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Assessing the Incidence of Natural and Man-made Disasters in District Kullu, Himachal Pradesh

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ABSTRACT

Positioned between Greater Himalay and the lesser Himalay Kullu valley is formed by the River Beas which arises from the Rohtang Pass situated in the PirPanjal range of mountain at the 3900 meters. above the mean sea level. According to the earthquake hazard zonation map, Kullu Valley is located in the zone IV and V and thus there are major incidents of earthquakes in which the most disastrous one occurred in the year 1906, and later in 2014 and 2016 though of lower magnitude. According to the landslide hazard Zonation of India, there are 1820 sq. km. and 3513 sq. km area occurs under the severe to a very high and high category of zones. The valley also faces frequent incidents of rockfall and landslides, the most disastrous landslide occurred in the year 1995 in Luggur Bhatti in which 65 people were buried alive under the slide. Being located at the River Bank, the Kullu Valley is prone to flash floods and cloud bursts and sometimes these are very disastrous, causing damage to agronomic landscapes, orchards, property including road infrastructure and bridges. In the year 1997, the cloud burst followed by a flash flood claimed the life of 124 people. Besides this, the Valley is prone to forest fires, snow avalanches, and droughts. Incidences of man-made disasters, mainly road accidents, and domestic fires have also increased in the valley and caused immeasurable damage.Based on primary and secondary information gathered, this paper gives an account of various natural disasters occurring in Kullu valley.

Keywords: Natural Disasters, Earthquakes, Flash Floods, Landslides, Cloud Bursts, Forest Fire, Kullu Valley

INTRODUCTION

Disasters have a strong link for the mountain ecosystem and owing to geo-physical complexities the geo-physical disasters are more common in the hilly regions. But, within the hilly regions some regions are more prone to frequent disasters than others. Historical records show that distressingcatastrophes have been a regular feature of the entire Himalayan region (Chandel, 2015). A disaster is a catastrophic event that disrupts and threatens life and property. According to WHO, disaster disrupts the normal living conditions thus causing a level of misery that exceeds the capacity of the affected community. The disasters can be natural or anthropogenic. Natural disasters include earthquakes, landslides, cloud bursts, floods, avalanches, etc. Though the occurrence of natural disasters is being linked with supernatural power, the triggering cause for all the disasters is manmade, including blasting, mining, mines, and unplanned development. Himachal is one of the enthralling regions of North-western Himalay, with varied climatic conditions that favour the thriving of floral, faunal, and cultural diversity. Himachal is bordered by the states of Punjab, Haryana, Jammu & Kashmir, and Uttar Pradesh. It has an altitude ranging from 350 to 7000 meters above the mean sea level. The geographical area of the state is 55,673 km^2 which is 1.7 percent of the country's area and 10.54 percent of the Himalayan landmass. Administratively, Himachal is divided into twelve districts but, geographically, the state can be divided into three distinct regions, viz. The Shivaliks or the outer Himalay (350 to 1500 meters); Mid-Himalay or inner Himalay (1500 and 4500 meters); and Greater Himalay or the Alpine Zone (4500 meters and above). Kullu valley is located between Greater Himalay and the lesser Himalay. The valley, having fragile topography has been threatened by the developmental activities, viz.:

- The exploitation of natural resources has increased over the years
- Increasing urbanization imposing threats to the ecology of the region
- Deforestation and overgrazing at an alarming rate

- Destruction of forests due to forest fire resulting in the loss of biodiversity
- Climate change advancing at a more rapid rate
- Soil erosion
- Changing rainfall patterns
- Drying-up of wetlands

This has increased the incidence of natural disasters the important ones being, earthquakes, landslides, flash floods, snowstorms and avalanches, droughts, dam failures, fires (domestic and wild), accidents, etc.

METHODOLOGY

Sources of Data: This paper is based on the primary and secondary data collected from different sources which have been used to draw the results.

Study Area: Kullu is located between latitude $31^0 2^0$'25 N to $32^0 25'^0$ N and longitude $76^0 56'3^0$ E to $77^0 52'2^0$ E at an altitude ranging about 1279 meters above the mean sea level. The total geographical area of the Kullu district is 5503 square kilometers and the district falls between the lesser Himalay and the great Himalay mountain range. The elevation of the mountain area is up to 4200-5000 meters above the mean sea level and the elevation of the valley is between 914-2100 meters above the mean sea level. Kullu has a topography of a valley with moderate to steep slopes and open valleys. Alluvial and non-calcic soil is the major types of soil found in the area. Kullu valley has a salubrious climate with average annual rainfall between 918 to 1124 mm. The minimum temperature falls from -2^0C to 5^0C during the winters and the maximum temperature rises from 25^0C to 37^0C during the summer. The economy of the Kullu district is dependent on agriculture and horticulture. The upper Kullu Valley including the Northeastern area falls in the seismic zone IV and V.

RESULTS AND DISCUSSION

Kullu district is prone to natural disasters like avalanches, earthquakes, floods, cloud bursts, and landslides and resulted in many casualties. According to the hazard profile, Kullu is located in a high vulnerability area, the vulnerability of earthquake and landslide are most as compared to other hazards. The hazard vulnerability zonation of Himachal Pradesh is shown in table 1.

Table 1: Hazard Vulnerability Zonation of Himachal Pradesh

Hazards	Vulnerability
Earthquake	II
Landslide	II
Floods	II
Avalanche	M
Industry	II
Const. type and density	II
Overall vulnerability	VII

Source: HP State Council for environment Science and Technology
M- Moderate; II- High Vulnerability; VII- Very High Vulnerability

Natural Disasters: Kullu is more prone to geological hazards such as earthquakes, landslides, and soil erosion, and hydro-meteorological hazards such as flash floods, cloud bursts, forest fires, drought, hail storms, wind storms, lightning, and avalanche, besides biological hazards such as pest attack, cattle epidemics, and food poisoning. According to the local people believe that failure to appease the local deity and disobeying them manifest in the natural disasters causing damage to life and property. The incidences of major disasters in the valley include:

Earthquakes: Kullu district is located in zone IV and V of seismic zonation of earthquake hazards and highly prone areas for earthquakes. The earthquakes recorded in the valley are listed in table 2.

Table 2: Earthquakes in Kullu district

Year	Magnitude	Location
1906	6.4	Near Karshing
2014	4	Kullu
2014	4	Kullu

2016	4.6	Anni

Source: District Management Plan Kullu-2017

Landslides: Landslide is the downslide mass movement of soil and debris which may be due to heavy rainfall, and removal of lateral support and earthquake, etc. The key spots of landslides in district Kullu are:

- Anni Sub-division: Bro, Jagat Khana, Sagofa, Sarga, Deem, Chayal, Gabal and Bakhun;
- Banjar Sub-division: Neuli, Siund, Sainj, BhyaliandLargi;
- Manali Sub-division: Gulaba, Nehru Kund, Rangri to Aloo ground near Bahnu Bridge

Moderate landslide vulnerable area in Kullu district is 1820 hectares and 3513 hectares is highly vulnerability out of the total geographic area of 5503 square kilometers. Distribution of landslide prone area in Kullu district is given in table 3.

Table 3: Landslide prone area in Kullu district (in hectares)

Severe to very high	High	Moderate to low	Unlikely	Total area
1820	3513	65	03	5401

Source: District Management Plant Kullu-2017

The major incidence of landslides in the valley is shown in table 4.

Table 4: Incidence of landslides in Kullu district

Area	Date	Loss
Luggarbhati	1995	Sixty-five persons were buried alive during the land slide
Manali	2011	Roads were blocked, electricity supply dismantled, a four-story traditional house collapsed due to weight of four-foot snow in Malana village.
Manali	2011	Collapsed terraced fields, uprooting and falling of trees, disrupting vehicular traffic at raison, Dobhi, Alu ground, Rangri, and Manali.
Manali-Leh Highway	2012	Blocked Manali-Leh highway, leaving people stranded amidst chaos and traffic bottlenecks.
Kullu-Anni	2013	Blocked the Kullu-Anni highway at two places and residents of hundreds of villages falling under 58 panchayats in Anni and Nirmand sub-divisions of Kullu had no connectivity with the Districtheadquarter headquarters for about one week.
Manikaran Gurudwara- Kullu	2015	Damaged the three Rooms of Gurudwara building leaving 7 pilgrims dead and eleven injured with an estimated loss of Rs. 29.10 lacs.
Pancha-Manihar Road at Parbati HE Project, Stage-II, Kullu	2016	Total nine persons (five killed &four injured) were buried alive during the slide.

Source: District Management Plant Kullu-2017

Wind Storms: Wind storms are common in Manali, the Upper Valley of Kullu and Aani areas during snowfall.

Anthropogenic Disasters: There are fewer incidences of anthropogenic disasters. Some of them are forest fires, urban fires, festival-related disasters, electrical disasters and fires, air or road accidents, and village fires. Among these, fire incidences are mostly common disasters in the study area.

Floods: Floods in the Kullu Valley are very frequent. There are small to large water streams which join the Beas river. Tributaries of Beas, nallahs, and Beas River are on boom during the rainy season and causing land erosion, property, and agricultural loss. The major floods in district Kullu are depicted in Table 5.

Table 5: Incidence of Floods in Kullu District

Location	Date	Damage
Solang village, 2 km stretch of NH-22 across SolangKhad was washed away	1988	Fifteen houses, thirty-five bighas agriculture land, 600 apple trees, thirty-two persons and thirty-five cattle heads lost their lives.
Kullu	1995	278 bigha's of agriculture land (8736 apples, 687 pears & 293 plum trees) damaged due to floods caused due to heavy rainfall and another of 1170 bigha lands of Government leading to total loss of Rs. 55.60 lacs

Kullu	1995	Flood and Landslide along Beas River in Kullu valley killed sixty-five people, NH damaged at numerous places, loss to the government and private property, road and bridges
Kullu	1997	Triggered by cloud burst. 124 human lives were lost
Sainj Valley district Kullu	2001	Sainj and Jeeba affecting about forty families, two bridges on Sainj and Jeeba nallahs and plenty of fertile land was also washed away. At number of places connecting road to Siund and Sainj was also washed away. Two persons and five cattle perished. Some other areas in Kullu district were also affected due to excessive rains in July and the population of 6355 was adversely affected.
Anni Sub Division of Kullu	2001	Village Badhali two houses occupied by a couple was buried alive and their two children were injured. In village Sarli seven people lost their lives, fifteen houses were washed away, besides the loss of twelve cows, eighteen oxen and forty sheep, about 115 bighas of agriculture and horticulture land was washed away.
Garsa valley in Kullu district	2003	Twenty-one people lost their lives, twenty-one people suffered major injuries and nine are still missing.
Kangni nalla near Solang in Kullu	2003	Thirty people lost their lives, nineteen were injured, while nine people lost their lives due to landslide near Bahang nalla
Bahang valley (near Manali)	2003	Two people lost their lives. Property and houses were damaged
Parvati hydel power project site in Manikaran area of Kullu district	2004	Seventy huts, the main approach road, two bridges and heavy machinery were washed away and vast low-lying land inundated.
Manali	2005	A 10-meter stretch of NH washed off
Shat Village, Parvati Valley	2014	More than 100-acres of land and many lives were washed away

Source: District Management Plant Kullu-2017

Forest Fires: Kullu forest area is prone to forest fires, people burn the dried grass in forests and sometimes it changes to disaster and a lot of damage has happened in the past years, many lives were lost and so much damage has happened to property like houses and cowsheds have been burnt due to forest fires.

Table 6: Incidence of Forest fire in Kullu district

Year	Area	Losses
2007	Kullu	Gutted six houses, eight shops, two rooms of a primary government school, thirty-five families rendered homeless and thirteen villagers were injured
2007	Banjar	Forty-six Residential houses & cowsheds completely damaged and nine Residential houses partially damaged & total Rs. 30.15 lacs relief were distributed.
2013	Manali	Property worth Rs. 1 crore damaged
2014	Manali	No loss
2014	Kullu	Thirteen houses gutted, property valued at two crores was destroyed, inflicted losses on thirty-one families, four of which lost their homes.
2015	Banjar	Gutted –forty-nine Residential houses, three cowsheds, two shops, three templesfully damaged and four Residential houses partially damaged inflicting loss on 113 families and total 64.91 lacs relief were distributed.
2016	Kullu (Gahar, PhatiKais)	Ten pucca houses (seven completely &three partially) have damaged consisting of 25 families comprising of 93members in all & total damage worth Rs. 1.75 Crores.
2016	Kullu (Banjar)	Three Kucha houses, two cows, twelve cattle & total damage worth Rs. 16.20 lacs
2016	Kullu (Banjar)	Fourteen cattle with total damage worth Rs. 1.00 lacs

Source: District Management Plan, Kullu-2017

Domestic Fires: Domestic fire is also counted in an anthropogenic disaster due to which there is a huge loss of life and property**.** There are many incidences of domestic fire in the Kullu district due to:

- Electricity and fire left in the fireplace of the kitchen in traditional houses.
- Blasting of LPG cylinders

Kath-Kuni temples and houses are more prone to fires because of the wooden structure.On 5 January 2008, Malana village of Kullu was fired completely and 900 people were homeless and loss is estimated to be around Rs. 15 crores.
Impact of Tourism: The tourism industry is a developing sector and many constructions are ongoing in the valley for the promotion of tourism. People come from different states of India by road and the drivers of plain area are not experienced to drive in the mountainous roads, therefore many mishappening has happened mostly in the congested roads of Parvati Valley. Rockfalls due to the cutting of rocks and mountains are also a serious matter threatening the safety of people traveling in vehicles. Large constructions of hotels have resulted in soil erosion and the collapse of the buildings. District Disaster Management Authority (DDMA) is stationed at Dhalpur, Kullu headquarter, which provides the disaster management reports for the risk assessment of the district. Road safety measures have been displayed from place to places, such as hoardings and posters are displaying: "*Don't drink and drive*", "*Jail in Kullu is extremely cold*", "*Drive Slow*", etc. There are four Fire stations in Kullu and there are 710 authorized strength of home guards and seven main police stations. Army and paramilitary forces including SSB unit is located at Shamshi and ITBP battalion is located at Babeli. Disaster management authority gave the mock drills in schools and offices for awareness and safety from sudden disasters.

Kullu District has undergone a rapid socio-economic transformation. The local communities are quite vulnerable to natural disasters because they are not aware of the threats posed by the deadly disasters. The district has undergone significant land-use change and at the same time the extent of economic and human losses due to natural and man-made disasters, especially in the last two decades, is distressing. The unchecked construction in the geomorphologically active regions such as the river flood plain, unstable slope, and debris flow has increased in recent years and is alarming. Owing to increased growth in the tourist sector and intensification and diversification of farming, the area has undergone a noticeable land-use change. District Kullu is prone to numerous disasters and generally, the susceptibility of the district is quite high. The Kullu district is linked with the rest of the state through NH-21. In any disaster event, if the communication through this highway is disturbed then the major population of the district will be vulnerable to natural fury. A number of Hydro Power projects have come up in the district which additionally adds to the vulnerability and life and property. Kullu valley being ecstasy for adventure sports is thronged by thousands of national and international tourists. Thus, the incidence of natural disasters has increased in the Kullu Valley in the last few decades because of:

- Reckless mining
- Use of high explosive in mining and generation of over-ground, underground debris
- Expansion of tourism and agriculture
- Rock-cutting
- Deforestation
- Off-loading into river beds
- Disposal of garbage
- Contamination of water
- Large-scale soil erosion
- Unplanned construction of hotels and other buildings

Though every region across the globe is more or less vulnerable to natural disasters, the Himalayan regionowing to complex geomorphology and hydro-meteorological settings, experience recurrent natural catastrophes, mainlythe water-induced hazards.This observation corresponds the findings of Rawat 2013 and Nibanupudi and Shaw 2015. Pandey (2002) stated that the population and infrastructure development, have amplified the susceptibility to threats, and living with the risk of natural hazards is part of everyday life and this is seen in the Kullu Valley.Though seismic intensity may not have increased, but the human population has increased manifold which increased the vulnerability to landslides and earthquakes. Road construction is the key factor accountable for land-related disasters. The setting-up of hydropower plants and industries has changed the land-cover, and destabilized the slopes for fulfilling therequirement of transport, power, etc.though, the disasters cannot be evaded, but, their catastrophiceffects can be curtailedby usingvarious planning measures, and execution of risk reductionmachinery. Haphazard construction of hotels and roads for promoting tourism activities are the primary factors for increasing the exposure to hazard. Natural hazard risks in the Kullu Valley haveamplifiedbecause ofdeforestation and severepressure on land. This corresponds the observation made by Prasad *et al*. 2016. In order to curtail the disasters to undertake following mitigation measures, viz.:

- Ensuring community participation for effective execution of risk management schemes, disaster mitigation programme;
- Ensuring the seismic fortification of existing and future buildings;
- Erection of flood walls, afforestation, check dams, etc. to avoid the incidence of land and water related disasters; and
- Promoting awareness generation regarding the damages of forest fire should be given to local people for mitigating forest fires disaster.

It is important to check the conversion of land from agriculture to non-agriculture purpose. At the same time, it is important to regulate the influx of tourist in Kullu Valley. In nutshell, it can be stated that '*We Cannot Stop Natural Disasters but we can arm ourselves with Knowledge: So many lives wouldn't have to be lost if there was enough disaster preparedness*'. Eco-development is an approach to economic development which is environmentally sound and ecologically harmonious for sustainable development in Himalaya regions.

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