SPATIO-TEMPORAL OCCURRENCES OF LANDSLIDES IN THE HIMACHAL HIMALAYA

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Abstract:

Landslides are destructive geological processes that have globally caused deaths and destruction to property worth billion dollars. Landslide occurrences are widespread and prolific in India covering more than 15 per cent of the total area. These are mostly concentrated in the Himalayan belt, parts of Meghalaya Plateau, Nilgiri Hills, Western and Eastern Ghats. The slope failure in the hilly terrain is due to geological processes and events. The frequency and magnitude of slope failure also increased due to anthropogenic activities such as road construction, deforestation and urban expansion. Keeping all these problems in mind research focusses on the Himachal Himalaya as it falls under very high risk zone in case of landslides and comprise of three objectives. They are: a) to record the temporal incidences of landslides in Himachal Himalaya, b) to analyse the spatial temporal pattern of landslides in the Himachal Himalaya. In this work an attempt has been made to collect data on landslides incidences and damage from the secondary sources like Geological Survey of India, Building Material and Technology Promotion council from Ministry of Urban Affairs and annual reports of disastrous weather events from Indian Meteorological Department. The methodologies adopted for data analysis are simple tabulations, bar diagrams, statistical and mapping techniques to represent the Landslide vulnerability of the Himachal Himalaya. The analysis of the study reveals that there is increase in the number of landslides. The spatial pattern of landslide incidences is positively correlated with susceptibility zones in terms of geology, geomorphology and anthropogenic activities.

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Introduction

Landslide, a frequently occurring natural hazard in the hilly terrains of India, shows preponderance of activity during the monsoon period from July to September and after the snow fall from January to March. The strong earthquakes also cause triggering of landslide, particularly in regions marked by critically disposed and unstable slopes. On a rough estimate, nearly 15% of India's landmass or 0.49 million sq. km area is prone to landslide hazard.

Landslide are the downslide movement of soil, debris rock, resulting from natural causes, vibrations, overburden of rock material, removal of lateral supports , change in water content of rock or soil bodies, blocked drainage etc. in himachal Pradesh the mass movement varies in magnitude from soil creep to landslide. Solifluction (form of creep in which snow or water saturated rocks move down the slopes) is another type of mass movement ta is common on the higher snow covered ranges of the state. The problem of landslide is common and frequent in Himachal Pradesh. Almost every year the state is affected by one or more major landslide affecting society in many ways. Loss of life, damage to houses, roads, and means of communication, agricultural land, and floods are some of the consequences of landslides in the region. Flash floods, particularly in narrow river gorges are the cause of some of the major landslides in Himachal Pradesh. These flash floods trigger landslides in the region, eventually jeopardising the stability of the hill as a whole.

The vulnerability of the geologically young, unstable and fragile rocks of the state has increased many times in the recent past due to various unscientific developmental activities. Deforestation, unscientific road construction, terracing and water intensive agricultural practices, encroachment on steep hill slopes are the anthropogenic activities which have increased the intensity and frequency of landslides. Among the man-induced causes, road construction in the hilly terrain is more responsible for landslides. The quantum of the damage by unscientific road construction may be judged by scientific research, which states that one kilometre of road construction in the Himalayas need removal of 60000 cubic metres of debris. Due to this and other anthropogenic activities, landslides have become a regular occurrence in the state, especially during the rainy season. Malling, nathpa, powai in the Spiti and Satluj Valley in Kinnaur district and Marlu, Bhang, Chhyal and Mandh in the Beas catchment are the areas where landslides occur every year.

Objective

a) To record the incidences of landslides in Himachal Himalaya.

b) To analyse the spatial pattern of landslides in the Himachal Himalaya.

Data base and Methodology

In this work an attempt has been made to collect data on landslides incidences and damage from the secondary sources like Geological Survey of India, Building Material and Technology Promotion council from Ministry of Urban Affairs and annual reports of disastrous weather events from Indian Meteorological Department. The methodologies adopted for data analysis are simple tabulations, bar diagrams, statistical and mapping techniques to represent the Landslide vulnerability of the Himachal Himalaya.

Results and Discussion

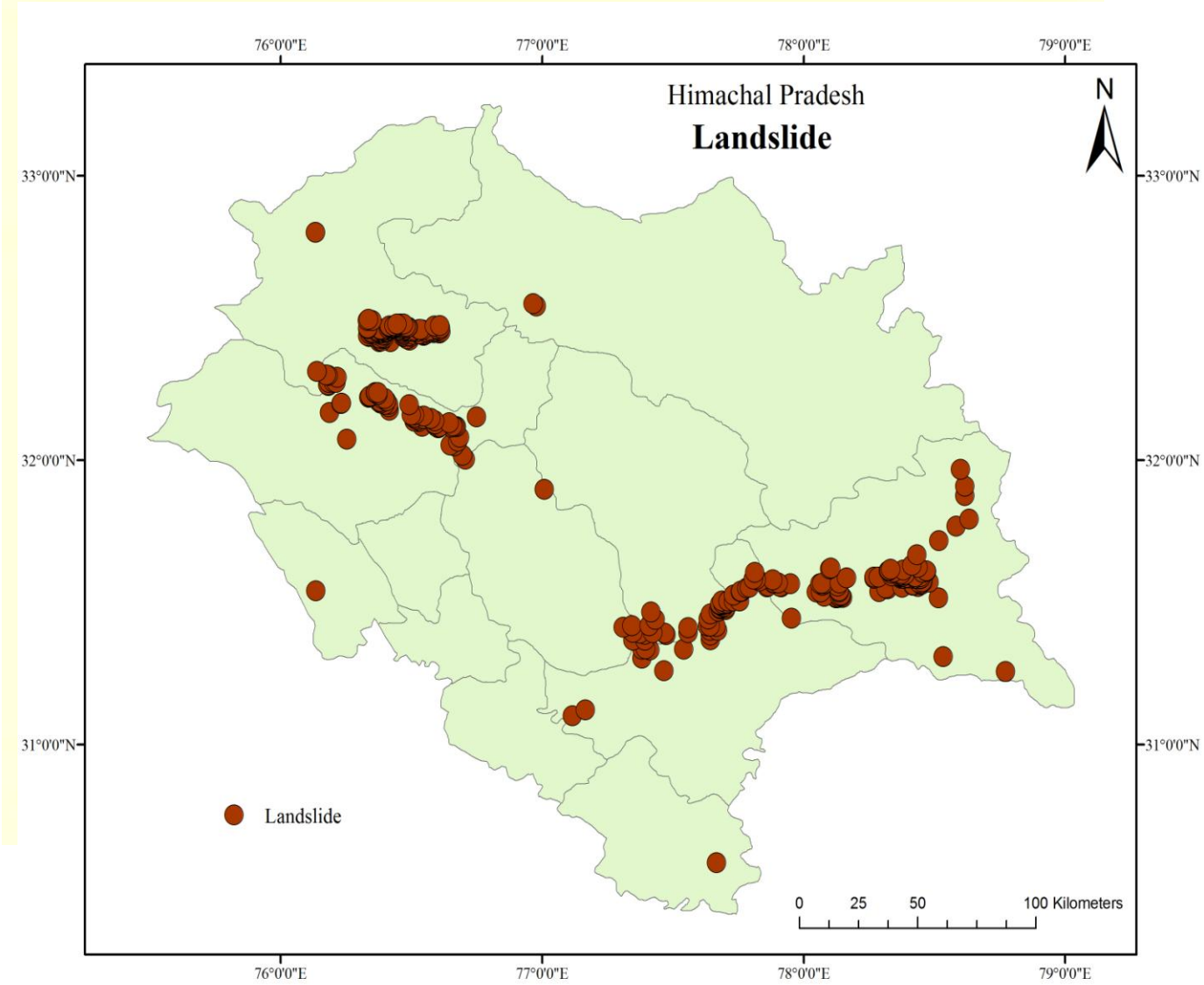
It is evident from the temporal data on the landslides given in the Table 1.0 that the landslides and their impact is on increase. The first landslide incidence recorded in Pawari in 1962 on NH-22. After that Chakki-Dalhousie landslide occurred in 1965 on 67-68 kilometre Pathankot – Dalhousie road. In 1973-74, the Pangi and Telangi landslide occurred 371 kilometre on NH-22 because of the road cut and toe erosion by Pangi Nala. The Naina Devi slide occurred in1978 due to heavy rain on the Naina Devi ridge on the Bilaspur. A major landslide in the Malling occurred 459 kilometre on NH-22 resulted by saturation along shear zones, high discharge and road cut. The Khadra Dhang slide recorded opposite to the Akpa village in 1981 due to percolation of rain and snow melt and toe cut. In the 1985, landslide reported from two places known as Thangi slide and Nacher slide both on the NH-22. The Soldan Khad slide took place on the NH-22 due to heavy rain and flash flood. In the 1989 the two landslides occurred in the Baspa valley due to road cut and toe cut by the river. In the 1990, almost 4 landslides recorded, out of which three occurred on the NH-22 and other on the Beas River as shown in the table given. The landslide of Himachal Himalaya enumerates over 350 incidences based on the Geological Survey of India. Majority of the Landslides have been recorded during the preparation of landslides zonation maps in the Satluj, Ravi, and Beas river valleys in Kullu, Mandi, Kinnaur, Chamba and Kangra districts. Many of these slides have been investigated during the geo-technical investigations of

river valley projects and for feasibility study of road alignment and rural and urban settlements. The spatial pattern on the map indicates that the worst affected road alignment runs along Ravi river between Gehra and Braumaur in Chamba district. The road alignment in the stretch passes through jointed rock mass belonging to Chamba formation represented by interstratified sequence of slates, phyllite and subordinate schist, Manjir formation comprising pebbly, siltstone, slate and bands of limestone and Katarigali formation composed of interstratified sequence of slates, phyllites, siltstone and beds of thinly bedded limestone. Nearly 50 slope failures have been recorded along this road in a stretch of about 30 kilometers. The Hindustan Tibet road (NH-22) alignment between Jeori and Khab passing through slope wash, debris, jointed gneiss and compact granites of Rakccham Granite formation is another sector which is widely affected by landslide in Kinnaur district in Satluj Valley. The nine major landslides in this stretch are at Poo, Mailing, Urni, Han, Akpa, Shillu, Shiasu, Dabling and Chango. Shimla has frequently experiencing landslides, with slips and subsidences commonly occurring within overburden material and adversely affecting roads and unsoundly founded constructions. Soil creep and landslides have also occurred in Dalhousie town, whereby closely jointed slates are covered with thick overburden consisting of fragments of slate embedded clayey matrix. The material is loose and incompetent.

Name of Slide	Location	Type of Slide	Date of Initiation	Cause /Triggering Factor	Damage/Loss	Remedial measures taken
Malling Slide	459km on NH-22	Composite slide, very active	1980 and major slide in 31 July 1991	Saturation along shear zones, high discharge and road cut	1000m road damaged	Draining of seeping water from the slide body
Ropagad Slide	Left bank of Ropagad on NH-22	Debris slide and creep active	August 1990	High wind speed and snow melt	Road damaged	None
Thangi Slide	389km on NH-22	Debris slide, flow and rock fall, active	March 1985	Toe cut by Thangi nala and wedge failure	100m road damaged	Retaining structures
Khadra Dhang Slide	Opposite of Akpa Village	Translational debris slide, active	August 1981	Percolation of wind and snow melt and toe cut	130m road damaged	Alignment of NH-22 changed
Pangi Slide or Telangi Slide	371km on NH-22	Rational cum translational slides. Active	1973 and major slide in 19 January 1975	Road cut and toe erosion by Pangi nala	300m road damaged	Retaining structures, drainage works, and wood piles.
Pawari Slide	367km on NH-22	Rational cum translational slides. Active	1962 major slide in 1977	Five road cut in slide body and numerous seepage zones	1000m road damaged	Retaining structures at number of places
Sapni Slide	Baspa – Satluj confluence near Karchham	Rational cum translational slides. Active	August 1989	Road cut in unconsolidated mass and toe cut by Baspa river	1000 X 700m orchard of Sapni village damaged	None, road to Sapni abandoned
Barua Slide	Near Barua village, Baspa valley	Planer debris slide and rock fall. Active	August 1989	Toe cut, dip slope and infiltration	440 X 4000m hill slope damaged	None
Urni Rockfall	347km on NH - 22 near Tapri	Rock fall very active	Reactivated in 1992	Road Cut and blasting caused joint failure	250m road damaged, 5 persons died	Retaining structures
Jakhari Slide	288km on NH – 22	Translational debris slide	February 1993	Water seepage and road cut	500m road damaged	New road cut
Nachar Slide	329km on NH – 22	Debris slide, very active	Old slide reactivate in 1985	Springs in middle slopes and road widening	500m road damaged and danger for village upper slopes	Retaining structures
Soldan Khad Slide	NH – 22	Debris slide active	1988 flash flood in Soldan khad	Heavy rain and flash flood	200m road damaged, 32 persons and 35 cattle' died	Realignment of road. bridge constructed
Naina Devi Slide	Naina devi ridge, Bilaspur	Rotational slide	August 1978	Heavy Rain	143 houses and road section washed away	Retaining structures, concrete pads and anchors.
Chhaki-Dalhousie Slide	67-68 km, Pathankot-Dalhousie road	Road and hill slope subsidence	1965	Ingress of water from springs and rain	70mm road subsided	Retaining wall
Luggar Bhatti slide	2km north of Kullu along left bank of Beas river	Toppling-cum- debris fall	September 12, 1995	Infiltration of water and toe cut during road widening	0.96 X 10 unconsolidated slope mass dislodged, 65 people died	None

Source: Sah and Virdi, 1991; Virdi et al., 1995; Sah et al., 1996;Bartarya et al.1996; Raju and Jalote, 1980; Sah and Mazari, 1998 and Reports of Geological Survey of India

The total recorded incidences of landslides revealed that there are maximum landslides in the Beas and Ravi valleys of the district Kangra and Satluj valley of the district Kinnaur. Out of the total landslides the mode of failure is mostly debris slide, wedge failure followed by rock fall and planar failure.



Conclusion

The hills and mountains of Himachal Pradesh are liable to suffer landslides during monsoon and also 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 agricultural crops requiring more intense watering etc. The devastating landslides mentioned herein point out to the need for 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 detail geological and geotechnical studies. The landslide prone areas should be avoided while locating new settlements or building, and those which are already occupied, should either be resettled or protective measures be adopted.

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