HAZARD MAPPING IN UPPER BEAS BASIN

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A B S T R A C T

Himachal Pradesh, nestled in the north-western part of the Himalayas, is a region fraught with the recurring menace of natural disasters, including earthquakes, landslides, cloudbursts, avalanches, and flash floods. Among these, landslides stand out as one of the most pervasive, wreaking havoc on natural resources, economic assets, and human lives. The burgeoning population coupled with the expansion of settlements into fragile terrains has exacerbated the impact of these disasters, particularly in the Lesser Himalayan region. Geologically youthful and tectonically active, the Himalayan ranges harbor numerous seismic faults, placing the region within Zone IV and V of India's seismic zone map. This seismic activity, combined with the region's ecological fragility, renders Himachal Pradesh acutely vulnerable to natural calamities.

Physiographically, the state is delineated into three distinct units: Lower Himalaya, Middle Himalaya, and Higher Himalaya, each susceptible to different hazards dictated by lithological, soil, and climatic variations. Rainfall and temperature patterns exhibit considerable spatial heterogeneity, with precipitation diminishing from west to east and south to north. The state grapples with the annual onslaught of natural disasters, ranging from cloudbursts to snow avalanches, wreaking havoc on infrastructure and human settlements.

In this context, understanding the dynamics of hazards in the Upper Beas Basin emerges as a critical imperative. This research aims to delve into the complexities of hazard mapping in this region, leveraging advanced techniques in remote sensing, GIS, and hydrological modeling to delineate vulnerable zones, assess risk profiles, and inform effective mitigation and adaptation strategies. By elucidating the intricate interplay of geological, climatic, and anthropogenic factors shaping hazard dynamics, this study seeks to enhance the resilience of communities and ecosystems in the face of mounting environmental challenges.

KEYWORDS

Natural Hazards, Hazard Mapping, Landslide Susceptibility, Remote Sensing Techniques, Geographic Information Systems (GIS), Disaster Risk Reduction

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1. Introduction

Himachal Pradesh is exposed to frequent natural disasters such as earthquake, landslides, cloudburst, avalanches, flash floods etc. with varying intensities. Though, landslides are considered as one of the most frequent it causes a large scale disruption of natural resources, economic valuables and human lives. In the recent years, growing population and expansion of human circumference on fragile land or hazardous areas have largely increased impact of natural disasters in the Lesser Himalaya region of India. Particularly, the Lesser Himalayan states are more vulnerable than other hilly part of the country. The Himalayan ranges are formed of younger geological formation, and tectonically very active. Large number of landslides occurs every year and causes loss of lives, extensive damage to properties and as well as natural resources.

The state is situated in the north-western part of Himalayas which is seismically very active. The high seismic activity in this region can be attributed to the Himalayan orogeny and to the numerous major seismic faults present in this region. Some of the major Himalayan faults, such as the Main Frontal Thrust (MFT), Main Central Thrust (MCT), and Main Boundary Thrust (MBT), are present here. Hence, this region comes under the Zone IV (severe) and Zone V (very severe) of the seismic zone map of India. 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. 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.

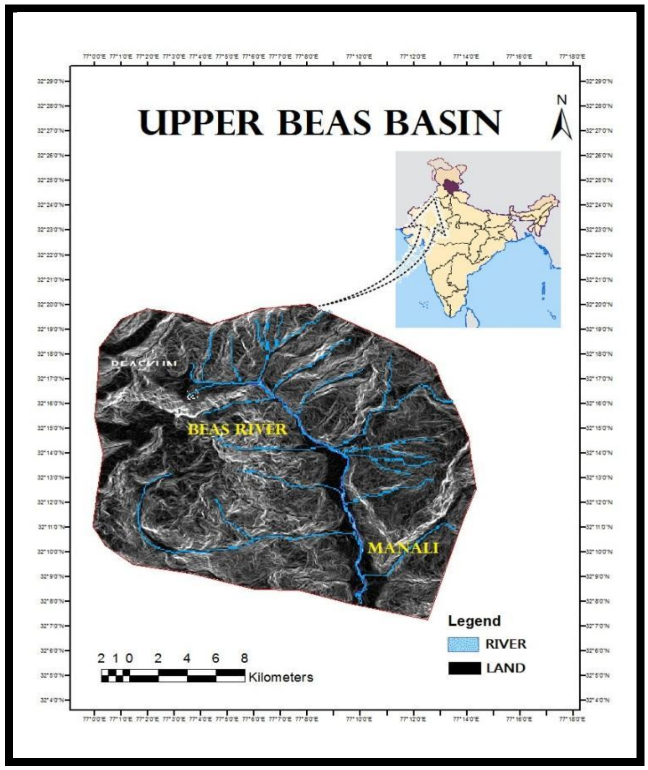

Fig. 1 Upper Beas Basin

Natural hazards are matter of immediate concern to the State of Himachal Pradesh, as every year the State experiences fury of nature in various forms like earthquakes, landslides, cloud bursts, flash floods, snow avalanches and droughts etc. The fragile ecology of the mountain state coupled with large variations in physioclimatic conditions has rendered it vulnerable to the vagaries of nature. The incidence of cloudbursts in the last few years has baffled both the meteorologist and the common man equally. 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 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 as opposed to long term development.

Floods, landslides, soil erosion, rock falls, debris flows, accelerated erosion and snow avalanches are common hazards in Kullu Valley. Population growth and economic development, especially since 1990, have increased the vulnerability to hazards, and living with the risk of natural hazards is part of everyday life (Pandey 2002). Natural hazards have had significant impacts on life, livelihood and property in the mountain regions. Hazards identification in high mountain areas involved intensive and lengthy fieldwork and mapping with the interpretation of landforms and its related hazards, compulsion of increasing intensity of land-use and careless application of technology leading to further land degradation. Frequent occurrences of hazards such as landslides, snow avalanche, floods and other types of mass wasting are becoming common features in mountainous regions.

2. Land use in Upper Beas Basin

This land cover land use map of upper Beas Basin has been prepared in ERDAS IMAGINE software. There are mainly three types of land cover land use pattern in upper Beas Basin area in 2011. Two types of land cover pattern– Snow covered, vegetation and settlement (land use pattern).

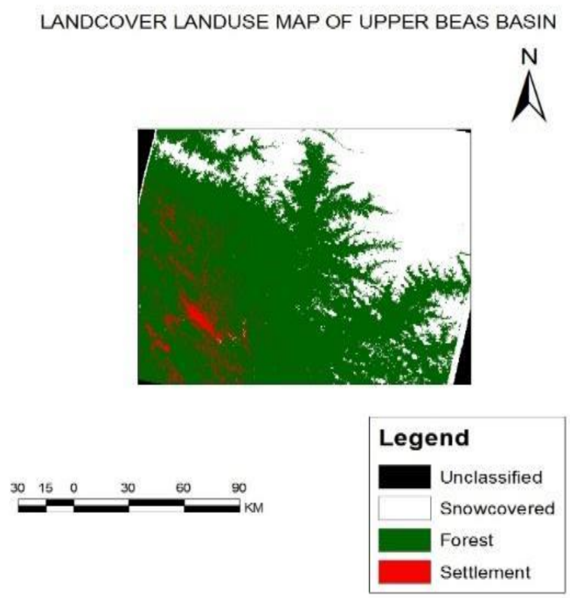

Fig. 2 Landcover landuse map of Upper Beas Basin

Snow Covered-

The Northern part of the area is under permanent snow covered area. Beas kund glacier is located here.

Vegetation-

There is a lot of vegetation in the entire area expect northern portion. The Coniferous and temperate broad leaved forests occupying most of the upper slopes in the valleys.

Settlement-

After 1980s, the Kashmir problem diverted a huge number of tourists to this area which accentuated the development of infrastructurefor tourism and related activities, speciallyManali. That is why a large number of settlement can be noticed around Manali .

3. FLOOD AND FLASH FLOOD IN UPPER BEAS BASIN

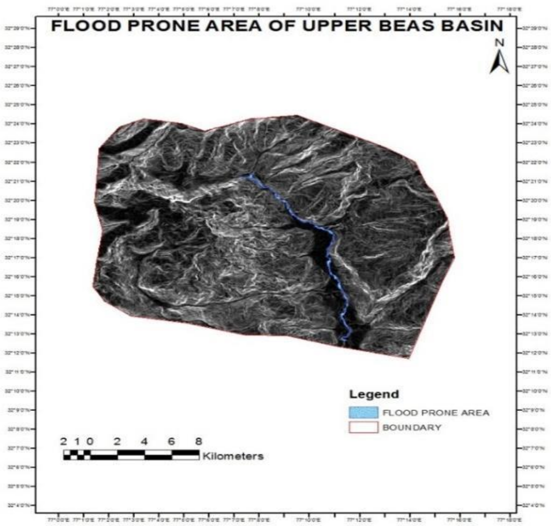

Fig. 3 Flood Prone Area of Upper Vyas Basin

Flooding is a natural event and it is an overflow of water covering the land which are dry in nature. Extreme floods occurred in frequently in the*Indian Himalayan Region* (IHR) **(Gardner, 2002; Gardner and Saczuk, 2004)**. Some flood occurs suddenly and recede quickly and some take days or month. Flooding also defines as a groundwater cover. Flood is occurs in continuous in the Upper basin area of the Beas river, but it is varies over the year. The river Beas and its tributaries have lowest level flood during the months of December, January and February and highest level during June, July and August. Occasionally the floods also occur in Kullu in August.**(Kullu district.gov.in)**In the Himalaya and adjacent regions, evaluations of floods and other disasters often assert an increasing frequency of whatever process is involved and imply that this is related to the degradation, primarily deforestation, of the Himalayan environment**(James S. Gardener**). According to the **Sanjay Dutta** the river course has narrowed due to dumping of muck generated by construction of ***Hydro Power Projects*** in the Kullu valley i.e. Illegal enterprise, haphazard construction, illegal dumping of muck generated by ***Hydro Power Projects***, have led to an alarming situation in the area **(Sanjay Dutta).**

Flooding also occur due to several factors such as high rainfall, low topographical area, riverbank erosion and rising water levels caused by global warming.Beas River originates from Beas Kund in Rohtang Pass from where it traces a path Manali to Mandi, through a densely populated valley. Due to this area is populated, grazing lands and many houses close to natural stream flow course that face imminent danger**(Sanjay Dutta).**

Fig. 4 and 5 : Filed Visit Photos of Upper Beas Basin

One of the important things that Flash flood. Flash flood is important phenomena in the Himachal Pradesh ad Upper Beas basin. Generally flash flood means it is occur within 6 hours after the collapse of a natural ice or debris dam, or a human structure such as a man-made dam. And flood means is an even that occurs after 6 hours after ending the natural ice or debris dam, or a human structure such as a man-made dam. Flash flood is frequently hazard in Upper Beas Basin. Due to Flash Flood there are significant damages of property has been found. Some other areas in Kullu district were also affected due to excessive flood in July and a population of 6355 was adversely affected. Prior to this, district Kullu experienced a flash flood due to cloud burst on the 22nd July, 2001 at 1:30 P.M(D.D.Sharma)

Two children were killed, many houses were destroyed, and many roads were also blocked by the Flood and Flash flood in Thadidhar village of Sargapanchayat in Nirmand sub-division of Kullu.(source:.**https://timesofindia.indiatimes.com/city/shimla/cloudbursts-floods-wreak-havoc-in-himachal-kill-2-children/articleshow/59946633.cms**)

Some events in Upper Beas Basin and Kullu valley have been stating by the following table, which are already happened by extreme Flood and Flash Flood.

4th and 5th Sept. 1995 flash flood in Kullu valley	Flash flood in Kullu valley occurred which cause damage to the tune of Rs. 759.8 million.
4-5 and 12 Sept. 1995	Flood and landslide along Bas river in Kullu valley killed 65 people. NH damaged at numerous places, loss to government and private property, road and bridges estimated US$ 182 million.
Flash floods on the night of 23rd July 2001 in Sainj valley in District Kullu.	Cloudbursts in the upper reaches of Sainj valley caused flash floods in two nallahs namely, Sainj and Jeeba, affecting about 40 families 2 bridges on Sainj and Jeebanallahs and plenty of fertile land were washed away. Connecting road to Slund 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 the population of 6355 was adversely affected.
Flash floods in the night of 21st and 22nd August 2001, cloudburst in Ani Sub Division of Kullu district occurred.	Due to flash flood 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.
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 still missing.
Flash floods in Kangninalla near **Solang** in Kullu district on 7th August 2003.	30 people lost their lives and 19 people were injured and 9 people are missing, 2 people lost their lives due to landslide in Bhang nalla.

Source: National Informatics Centre, Himachal Pradesh

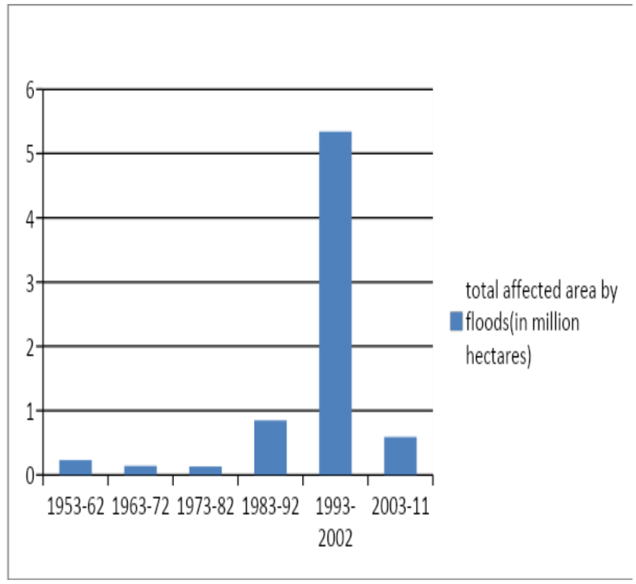

Fig. 6 : Total Affect area by Flood (in Million Hecture)

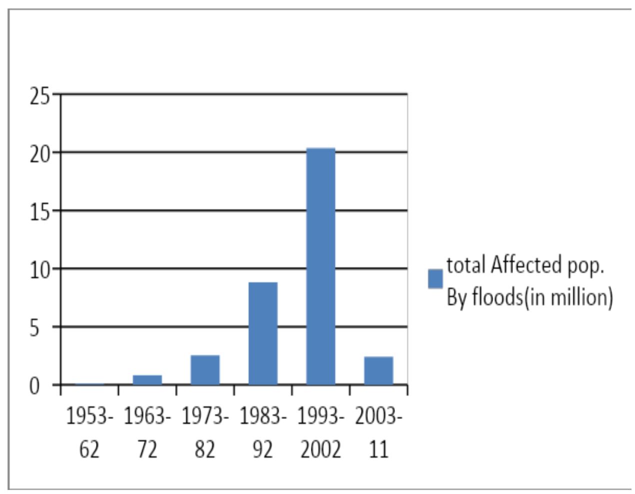

Fig . 7 : Total Affected Population by Flood (In Million)

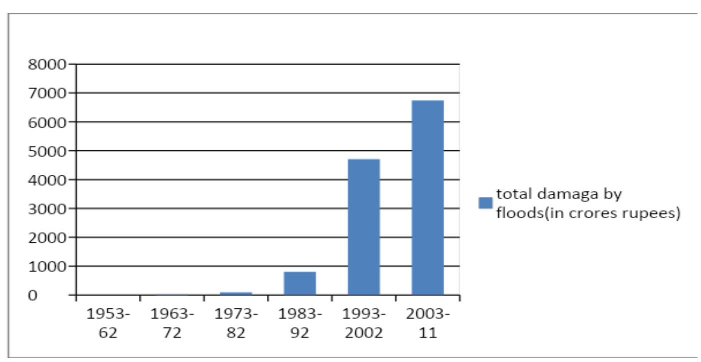

Fig. 8 Total Damage by Flood (In crore Rupees

4. CONCLUSION

Owing to the typical geomorphic setting such as high relief variations, thick forest cover, presence of glacier and glacial lakes along the higher reaches, the Beas River is prone to cloudbursts, flash floods, forest fires, landslides and mass movement. The sustainable livelihood of Beas River may best be bestowed by enhanced landuses aided by technologies of bio-engineering, denaturalization of degraded mountain geosystem and resilience for changes. Himalayan watershed has undergone a most dynamic change in land-use owing to the rapid increase in the population. The change in biophysical systems posed the direct bearing on the hydrological regime of Beas River. The peoples' perceptions regarding origin of hazards and techniques of control to the hazards showed that indigenous and lowland communities are more susceptible to hazards. Deforestation, slope cutting, construction of roads and heavy rainfall were high responsible factors resulting frequent landslides and soil erosion. Hazards cannot be avoided, however their disastrous pursuits can be lessened through pro-active uses of a variety of planning measures, infrastructure and risk transfer mechanism. Afforestation, embankment, better drainage techniques on slope, check on urban sprawl, and ecotourism are effective techniques to offset the local hazards and livelihood vulnerabilities.

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