Impact:

The availability of these natural, built and intangible environmental resources have provided the base on which the tourism industry has grown in Himachal over the past few decades. The first hotels to be built by the HPTDC were at the sites of historical dak bungalows located at Barog and Kairighat – which have unfortunately been demolished.

14.22 Response:

On the positive side, certain measures caring for the environment have stemmed the tourism. Some examples are, GI Tags for various handicrafts like shawls. UNESCO World Heritage Site Inscriptions for the Kalka Shimla Railway Line and the Great Himalayan National Park. Restorations of significant sites like the Gaiety Theatre, Shimla as earlier, tourism continues to be perceived as a double edged sword and there is little doubt that it will continue to grow. What remains to be addressed is how will it shift from a number-driven low-value phenomenon to a high-value one in a highly sensitive cultural and natural environment.

TRANSPORT

CHAPTER-9

15 Introduction

Efficient transportation systems are necessary for ensuring access to resources, markets, and services (like health and education) alongside other amenities. Availability of cost effective mobility options or the lack of it has direct implications on the economic efficiency of urban and rural economies and the overall well-being of the people. Increasing rate of urbanisation, population growth and growth led increased economic activities all contribute to placing great pressures on the existing transport systems. It is estimated (NITI Ayong) that India's transportation demand has grown by almost eight times since 1980 which is far more than any Asian economy.

India's transport sector is large and diverse, that caters to the transport needs of 1.1 billion people. In 2012-2013, the sector contributed about 5.2 per cent to the nation's GDP, with road transportation having a major share of it. Since the early 1990s, India's growing economy has witnessed ever increasing demand for transport infrastructure and services. With services and manufacturing industries particularly concentrating around major urban areas,andthese areas contributing to a sizable portion of GDP, efficient and reliable urban transport systems are crucial for India to sustain high economic growth. Besides, transport also has a significant social dimension: it plays an important role in reduction of poverty by improving access to labour markets and thus increasing incomes in poorer communities.

However, like all other things, it also does not come without a cost. Transportation is both energy- and emission-intensive as it uses considerable quantities of fossil fuels, particularly oil and contributes substantially to greenhouse gas emissions (Price et al., 1998, Åkerman and Höjer, 2006). The world consumes more oil than any other primary energy, and transportation accounts for more than half of the total primary oil demand (IEA, 2008). It also accounts for 23% of total CO2 emissions, of which 73% is generated by road transport (IEA, 2007a). The rate of growth of transport sector energy demand was 2.3% in 1980–2006, and its share in the total global final energy consumption has increased from 23 to 28% during the same time period. Because of the limited substitution (mainly in road transport) and short-run price inelasticity for oil in transportation (Dahl, 1994; Krichene, 2002), the sector will account for threequarters of the projected increase in oil demand worldwide; and its share in global primary oil consumption in 2030 will be 57%, compared to 38% in 1980 (IEA, 2008). Out of the total world transportation oil demand in 2005–2030, developing countries will have a three-fourth share on account of faster growth in economies and populations compared to their developed counterparts (IEA, 2007b). Urbanization and rising income levels have instrumented rapid increase in present and future transportation demand and vehicle ownership and use in developing countries (Faiz and Sturm, 2002). This has posed a serious challenge to energy security and sustainability of different societies and to the world as a whole.

Therefore, current growth trajectory in India directs us on an unsustainable path of private vehicle led development which brings along the related concerns of heavy congestion, high air pollution, high GHG emissions, safety issues, etc. With growing concerns towards sustainable development and mitigating climate change, it is realised that there is a need to shift from the current unsustainable approach to a more sustainable approach that allows movement and transport activity in a way that helps in mitigating the above issues and strengthen the process of urbanisation in the long run.

Inappropriately designed transport strategies and programs, can result in networks and services that ignore the changing needs of users, aggravate the condition of the poor, harm the environment, and exceed the

capacity of public finances (World Bank, 1996). In urban areas, where intense transportation activities are associated with high spatial concentrations of people and activities, these socio-economic-environmental impacts are more pronounced (Loo and Chow, 2006). Transport sector is considered as one of the most significant sources of unsustainability in urban areas (May et al., 2003).

Analysing the physical and material basis of development has been an area of intense research in the recent past. Several studies (e.g. Dittrich et.al, 2012; OECD, 2011; UNEP, 2011; Gilzum, 2010) have focussed on this aspect to understand issues underlying unsustainable development. Going by the findings of these studies, it is estimated (e.g. Dittrich et.al, 2012) that global material extraction of biomass, fossil fuel, minerals and metal ores has grown by almost 80 per cent over the past 30 years from 38 billion tonnes in 1980s to 68 billion tonnes in 2008. The big five material consuming countries: China, the United States, India, Brazil and the Russian Federation; together consume more than half of resources and if the 15 leading consumer countries are combined, together they influence about three quarter of resources of the world. However interestingly, despite intense use of energy and materials in their consumption patterns, the pollution levels in these consumer countries are very low. Such a paradox is explained by three factors: stringent environmental regulations, the greening of industry, and relocation of most polluting activities to the developing world. The problem of developing countries is thus twofold: the increasing resource intensity of consumption in developed countries (even though their production is becoming less resource intensive), getting shifted to emerging economies through international trade; and the resource intensity of both consumption and production in developing countries increasing in absolute terms in their industrialization process.

Seen in context of India, GFN and CII (2008) estimates show that India has the third biggest ecological footprints, that its resource is already twice of its bio capacity with its bio capacity having declined by half in the last few decades. Being one of the provinces in India located on the western Himalayas, Himachal Pradesh is a predominantly mountainous state with altitudes ranging from 300 meters to over 5000 meters. The state is known for having achieved good social sector outcomes: in health, education, gender equality and access to rural infrastructure, well acknowledged in India and internationally (World Bank 2015). Ninety percent of its 7 million population lives in rural areas 80 % of which is dependent on agriculture (largely rain fed) for livelihood making subsistence farming practiced in the state more vulnerable to droughts and crop failures. Overall, scenic beauty, biodiversity, hydro power potential and horticulture are the key strengths of the state. Tourism, the main non-farm commercial activity, is mostly confined to four major circuits(Shimla-Narkanda, Kullu-Manali, Kangra-Dharamsala, and Chamba-Dalhousie). For want of efficient and reliable modes of transport, the state largely remains un-explored by tourists. Tourism business is seasonal attaining peak during the summer and winter months. With the increase in per capita incomes, the vehicle ownership per household has increased in the recent few years.

The ecosystems here harbor a wide range of natural resources and are particularly sensitive to change. Regional changes in climate have already affected many physical and biological systems in the mountains. Analysis of temperature trends in the Himalayas and vicinity shows that temperature increases are greater in the uplands than the lowlands. Climate change impacts on water resources include: increased frequency of precipitation; increase in extreme rainfall intensity; increased variability of rainfall patterns; increased likelihood of water shortages; reduced levels of precipitation as snow; loss of glaciers volumes; earlier snow melt and increased temperature. Other observed parameters include movement of apple orchards to higher altitudes, loss of various tree species, drying of traditional water sources, change in bird types and population, reduction in crop yields, and increased vulnerability of winter cropping due to changes in rainfall patterns and planting dates (MOEF, 2009). Projections by the Government of India (MOEF, 2009) are even scarier: the annual temperature in the state is projected to increase up to 2.6±0.7cby the 2030s and the annual rainfall

upto 1604±175.2 mm. The projected precipitation is likely to increase by 5% to 13% by 2030s as against 1970s levels. For a state like Himachal Pradesh heavily dependent on agriculture for livelihoods and GDP, the impacts of Climate Change on water resources are of critical significance.

Discussions in this chapter aim at attempting to develop transport sustainability indicators for transportation sector for Himachal Pradesh. This paper executes the initial step of ascertaining the potential list of SDIs for transportation sector. First, the concept of sustainable transport system is outlined. The state of transportation in the state is analysed, challenges are identified to help getting a clear perception of the sector in the state. Towards the end policy options are discussed and conclusions are drawn. It is argued that a combination of all policy instruments namely command and control, economic instruments, market related instruments and moral suasion should be applied to achieve the best results.

15.1 SUSTAINABLE TRANSPORTATION SYSTEMS

The concept of sustainable transportation systems is defined as the one in which fuel consumption, vehicle emissions, safety, congestion, and social and economic access are of such levels that they can be sustained into the indefinite future without causing great or irreparable harm to the future generations throughout the world (Richardson, 1999). It in essence embodies the triple bottom line: economic, social and environmental sustainability.

Economic dimension in transportation looks into the productivity of its resource use, its contribution to the economy and satisfaction of economic needs of people. Also, from economic point of view, transportation sector not only facilitates business, but it is a business by itself. Transportation needs to be cost-effective to be financially sustainable. Acknowledging the importance of economic dimension of transportation, World Bank (1996) suggests that economic sustainability requires sustainability in vehicle fleet, transportation infrastructure and public transportation system. Transport services—as agents of change—not only contribute to the economy through production of vehicles, production of fuels that power the vehicles and provision of transport infrastructure, but also 'creates' raw material and labor, which is otherwise unusable due to its inaccessibility, and 'combine' (unite) them by broadening the areas of the business activity (WBCSD, 2004). Literature concerned with developing world has shown that though transportation is not a panacea to poverty, it has enhanced the agricultural outputs and access to market and essential services (Binswanger et al., 1993; Jacoby, 1998).

Transportation sector is governed by social changes (Black and Nijkamp, 2002). Also, transportation planning has consequences on social dimensions like equity and exclusion (Ahmed et al., 2008, Kenyon et al, 2002). The prioritization of highway development over public transportation has had inequitable effects on low-income populations, often restricting their ability to access social and economic opportunities, including job opportunities, education, health care services (Sa´nchez et al., 2003). Relative emphasis on people who are already motor-mobile as against the ones who are walking or unconnected with the existing transportation network would increase the rich poor gap in the society. Also poor in the cities tend to spend more on transportation (Laquian, 2004). In the cities of many developing countries, poor families sometimes spend up to 20% of their income on transport, while the average family does not even require half that sum for its mobility needs (GTZ, 2002).

Safety of human life has also become a major concern in transportation. As per World Health Organization (WHO) Global Burden Disease study (Murray and Lopez, 1996; WHO, 2002), road traffic injuries in developing countries are the cause for one fourth of injury-related deaths. It is ranked ninth in the overall cause of death in 1990, which is likely to rise to the sixth rank by 2020, with India, in particular, bearing the most of the burden.

One of the most dangerous aspects of the road traffic injury is the profile of the victim. Over 90 percent of deaths and injuries occurred in developing countries, with children accounting one in every five fatalities. Road traffic injuries are now one of the leading causes of deaths among children in the age group of 15-19 years .It is often argued the road traffic injuries are a symptom of a far deeper malaise. Governments are spending billions of dollars on construction of roads. These investments are geared to reduce journey times, increase vehicle speed, and accommodation of more cars. It ultimately leads to more emission, congestion and road accidents.

Road transport contributes significantly to urban air pollution in India. The World Health Organization estimates that suspended particulate matter leads to the premature death of over 0.5 million people per year. The economic costs of air pollution have been estimated to be equivalent to about 2% of gross domestic product in many countries. Among the main transport-generated pollutants are suspended particulate matter, lead, and ozone. A study of the select Indian cities indicates that the share of transport sector's contribution increases when tinier fractions of particulates are considered. For instance, in Indore, while transport contributes to 30 percent of PM10, its share in PM2.5 is 46 percent; and in Chennai it contributes to 20 percent of PM10 and 35 percent of PM2.5. Air pollution is estimated to be the fifth leading cause of death in Indian.

Studying the health impacts of air pollution is complicated due the fact that these pollutants interact with each other and other atmospheric factors. For instance ozone pollution is not directly emitted but forms as a result of complex interaction between two other emitted pollutants namely nitrogen oxide (NOx) and volatile organic chemicals (VOCs). The actual impact is also dependent on exposure. Besides, it is estimated that the transport sector is responsible for about 25 percent of emissions of the gases contributing to global warming in industrialized countries, but only about one-half this amount in developing country cities. While the proportion appears to have been stabilized in the Organisation for Economic Co-operation and Development (OECD) countries, it is still growing in the developing countries as motorized transport increases.

There is often an observed synergy between GHG reduction and local environmental and economic interests. The GHGs that most contribute to global warming in the transport sector include carbon dioxide (CO2), methane, and nitrous oxide (N2O). Emissions of CO2 are directly proportional to the quantity of carboniferous fuel consumed; other things being equal, reduced fuel consumption will reduce economic costs and global pollution simultaneously. Better traffic flow conditions typically reduce fuel consumption per kilometer. The current generation of diesel vehicles appears to be more damaging to public health than are gasoline or gas-powered vehicles. Thus, while diesel is a particularly in-efficient fuel from the point of view of reducing GHG emissions, only the new generation of clean diesels should have a role in GHG strategy. Furthermore, mitigation measures for local pollution focus on emissions of vehicles in use, whereas the entire life cycle (from well to tailpipe) is relevant for analysis of GHG emissions. Some emission reduction measures in fuel quality also lead to green-house gas emissions. For instance, worldwide policies to reformulate transport fuels to mitigate local pollution by means of severe hydrotreating to limit sulfur in gasoline and diesel to 10–50 parts per million by weight make refinery processes increasingly energy intensive.

Internalizing the cost of environmental externalities in the road transportation sector has not been possible (Santos et al., 2010); even though it is known that Co^2 emissions from the transportation sector are growing faster than total Co^2 emissions (Saboorietal,2014). The problem is to such a degree that the Intergovernmental Panel on Climate Change recently claimed that without aggressive and sustained mitigation policies being implemented, transportation emissions could increase at faster rate than emissions from the other energy end-use sector by 2050 (Intergovernmental Panel on Climate Change, 2014). The Scientific and Technical Advisory Panel of the Global Environment Facility by the United Nations Environment Programme claims that

a sustainable future relies on the decoupling of economic growth and CO2 emissions in the transportation sector.

15.2 TRANSPORT SECTOR IN HIMACHAL PRADESH

15.2.1 Current State

Owing to its geo-political conditions (as most parts of the state are remote and inaccessible, road transport is of utmost importance for the state. The sector makes substantial contribution to the state economy both directly and indirectly. Directly its contribution comes in the form of value of services generated during the year and to the employment generated. Indirectly, being the sole mode of transport in the state, its contribution comes in the form of value addition made in goods and services produced by other sectors. The sector is growing at the rate of over 6% and is expected to contribute more with increased transport demand led by the rising incomes.

The vehicle population in the state has shown a phenomenal growth over the past few decades. From an average growth rate of 2.7 % during 1980-85, growth rate of vehicle population in HP increased to 7.8% in 1995-2000 (Himachal SoER, 2005). After 2007, the vehicle population has grown at an average rate of nearly 17%. The total registered motor vehicles in the state have been reported to be 736,604 as on 31 March 2012 that is a 18.5 % increase over a total of 621,714 vehicles registered in 2011 (MORTH, 2012).Out of the total vehicles, non-commercial vehicles accounted for nearly 81 % of the total vehicles in 2012. The commercial vehicles were nearly 20 % of the total vehicles in the State. Two wheelers and cars dominated the vehicle composition, accounting for nearly 77 % of the total vehicle population. An average growth rate of nearly 15.5 % was observed in case of two wheelers from 2007-12; cars indicated a further higher average growth rate of nearly 20 % over the same time period. Apart from the above, nearly 0.2 million vehicles registered elsewhere enter the State during the tourist season that lasts for 9 months a year (Himachal SoER, 2005).

This clearly indicates an exponential growth in traffic volumes particularly personal vehicles in HP. This in combination with slow growth in road infrastructure and services has led to the rising problems of congestion, pollution, depleting air quality, etc. over the years. Easy availability of finance, rising affordability of the locals along with lack of adequate public transport system have led to the increasing preference of personalized modes. This therefore, calls in for a need to promote measures that wean people away from personalized modes and help promote more sustainable modes especially public transport.

While the growth of private vehicles has been phenomenal, the growth of public transport is negligible. In the absence of a maximum life span of vehicles under the statute, obsolete technology vehicles ply on the roads, leading to the problems of pollution and road safety. The taxation policy of the State imposes a one-time, nominal tax for private vehicles, while public transport is subject to a multiple-tax regime charged at very high rates on a per kilometre basis. Petrol and diesel are the only sources of energy for the vehicles, as CNG and electrically propelled vehicles are yet to be introduced. For these reasons, the transport sector in the state was also chosen to be the focus area for the green growth initiative.

Public transport in Himachal Pradesh is mostly conducted through the Himachal Road Transport Corporation and is fully owned and managed by the state. Constituted in 1974, the Corporation has a fleet of 2500 buses and operates the same both within and outside the state. The study discovered that there were at least 294 new roads opened in the last few years, but no service has been provided by the HRTC so far. Public transport is subject to a very high tax regime. The public transport vehicles pay taxes on a monthly basis compared to

the one-time, nominal tax levied on private vehicles. Even the taxes levied on the interstate routes are very high—almost double the normal Special Road Tax (SRT). In addition, inter-state movement of public transport in India (both buses and trucks) is subject to a severe problem of "tax exporting". This arises when governments tax the non-resident population on arrival to its territory, as corridor states levy high rates of tax on a competitive basis on the entry of outside vehicles. Even though the Motor Vehicles Act (which is a federal legislation applicable to all states) has a provision for scrapping vehicles on the basis of age, it does not specify any age limit. Because of this, there is a "free rider" problem with owners of antiquated vehicles plying highly polluting, unsafe vehicles with old technology having to pay less private marginal cost at very high social cost. The externalities in the form of pollution, road accidents and congestion enhance the marginal social costs. Data shows that buses up to 20 years of registration age are still in operation, while trucks of more than 30 years registration age are still on roads. Road safety is a major concern in the state. In 2013, the total number of road accidents reported in the state were2,981, registering a negligible average growth rate of 1%. The total number of fatalities reported in 2013 were 1,054 and reported an increase of nearly 30 % since 2005(MoRTH, 2013). The total number of accidents per lakh population reported in HP in 2013 was 42.4, higher than the national number at 38.9 accidents per lakh population. Similarly, the total number of road fatalities per lakh population in HP in 2013 was 15, which was also higher than the national value of 11 fatalities per lakh population (MoRTH, 2013). The above statistics indicate that though the growth in accidents and fatalities over the years has been slow, but still the number is higher than the national average and needs immediate attention.

15.2.2 Road safety statistics is presented as under

The major concern in terms of air pollution is unsafe levels of PM2.5. HPPCB (2014) notes that increases in the values of PM2.5 is a matter of concern. There is no exclusive study on air pollution in the state; however, Greenstone et al. (2015) estimates for India (including Himachal Pradesh) find that 660 million people in India (54.5% population) live in regions that do not meet the 40 µg/m3 National Ambient Air quality standard (NAAQS), and 262 million people live in regions with levels twice this standard. They further observe, "Nearly every Indian (99.5% population) lives in an area with PM2.5 pollution above WHO's 10 µg/m3 guideline (Greenstone et al., 2015: 42). All major towns of the state fall within the category of 40-60 µg/m3. HPPCB (2014) attributes this increase in the values of PM2.5 to the increased vehicular pollution. The loss of quality of life due to the increase in air pollution is estimated to be an average 3.2 years (Greenstone et al., 2015). Vehicle population data of the state shows that the share of buses in the overall vehicle population is less than one percent and has been static at that level for the many years. There has been a 100% increase in vehicle population in the past five years. Cars and twowheelers constitute more than three quarters of the total vehicle population, and its proportion has increased from 61% in 2010 to 77% in 2015.

15.3 Infrastructure development trends

15.3.1 Road network

Road transport forms the backbone of the transportation sector in HP. The role of roads in movement of people and goods is therefore critical in the overall growth and development of the human settlements in Himachal Pradesh as they stand today. Contribution of roads has not only been in making the isolated regions accessible but has also improved the overall quality of life of the people by enabling and improving the overall movement of goods and services across the State. Given the above, development of roads has been a focus area of the state government since its formation.

Photograph relating to Road Construction issues in hilly area

In the administrative state of Himachal as it stood in 1948, there were only 288 km of motorable roads in the state (Draft 12th FYP (2012-17) & Annual Plan 2013-14). Since then, the state government has been assigning a very high priority to road sector. By 1971 i.e. at the time of formation of full-fledged State, significant progress had been made and the total motorable roads in the state had reached 7609 km. In 2012-13, 95 percent of the total road length of 34,647 km in the state was motorable amounting to 32,965 km. (Economic Survey of Himachal Pradesh 2013-14). In terms of availability of roads per unit area, the road density at the state level is only 0.62 km per sq. km, much lower than that at the national level value of 1.21 km per sq. km.

The road statistics show an extremely slow rate of growth of an average of 2.5% per year from 2004-05 till 2012-13. However, a large part of the state is still deprived of the benefits of the roads and resulting development. By the end of March 2012, only 55.19% villages of the state have so far been connected with motorable roads and about 43.91% villages are still deprived of the benefits of the road connectivity (Draft 12th FYP (2012-17) & Annual Plan 2013-14). Also, some of the roads are seasonal and get closed during winters and monsoons due to heavy snowfall, landslides and washouts.

As per the state master plan, about 39,045 kms aggregate road length is required in the State to provide optimum connectivity to all the Census (17449) villages, the approximate fund requirement, at 2011-12 prices, for constructing the balance road length in the State, as well as all-weather roads, is INR 7,396 crores (Draft 12th FYP (2012-17) & Annual Plan 2013-14).

Also, out of the total motorable roads in 2012-13, only 7 % roads were double lane roads and nearly 90 %were single lane roads. While motorable single lane roads have grown at an average rate of 3.9 % per year between 2004-05 and 2012-13; motorable double lane roads have grown at an extremely slow rate of less than 1% (Table 1).

Data indicates that the primary focus of the government has been on providing access to the inaccessible villages/habitations in the state followed by conversion of existing nonmotorable roads into motorable roads. Government programmes, both state and national level programmes like Pradhan Mantri Gramin Sadak Yojana (PMGSY), Border area road development programme, Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and others have been discussed later.

15.3.2 Railways

Rail transport is almost negligible in the state. Not much progress has been made in rail transport since independence. Only 44 kms track has been laid in the past six decades (Draft 12th FYP (2012-17) & Annual Plan 2013-14). In 2014, the state had a total rail network of 296 route kms. In terms of the route kilometres per lakh population covered by the state rail network, HP has only 4.32 route kms per lakh population which is lower than the India average at 5.44. Also, in case of route kms per 1000 sq. kms of area, HP with only 5.32 route km. per 1000 sq. km, is much lower than the national average of 20 route kilometres per 1000 sq. km.

At present, there are only two narrow gauge railway lines connecting Shimla with Kalka (96 km.) and Jogindernagar with Pathankot (113 km.), also known as Kangra valley railway. While Kalka Shimla Railway is designated as 'World Heritage' railway by UNESCO; Kangra valley railway is on tentative list of UNESCO world heritage railways. Apart from these, a broad gauge line also exists which connects Nangal Dam in Punjab to Charuru (District Una). Currently, this line is being extended till Talwara (Punjab) with track operational till Churutakarla. The work is still under execution. (Economic Survey of Himachal Pradesh 2013-14)

Another broad gauge line is planned to come up from Bhanupalli-Bilaspur- Beri- Lehon a sharing funding pattern of 25% from state, 25% from Ministry of Railways and additional 50% from Ministry of Finance. The work on this line has yet not started (except survey work).(Economic Survey of Himachal Pradesh 2013-14).

15.3.3 Civil Aviation

Like railways, the presence of air transport in HP is also negligible. At present there are three airports in HP, in Shimla, Kangra and Kullu-Manali. Apart from that, there are 57 operational helipads and 12 new helipads are also in offing. To provide better connectivity and open up remote and tribal areas to the tourists, the state government has introduced heli- taxi services in the state (Economic Survey of Himachal Pradesh 2013-14).

15.4 Public transport services

15.4.1 Intercity operations

Apart from the growing mobility needs of the locals, there is a heavy tourist inflow of passengers into the state placing additional pressures on the exiting transport infrastructure. In absence of other modes, the onus of providing passenger services falls on the road transport system making buses the most important public transport mode in the state. Public transport system in the state mainly comprises bus transport service offered by the state owned road transport undertaking and the private operators plying their vehicles (including buses, taxis, etc.) under stage carriage permits.

Himachal Road Transport Corporation (HRTC) provides mobility services to the passengers within the state and also across interstate borders. The corporation also provides obligatory free, concessional and subsidized transport services to various sections of society. In addition, the corporation provides services to far flung remote areas where the traffic is low making operations infeasible on economic grounds. The total fleet strength of the corporation has increased from 733 in 1974 to 2297 in 2014 (Department of Transport, HP).

Private bus operators also play a dominant role in meeting the mobility needs of the people in HP. In 2014, the total number of private stage carriage buses operational in the state was 3367 which is nearly 1.5 times the number of public buses being run by HRTC.

15.4.2 Intra city operations

In the main cities in HP like Shimla and Kullu, HRTC has recently started intra city operations on main city routes. In absence of adequate public transport services provided by the government for intra-city travel, the burden of meeting the intra-city mobility needs in the cities in HP mostly falls upon the contract carriage vehicles like taxis, mini buses etc. operated by the private sector.

With increasing mobility needs, a phenomenal increase in the segment of private run contract carriage vehicles has been observed in the segment of contract carriage vehicles in the state. The total number of light motor vehicles carrying passengers in the state has increased by more than 61 % in the last five years from 2007 to 2012. However, there are serious concerns in terms of quality of services and passenger security in these vehicles (Transport Policy, GoHP, 2014).In absence of adequate public transport services, the dependency on personalized modes has also increased over time in cities in HP bringing along problems of congestion, rising pollution levels, and others.

15.5 Freight transport

The State has had a huge and ever growing demand for movement of goods ever since its formation. With opening of new areas with development of roads, industrial and tourism development; need for movement of

Slope Stabilization through Bio-engineering

goods has increased phenomenally. The goods transport is also dependent on road transport in HP further adding onto extreme pressures faced by the road network.

The number of goods carriage vehicles (including trucks, lorries and light motor vehicles carrying goods) in the state have doubled up since 2007. The total number of goods carriage vehicles registered in HP in 2012-13 was 96,855. The number has grown at an average rate of growth of 16.35 % per year since 2007.

The State's transport policy clearly states that the freight segment in HP is characterized by proliferation of small operators with high operating costs in the absence of economies of scale, dominance of old and polluting fleet, cartelization of operators to enforce rates and terms as per their choice, and problems of overloading associated with ill effects in the form of accidents and damage to the roads. In the absence of ample employment opportunities in other sectors, the transport sector has by default absorbed a large chunk of manpower which is now totally dependent on it for livelihood. It therefore presents a delicate politico-economic policy problem and the challenge to find an easy solution is difficult to the extent of being infeasible. Further, it is realized that the the goods transport has not seen any new innovation in technology and operation in the past many years due to which the transportation of farm produce and industrial products at competitive fares remains an area of serious concern (Transport Policy, GoHP, 2014).

A similar situation exists in the tourist transport segment. In this segment, an additional complication is introduced by its overall with the stage carriage operation. There is a rather thin distinction between the operational parameters of stage carriage and contract carriage operation. Ideally, the contract carriage operation should be limited to taking passengers from one place to another with no stoppage for boarding and alighting the passengers enroute.The stage carriage operation on the other hand is operation on affixed route, from stage to stage, and committed regardless of pre-booked passengers. In the absence of enough tourist business throughout the year and in all places, the contract carriage vehicles (both buses and taxis) start operating on a fixed route taking passengers from place to place en route. It often leads to violent conflicts with stage carriage operators and instance of legal action for violation of the Act.
With market being supply driven dominated by small operators, there is a cut throat competition in busy places and instances of over charging in remote localities. It has seriously affected the vehicle maintenance leading to problems of pollution and road accidents. Frequent problems of mixing kerosene with diesel are also reported.

15.6 CHALLENGES

15.6.1 Gaps in Laws and Regulations

Most of the transport externalities like pollution, congestion and road accidents partly arise partly due to some of the provisions of the Motor Vehicles Act (henceforth referred to as the Act). Some of relevant provisions are detailed as under:

(I) Section of the Act empowers the Central Government to prescribe the maximum life of a motor vehicle. This provision has largely not been used so far. It implies that vehicle of any vintage could be plied on roads. This coupled with defective inspection and maintenance regime leads to defective and unfit vehicles being plied on roads. Owing to this, some of the 30-40 years old vehicles could also be seen on roads. Most of these vehicles are highly polluting and do not support safety features available to the new technology vehicles.

(ii) The Act does not prescribe maximum age limit for holding a driving license. Therefore, aged people/ people with poor reflexes could also ply vehicles. Likewise, the medical test does not prescribe detailed protocol that takes account of physical limitations arising out of advancing age and genetical predisposition.

(iii) The current licensing regime does not take into account the driving behaviour of the licensee. Even the provision of Section empowering the Registering and Licensing Authorities to cancel or suspend a license are rarely resorted to. There is no data base tracking the accident record of a person as a result which renewals are automatic and are done merely as a formality. The situation gets further complicated as the current insurance regime also fails make a distinction in insurance premium based on driving behaviour giving opportunity of free riding to habitual offenders and encouraging high risk driving behaviour.

(iv) Section 67 of the Act empowers the State Transport Authorities to fix fare rates for freight and passengers. However, no scientific bases are prescribed nor is there any time frame for fixing rates. As a result, there is lag between the cost escalations and fare revision leading to implicit subsidy in operation overcharging. It has serious implication for maintenance affecting pollution levels and safety standards.

(v) As the Act is an outcome of the decontrol era, it has kept both vehicle ownership as well as permit regime in open market formulation leaving no scope with the authorities to impose restrictions to control vehicle population or unfair competition. It directly affects road congestion and safety as with too many commercial vehicles plying on roads, there is commonly noticed problem of buses chasing each other to get passengers leading to road accidents.

(vi) While there are four major players in transport operation: vehicle, driver, passenger and the road; the current provisions of the Act only regulate the first three and do not take into account the road at all;

(vii) The current Motor Vehicle Taxation provisions also do not incentivise vehicle maintenance and safety. The relatively weak enforcement of existing laws combined with minimal penalties contribute to rampant flouting of transport rules and regulations.

15.6.2 Fragmented Institutional Frameworks

Transport systems require several functions to be performed in a well-coordinated manner for seamless and comfortable travel experience for commuters. For instance, the road management, land use planning, development of industrial areas, and urban development. Transport planning has to be integrated with land use planning right from the beginning to ensure provision of services. Within road infrastructure, there different categories of roads with equal number of agencies to handle them. For instance, while national highways, state highways and major district roads are handled by PWD, there are a number of agencies in rural roads.

Similarly transport infrastructure is also handled by multiple agencies. Bus operation is with HRTC and private operators, the bus stands are with Bus Stands Management Authority and rain shelters are with PWD and institutions Local Self Government. With so many agencies in the fray, it is difficult to fix responsibility and there is often a confusion in pursuing a common agenda. This problem is particularly pronounce in the road accidents as with multiple agencies it is difficult to fix responsibility and the conclusion on cause of accidents is often the driver's fault.

15.6.3 Distorted Land Markets affecting Transport Infrastructure Development

Very high costs of land acquisition along with arduous and time-consuming processes are a major barrier for planning integrated transport infrastructure. About 70 per cent of delays in all infrastructure projects in 2008 were due to problems related to land acquisition (Mohanty et al., 2009). One of the factors is the heavily distorted land market, caused by zoning and development control rules in cities that limit the supply of land that can be devoted to commercial, industrial or residential use. Significant amount of public lands keep large portions of well-located land outside markets. Cumbersome and time-consuming forest to non-forest land

conversion rules increase cost of land. The Floor Area Ratio (FAR) and Floor Space Index (FSI) regulations as espoused in the Development Control Regulations (DCR) are too low compared to international benchmarks Exceptions to these rules are traded on a highly selective and non-transparent basis, offering little incentive for land owners to surrender their lands for infrastructure development.

All attempts to develop well-planned townships outside the existing city limits and eventually relocate major activity centres to decongest the city has met with limited success. In most cases, there is inadequate transport infrastructure to serve these new suburban developments and the residences located around them. Because of such policies and unplanned growth in our suburbs, they are often characterised by a mix of industrial development, dumps and incompatible land uses. These unplanned extensions of settlements potentially cause conditions in the overtaken villages to deteriorate, both physically and socially. Suburban sprawl has also sprung up along major national and state highways out of towns in the state to the distant countryside. This type of low-density, sprawled decentralisation causes enormous challenges for provision of good public transport services to such areas. In Himachal Pradesh (as is the case with country as a whole), it has consequently led to rapid growth in car and motorcycle ownership and use, leading to increasingly congested roadways that slow down buses, increasing bus operating costs, further discouraging public transport use.

15.6.4 Lack of Comprehensive Design Standards for Transport

Common standards for design, operation and maintenance of transport infrastructure and rolling stock are relatively absent in India. The Indian Road Congress (IRC) has been the nodal agency that sets design guidelines and technical standards for construction of roads and bridges, primarily for intercity roads but also for urban roads. These standards are voluntarily followed by all road construction agencies. A critical feature is that IRC codes are not adhered to for urban road development, they are not mandatory for municipalities or public works department and hence they fail to enforce these standards on the contractors. As a result, a part of the right of way is developed while the rest is left undeveloped, leading to unorganised and unregulated traffic - a major cause of the high occurrence of traffic accidents and fatalities.

Instance of mismatch between road size and vehicle density and size are common. Small roads having a limited carrying capacity linking major habitations are often choked and congested. There are serious constraints in capacity expansion due to non-availability of land, road encroachments, and high costs of acquisition. With 66 percent of land being classified as forest land, the government cannot even put its own land to use in transport infrastructure development. There are many instances of road accidents due to a bigger vehicle plying on smaller roads or roads encroached by idle parking or other encroachments.

15.6.5 Human Resource Challenges

Transportation is a complex system as it constitutes several activities, stakeholders and processes. Unfortunately, the capability for undertaking a coordinated approach along with a holistic understanding of transport issues and their causes involved is generally lacking at the state government and city level. This is attributed to a lack of transport management skills amongst city and state officials. In most cases, state and city level agencies dealing with transport planning and provision have typically suffered from overstaffing with people with homogeneous skills consisting of largely untrained and unskilled manpower on the one hand and shortage of qualified technical staff and managerial supervisors on the other. It is a major reason that they have not been in a position to deliver the current demands for transport services, let alone plan for the growing needs of cities and peri urban areas. The staff and management at these agencies are typically not accustomed to innovation and taking up new tasks, and are more comfortable opting for traditional methods





Use of Different Techniques Need and Evidence based

of procurement and working with government grants and and loans. This limitation has been a major factor in limited IT penetration in the sector and relatively lack of technological innovations in operation and management of fleet. Even the optimization of fleet usage and inventory management have suffered due to this reason. With the technology and electronics taking over the vehicle operation, the state has therefore to focus on upgradation of skill of the existing manpower and tapping new skills from the market.

15.6.6 Absence of Reliable Transport Data

The absence of a database with scientific management and analysis of transport statistics has severely constrained the ability to formulate sound transport plans and reliably assess the impact of the different projects carried out in thissector (Bhatt et al., 2013; Agarwal, 2006; Ahluwalia, 2011). The reliability and accuracy of even the available data is suspect at present since much of the data collected is either part of a specific study or collected with a specific project in mind. Secondly, available data is scattered over a multiplicity of different agencies and often difficult to obtain. Thirdly, the data is neither collected regularly nor kept up to date which is a limiting factor for larger policy and planning functions. In any case, the data is not available at regular intervals and does not lend itself to any kind of trend analysis. This seems to be a major problem observed across Indian cities, which is why the urban transport management seems to be a major challenge.

Besides, inability to generate and maintain work flow based data has been a major handicap in identifying unsafe drivers and old and polluting vehicles. In many cases, accident inquiries have revealed that the vehicles were not fit to be plied on road but were still operating as there were no system generated checks. Likewise, it is not possible currently identify old polluting vehicle and unsafe vehicles with obsolete technology.

15.6.7 Energy Security

The current transport operation in Himachal Pradesh is totally dependent on fossil fuel. Besides raising energy security concerns, it makes the sector amenable to frequent cost escalations arising out of crude oil price hikes and exchange rates. It is particularly relevant since India imports most of its crude oil requirement. It is estimated that production of crude oil in the country has increased at an average annual growth rate of around 1.6 per cent from 2000-2001 to 2010-2011, whereas the consumption of petroleum products over this period has increased at a rate of more than 4 per cent annually (MoPNG, 2012). The reserves to production (R/P) ratio of crude oil in India indicates enough reserves for 30 years, whereas the R/P ratio worldwide indicates enough crude oil to last for 46 years (TERI, 2011). India has become, and will continue to be, increasingly dependent on imported crude oil. Even though Himachal Pradesh is an energy surplus state, no planned attempt is made to promote the use of electric vehicles. It is estimated that total petroleum consumption by the transport sector is expected to grow three-fold from 2010 to 2030.

15.7 POLICY OPTIONS

15.7.1 Promoting Transformational Technologies

In this technology driven world, companies worldwide are testing automated cars, trucks, and driverless vehicles equipped with artificial intelligence may soon revolutionize transportation. Likewise, vehicles connected to one another with advanced high-speed communication technologies may greatly reduce crashes. These revolutionary technologies and services can potentially speed deliveries, prevent crashes, and ease traffic congestion and pollution. Several developed countries have regulations for mandatory recall of

vehicles if defects are found and reported by the customers. The challenge is how to adopt them and develop a policy regime that encourages modern less polluting and safe vehicles. Our Motor Vehicle Rules and Taxation Rules could play a major role in this. Simultaneously, benefit should be taken under national initiatives.

One of the major initiatives by the Government of India towards improving road safety is the plan to launch the Bharat New Vehicle Safety Assessment Programme (BNVSAP). It is an Indian version of the global New Car Assessment Programme (NCAP) wherein cars would receive star ratings based on safety features. The programme would include frontal and rear crash tests and require compulsory safety features like ABS and airbags. BNVSAP is likely to be mandated for all cars.

In commercial vehicles, ABS is mandatory for all new models launched after April 1, 2015 whereas manufacturers were allowedsome grace time to incorporate ABS in the new vehicles sold under existing models. However, no timeframe has been rolled out for mandatory airbags in commercial vehicles.Some global automakers in India have started offering safety features in several of their models to safeguard their brand image, retain customer confidence and to be prepared for the upcoming safety regulations. To gain acceptance of customers with lower awareness of safety related features, these OEMs have also been using their dealerships to educate customers about the benefits of such features.

The issue of auto emissions and overdependence on fossil fuels is also being tackled through India's policies related to fuel efficiency of vehicles. The Bureau of Energy Efficiency (BEE) has already notified new norms under the Corporate Average Fuel Consumption (CAFC) policy, which when implemented would mandate a mileage increase of about 14 per cent for all passenger vehicles from 2016-17. It would also require labelling of all new cars, wherein information of fuel consumption relative to other models in the same weight class would be provided. This would help customers make a more informed choice which could cause a pull for low-fuel consuming models. Customer preferences in India have always been in favour of better fuel economy vehicles due to lower operating costs and this has been a key reason of success for market leaders in passenger vehicles.

As the weight of a vehicle directly impacts its dynamics, agility, fuel consumption and CO^2 emissions, it has been drawing the attention of the automotive industry for decades now. Lightweighting strategies today are a combination of component design, manufacturing process innovation and substitution of materials. Leading car manufacturers in India have been targeting lightweighting with materials such as aluminium, magnesium alloy, high performance engineering plastics and high strength steel. Vehicle manufacturers have to align with Tier I and II suppliers to achieve the desired results. The automotive industry is looking at other sectors as well to quicken its own learnings in material science. One such sector is aviation and aerospace. Cross industry exchange from aviation to the automotive industry could increase the pace of adoption of advanced materials. A faster learning curve could be possible if knowledge of composite design, crash simulation, recyclability, material failure mechanism and assembly technologies is transferred from the aviation to the automotive industry.

15.7.2 Promoting Alternative Fuels

Apart from conventional vehicles, there are a variety of alternative fuel based vehicles on the road, such as CNG, LPG, electric vehicles, etc. Of all the alternatives available, Electric Vehicles (EVs) have been on the radar of the government and OEMs, globally. However, the scenario of roads filled with electrically operated cars still seems distant. According to the 2015 Global Automotive Executive Survey, by 2020, less than one in 20 vehicles is expected to be equipped with electrified powertrains, which may be dominated by full or partial

hybrids. The plug-in hybrid and battery EVs are expected to capture a smaller portion of the pie, followed by fuel cell electric cars that have the least share. By 2020, only 0.01 per cent of cars are expected to be equipped with fuel cells i.e. about 16,000 units per annum.

The EV industry in India is presently far behind, with less than 1per cent of the total vehicle sales. Currently, Indian roads are dominated by conventional vehicles (ICE) and have approximately 0.4 million electric two-wheelers and a few thousand electric cars only. The Indian EV industry has been on the back seat due to various challenges that are similar to the global EV industry. High cost of batteries and cars has been a major obstacle to the widespread consumer adoption of EVs in India. Lack of inexpensive and robust charging infrastructure is another parameter which has hindered its growth.

Despite achieving more fuel savings in an electric car as compared to conventional cars, an EV owner cannot recover the high cost of vehicle, which leads to high cost of ownership. A typical electric car in India costs around INR 0.5 to 0.6 million which is approximately 2.5 times higher than an entry level fuel efficient conventional car. Also the battery life of the EV is approximately four to five years and the replacement cost is around INR 0.2 to 0.3 million, which further adds to the cost of ownership. Besides price, another barrier that has prevented the widespread adoption of EVs is range anxiety.

The launch of FAME was yet another major move by the government to encourage sales of electric and hybrid vehicles in India. The scheme, formulated as part of NEMMP 2020, was rolled out by the Ministry of Heavy Industries and Public Enterprises, in collaboration with the Society of Indian Automobile Manufacturers (SIAM).Under this scheme, the government will provide demand-side incentives up to INR 0.14 million for every electric car sold. With a planned investment of INR 7,950 million, phase I of the scheme started from April 1, 2015 and will run till the end of 2016-17.

Going forward In Himachal Pradesh, the penetration of EVs in urban areas depends on the acquisition and ownership costs as well as quality of and accessibility to charging infrastructure. The policy regime should work towards developing an environment that encourages the private sector to create charging infrastructure in the country. Another important focus, to boost the EV market, should be on batteries that typically constitute up to half of the vehicle cost and weight. The government should support research activities to develop innovative and low-cost batteries, recycling and reuse of batteries, etc. The NEMMP,focusses on battery cells and Battery Management System (BMS) technology as a priority.

The state will need to put a policy in place for enabling such developments getting adopted rapidly.

15.7.3 Controlling Emissions

Nationally, the issue of auto emissions and overdependence on fossil fuels is also being tackled through India's policies related to fuel efficiency of vehicles. The Bureau of Energy Efficiency (BEE) has already notified new norms under the Corporate Average Fuel Consumption (CAFC) policy, which when implemented would mandate a mileage increase of about 14 per cent for all passenger vehicles from 2016-17. It would also require labelling of all new cars, wherein information of fuel consumption relative to other models in the same weight class would be provided. This would help customers make a more informed choice which could cause a pull for low-fuel consuming models. Customer preferences in India have always been in favour of better fuel economy vehicles due to lower operating costs and this has been a key reason of success for market leaders in passenger vehicles.

For petrol vehicles 'Three way' catalysts, precise engine, fuel controls and evaporative emission control have been quite successful. More advanced versions of these technologies can reduce smog-forming emissions from new vehicles by a factor of 10. For diesel vehicles 'Two way' catalysts and engine controls have been able to reduce hydrocarbons and CO emissions but NO^x and toxic particulate matter emission remain very high. Cleaner fuel quality petrol and diesel contain significant amount of sulphur and other compounds that make it harder for existing control technology to keep vehicles clean. Fuel quality specification have been laid down by BIS (Bureau of India standards) for gasoline and diesel for the period 2000-2005 and beyond 2005 for the country, it becomes necessary to reduce its sulphur content, for which Bharat IV has been reduced to 50ppm. For gasoline lead was phased out in the entire country w. e. f. 1 Feb. 2000. Alternative fuels such as natural gas, biodiesel, and ethanol can deliver benefits to the environment while helping to move the world away from dependence on oil. All these fuels inherently burn cleaner than diesel and petrol and have lower carbon content resulting in less CO2. The Indian auto industry is working with the authorities to facilitate for introduction of the alternate fuels. India has also set up a task force for preparing the hydrogen road map. LPG has been introduced as an auto fuel and the oil industry has drawn up plans setting up auto LPG dispensing stations in major cities.

For Himachal Pradesh, one very useful measure could be to develop state of the art Inspection and Maintenance (I & M) systems. It is the most important step towards emission control and road safety. It requires developing machine guided inspection and maintenance. It is possible to reduce 30-40% pollution load generated by vehicles through proper periodical inspection and maintenance of vehicles.

15.7.4 Pricing of Transport Services

Appropriate pricing strategies are essential for making transport business sustainable and promoting pollution abatement technologies and road safety. The growth of the transport sector and the consideration of allocative efficiency would require the pricing of any mode of transport to follow the long run marginal cost pricing principle. However, there are problems due to both market failures and distributive considerations which create problems in applying such a marginalist principle in the real-life context. The ground-fixed infrastructural items (like roads and bus terminals, etc.) have got certain 'public good' character while transport operation often exhibits tendencies of vertical integration and large-scale economies leading to a natural monopoly situation. There are also problems of negative externalities arising from environmental stress due to both fuel consumption as well as congestion in use. Besides, there are positive dynamic developmental externalities generated by the expansion of the transport sector and particularly the higher connectivity within a country. Finally, the skewed distribution of income and assets among individuals of a society like ours alsocreates problem of access to the market of transport service for the poor because of their

limited ability to pay, if transport charges are to cover the full cost at the margin even under competitive conditions. In each of these cases, market driven prices give rise to a serious problem of inequity. The following sources of such inequity which would justify state intervention through price regulation of this sector, among others.

First of all, the public good character of the ground-fixed infrastructure, including the dynamic developmental externalities generated by its development, ideally requires individuals to pay according to their marginal benefits derived from the last unit of its supply. Since exclusion principle is either non-applicable or is of limited applicability in the case of use of such public good type service and since there is only limited substitutability in its consumption, marginal utilities would very likely differ among individuals for any given level of supply of the public good. However, the users of such service would very likely take advantage of free riding and the market would fail to elicit the true offer prices of consumers according to their respective marginal utility.

The asymmetry of information in such a situation between the suppliers or regulators of prices and the consumers leads often to a situation where it becomes difficult to finance a project as per the social (pareto) optimality rule that sum of the offer prices by all the individual consumers should equal the marginal cost of supply of the public good. That is why either the transport infrastructure would be undersupplied (if it is left to the market mechanism with private capital to take the investment initiative), or the cost would not be recovered even if the state plays a pro-active role in augmenting the capacities of such infrastructure so that the society can benefit from its forward and backward linkage effects. As a result, a social practice has evolved that publicgoods like roads are considered free access infrastructure and are maintained and expanded out of funds mobilised from various taxes and levies by the government which are not fixed as per any pricing formulae of private good. The social distributive consideration often leads to underpricing of such services vis-à-vis normative costs. In the context of the state, subsidized or free use of road and transport services have resulted in underpricing, poor maintenance and delayed augmentation of capacities. That is why not only the Himachal Road Transport Corporation is running in losses but it is true for all state PSUs in the road transport and other modes like railways also. Secondly, the natural monopoly tendencies develop in transport sector due to large-scale economies or requirements of technicalities of operation of a transport network. These often lead to the emergence of a monopolistic situation in passenger and goods transport causing iniquitous exchange and inefficient resource allocation. The consumer in such a situation is exploited due to the fact that the price paid is more than the marginal cost of supply of the transport service as the profit maximising objective of the monopolist results in the marginal revenue and not the price being equated with the marginal cost. The resulting allocation of resources and the extent of supply of the transport service would be sub-optimal, and would reflect a situation of undersupply of the service. This explains the state intervention in taking over the responsibility of supplying the transport services fully or partially in a region and regulating the prices.

The planning for augmentation of capacity or operation of the transport infrastructure in the state has been guided by the normative requirements of the economy or society across the state subject to the political-economic constraints of the mobilisable financial resources from the internal sources of the sector and the financial health of the state. The prices have, on the other hand, been guided by the social distributive consideration that such service is a 'necessity' of 'common man', often resulting in a large effective subsidy to the consumers. Alternatively, the pricing principle has taken advantage of cross-subsidization whenever product diversification has been possible to lessen the burden of effective subsidy. The effective subsidy to a consumer is the shortfall of the price charged from the cost of supply, and cross-subsidization of consumer B by consumer A to be the excess of price over cost paid by consumer A to cover the shortfall of the price paid by

consumer B from the cost of the product. Such subsidies lead, on the one hand, to the problem of resource mobilization for the planned program of maintenance and expansion of the transport system of the concerned mode and, on the other, cause the prices to induce diversion of resources to those modes of transport which might involve higher use of scarce resources of the society.

Finally, the adverse externalities generated by transport operation through emission of gases, road congestion, noise, etc. lead to unsustainable transport use causing enormous health and time cost to the society. As pollution has been a public bad in character, and as environmental services are not marketed, the market prices fail to reflect the cost of externalities and are often substantially lower than the marginal social cost involved in the supply of transport services. This also involves the serious issue of horizontal equity in exchange. The user of transport gets away without paying anything for the damage he causes to the society and thereby induces misallocation of resources in favour of a relatively more polluting mode of transport.

15.7.5 Promoting Equity serving the disadvantaged

Transport having more of the character of a necessity in the basket of a poor man's consumption, the utility function of the poor will involve inelasticity of substitution between a transport and a non-transport good. Since variation in prices facing the poor would have both an income effect and substitution effect, a higher price of transport would have an adverse effect on real income as also on social welfare level. This leads often to the argument that ideally society should resolve such distribution problem by income transfers through lump-sum taxes and subsidies independent of the regime of the relative prices, as this would not cause any distortion in the allocation of resources. However, often the political-economic transaction cost of implementing such policies of income transfer becomes too high, reliance by default, has to be placed on the use of prices as instrument of resolving the distributive problem through subsidy in consumption of the necessities.

Equity in transport is particularly relevant for Himachal Pradesh since the road transport is the only mode of transport and a large section of the population lives in far flung areas where private provision at cost recovery based market price would keep weaker sections of the population out of the service benefit. It has implications in terms of access of vital services like health and education along with opportunities like investment and employment. One of the major limitations that has emerged out of such a policy in the state is that transport prices have often been regulated in the name of serving social purpose without due regard to the consideration of covering costs, the total effective subsidy has been too large adversely affecting the quality of transport service if not also the quantity – of both ground infrastructure and transport operation. Where the regulating authority has been successful in controlling the aggregated effective subsidy, such control has been accompanied by extensive cross-subsidisation through product differentiation targeting the consumers of different income classes. However, the product diversification has been possible to lessen the burden of effective subsidy. The effective subsidy to a consumer is the shortfall of the price charged from the cost of supply, and cross-subsidization of consumer B by consumer A to be the excess of price over cost paid by consumer A to cover the shortfall of the price paid by consumer B from the cost of the product. Such subsidies lead, on the one hand, to the problem of resource mobilization for the planned program of maintenance and expansion of the transport system of the concerned mode and, on the other, cause the prices to induce diversion of resources to those modes of transport which might involve higher use of scarce resources of the society.

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However, as these policies have often been pushed beyond the levels warranted by the optimisation of social welfare, the benefit of redistribution has been more than offset by the loss of allocative efficiency. This has resulted in the poor quality of infrastructure and its maintenance and its quantitative inadequacy relative to the demand (as has been seen in the inability of HRTC in plying buses on new PMGSY roads) for the given structure of prices. The state should therefore put a policy in place whereby the passenger fares are revised based on basket of cost items like bus costs, interest rates, petroleum prices, and wages. A formula of revision based on weights assigned to each item depending on its share in the overall cost could be worked out and the revision is done after a certain percentage increase in overall cost occurs. It is most important since it will have a substantial impact on technology adoption and hence on pollution and road safety outcomes.

15.7.6 Policies Promoting Maintenance of Transport Infrastructure

Limited financial investible resources have been thinly and widely distributed over the road network resulting in inadequate structural thickness of roads and their poor riding quality. Overloading of commercial vehicles has further caused damage to the roads adding to the problem of inadequacy of maintenance expenditure and poor road quality. Poor roads affect not only the speed of vehicles but also their fuel consumption because of the consequential rise in the roughness index. The total impact on environment through vehicular emissions of polluting gases and congestion imposes considerable cost on the society. Part of the environmental cost of roadtransport is imputable to inadequate carrying capacity and quality of roads.

The major reason behind the low quality of inadequate road infrastructure service has been insufficient allocation of resources and poor management. The problem in road pricing arises basically from the public good character of road service and asymmetry of information between the supplier and the user of road and the free riding tendency of the latter. That is why road charges are levied as taxes and the expenses on roads are charged on the government budget. This instantly makes the issue of implementing the social optimality rule of charges somewhat of a non-issue and the two are supposed to be independently determined.

In Himachal Pradesh, especially in the context of the State Transport, there remains, however, the problem of low quality and inefficiency in the delivery of transport service that is associated with the problem of losses and consequent lack of funds/resources for upgradation of the quality of bus service and expansion of its capacity in public sector. In view of the general excess demand for passenger road transport service and poor quality of public transport, there is no compulsive force to induce the private operators to upgrade the quality of their services. The policy response therefore has to identify ways to create a dedicated road fund to support maintenance.

15.7.7 Freight Transport

The state has had a huge and ever-growing demand for movement of goods ever since its formation. With opening of new areas with development of roads, industrial and tourism development; need for movement of goods has increased phenomenally. The goods transport is also dependent on road transport in HP further adding onto extreme pressures faced by the road network. The number of goods carriage vehicles (including trucks, lorries and light motor vehicles carrying goods) in the state have doubled up since 2007. The total number of goods carriage vehicles registered in HP in 2012-13 was 96,855. The number has grown at an average rate of growth of 16.35 % per year since 2007.

Appropriate taxation policy has to be put in place to ensure that multi axle trucks are promoted in the state and old polluting vehicles are put off the road. Two possible ways of doing so can be by putting a limit of age of vehicle in the conditions of goods carriage permit and charging very high taxes after a certain age of the vehicle.

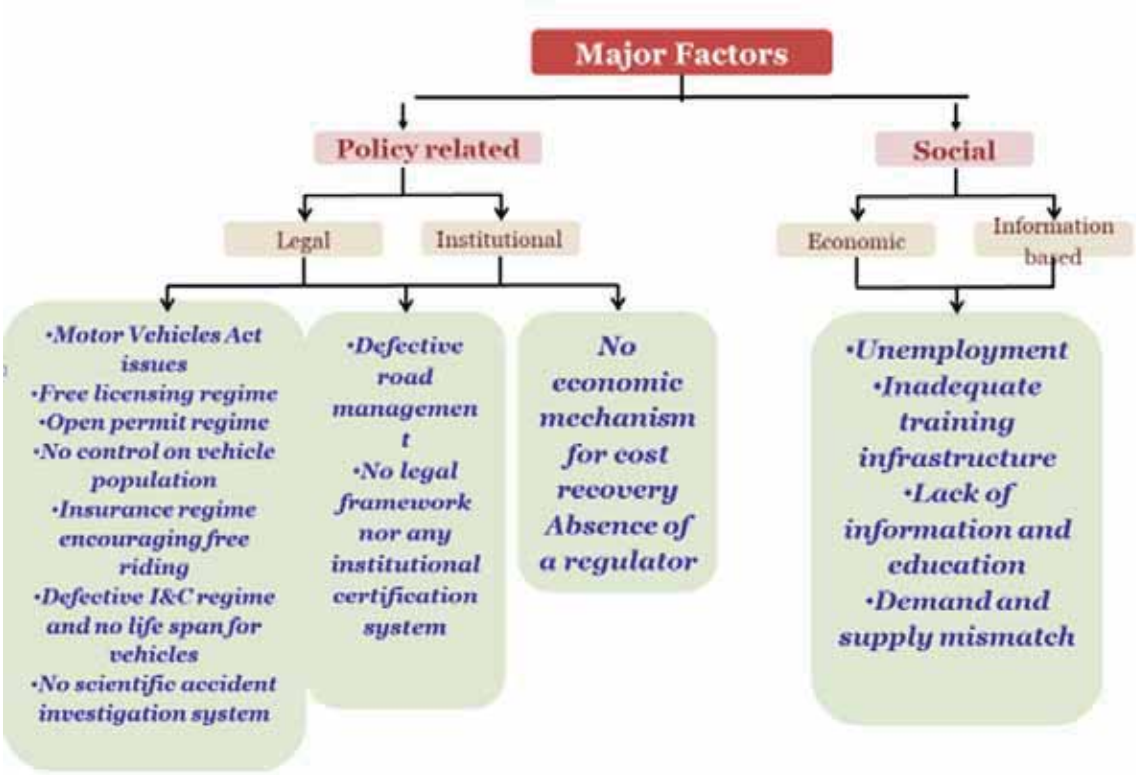
15.7.8 Skilling Manpower

With introduction of EVs and HVs, the state needs to quickly frame policy and develop infrastructure to maintain such vehicles. Otherwise, it is likely to lose employment opportunities to the expatriates. Among the major skill requirements relate to mechatronics, AI and machine learning, robotics, digital and data mining analytics. With changes engine mechanics from mechanical engines to electrical motor control to battery and power management, sensor making to computational skills; employers will be looking for specialists. As automation and connectedness becomes the center of the industry, understanding how AI works and its

application in the automobile industry will become critical. Likewise, robotics and digital experience becomes a must in the changed scenario. Finally, as designing and assembly of vehicles becomes complex, it is imperative for organizations to deploy tools that can collate, analyze, and generate insights from data collected from every lifecycle of a vehicle. Closing the gap for the automotive industry of the future will require auto companies to adopt three-pronged strategy: building, buying, and borrowing talents.

15.7.9 Incentivizing Road Safety

For effectively controlling traffic injuries and deaths, the state needs to put in place strict licensing regime where by no unfit person could obtain a license, maintain data to keep track of the driving behavior of the licensee, thoroughly revamp the inspection and maintenance regime by putting up fitness centers across the state, enforcing permit conditions effectively to cancel permits in case of major violations, introduce tax reforms for disincentivizing unsafe vehicles, reconsider road inspection committees by putting independent professionals therein, and have effective accident enquiry systems which could suggest appropriate changes in policy and procedures. All stakeholders should be brought on board and a coordinated multi-sectoral policy is put in place to ensure that safety measures are implemented religiously.



15.8 CONCLUSION

As can be seen from the discussions above, the magnitude and complexity of our mobility challenges requires a comprehensive framework that addresses the issue holistically. The geo-physical location of the State with extreme weather conditions, rural urban migrations, coupled with our economic growth aspirations warrants a tailored approach, unique to our State. While it is worth noting that both the central and the State Government have come out with various initiatives like National Urban Transport Policy, the Auto Fuel and Vision Policy & the National Electric Mobility Mission Plan 2020; and Electric Vehicle Policy government, creation of a road safety cell with multi stakeholders, and creation of a road safety fund by the State Government.

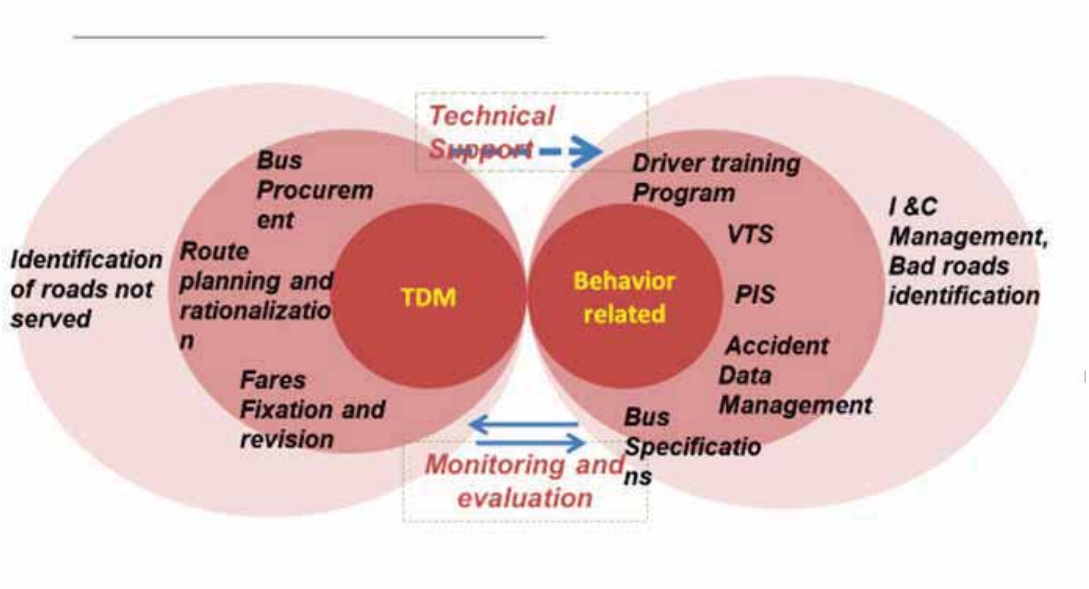


Figure : Policy Options for Himachal Pradesh

As most measures require a certain level of information of actual situation on the ground, accuracy and reliability in traffic data collection is fundamental in understanding our current mobility needs and planning future initiatives and infrastructure. Therefore, standardized guidelines for data collection – type and methodology – need to be developed. The right infrastructure and technology for data collection also needs to be installed to enable informed decision making. This can include smart traffic sensors, CCTV cameras, and innovative technological interventions using IoT (Internet of Things). In addition, commuters can also volunteer data off-line through surveys as well as online methods such as through smartphone apps and share real-time traffic and road information.

Public Awareness and Communication Behavior change is a critical lever for initiatives to succeed, and a visible and coherent communications strategy is essential to drive behavior change. Successful examples could be seen in some of the national programs like Swach Bharat Mission where due to an effective communication strategy, very good results are achieved within a short time. New initiatives tend to succeed when public will is behind it, and for that, it is critical that the Government demonstrates its will to execute the project. Reputable brand agencies should be deployed, especially to drive largescale changes, which may require either behavior change or public acceptance. Reaching out to the modern commuter has also become easier through social media platforms like Twitter etc.