

LANDSLIDE HAZARD IN SHIMLA DISTRICT

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Abstract: Shimla district situated in the Lesser Himalaya, receives heavy rainfall during the monsoon season. During rains the area experiences slope failures in the form of landslides. The landslides is a acute problem in the Shimla district and over the last few decades the number of landslides and subsidences have increased due to construction of roads and buildings over the vulnerable geological structure. The occurrences of landslides have continued to pose problems to the people of the area and communication system along the National Highway-22. A detailed study has been made by the author about landslide occurrences in the Shimla district. The results of the study regarding the causative factors and mechanism, together with the suitable preventive measures have been presented in this paper.

Key Words: Himalaya, landslide, subsidence, vulnerable.

INTRODUCTION

A landslide is the movement of large amounts of soil, rocks, mud and other debris downward along a slope. The movement is caused by the pull of gravity and occurs when a mountainside or hillside weakens and is unable to support its own weight. The amount of material that fall in a landslide can be as small as the size of a refrigerator or as large as an entire mountainside. The falling material can move slowly or quickly and may travel a few feet (meters) or several miles (Kilometers) before it stops. Some landslides move only a little each year, such as during the monsoon seasons.

Landslide has been considered to be the most devastating hazard and become a common feature in the Shimla district. The situation becomes so acute during the monsoon seasons when the area receives rainfall. The down slope movement of large volumes of surface materials under gravitational influences represents an important type of environmental hazards in the study area. Rapid movements cause loss of life and damage but slow movements have less potential to kill but can be costly.

As a place of peace and tranquility the Shimla district attract large number of tourists. This has created an ever increasing population pressure over the different parts of the Shimla district. A number of high-rise multistoried buildings have been constructed to accommodate the tourists and for residential purposes. This is destabilizing the existing stability of slopes. Vulnerable geological structures, heavy rainfall and deforestation have aggravated soil erosion and landslide.

THE GEOGRAPHIC LOCALE OF THE STUDY AREA

The present study is based on a Himalayan mountainous region of Himachal Pradesh where Shimla district is selected for studying the occurrences of landslides.

Shimla district is located in the south-west border of the Himachal Pradesh. It is bounded by Kinnaur district in the north-east, by Kullu and Mandi districts in the north-west and by Solan and Sirmour districts in the south-west. The district extends from $30^{\circ} 45'$ north to $31^{\circ} 44'$ north latitudes and from $77^{\circ} 0'$ east to $78^{\circ} 19'$ east longitudes covering an area of 5131 square kilometers (Fig. 1). The whole district lies in the Himachal Pradesh. The state of Himachal Pradesh is a mountainous state in the north-west India, lies between $30^{\circ} 22' 44''$ N to 33°

12° 40" N latitudes and 75° 47' 55" E to 79° 04' 28" E longitudes, extending over an area of 55,673 square kilometers with a population of 6856539 according to 2011 census.

The study area exhibits rugged mountainous topography having steep valleys and steep side parallel ridges. The ridges run almost in north-west and south-east direction. The district mainly lies in the lesser Himalayas. It has the main central thrust in the north and main boundary fault in the south. The geological formations are predominantly shales, conglomerates, quartzite, slate and limestone. All these features are conducive to the occurrences of landslides. Owing to wide range of altitude and climatic conditions, Shimla district has diverse and rich flora. The *Oak* (*Quercus Incana*), *Chil* (*Pinus Longifolia*), *Kail* (*Pinus Excelsa*), *Deodar* (*Cupressus Torulosa*) *Safeda* (*Eucalyptus Globulus*) are the different species of trees found in the study area. Climatically, the area experiences sub-tropical types of climate, due to its location in the sub-tropics. Shimla district experiences three well defined seasons, viz summer, monsoon and winter. Spring is the transitional period between winter and summer and that between monsoon and winter is autumn.

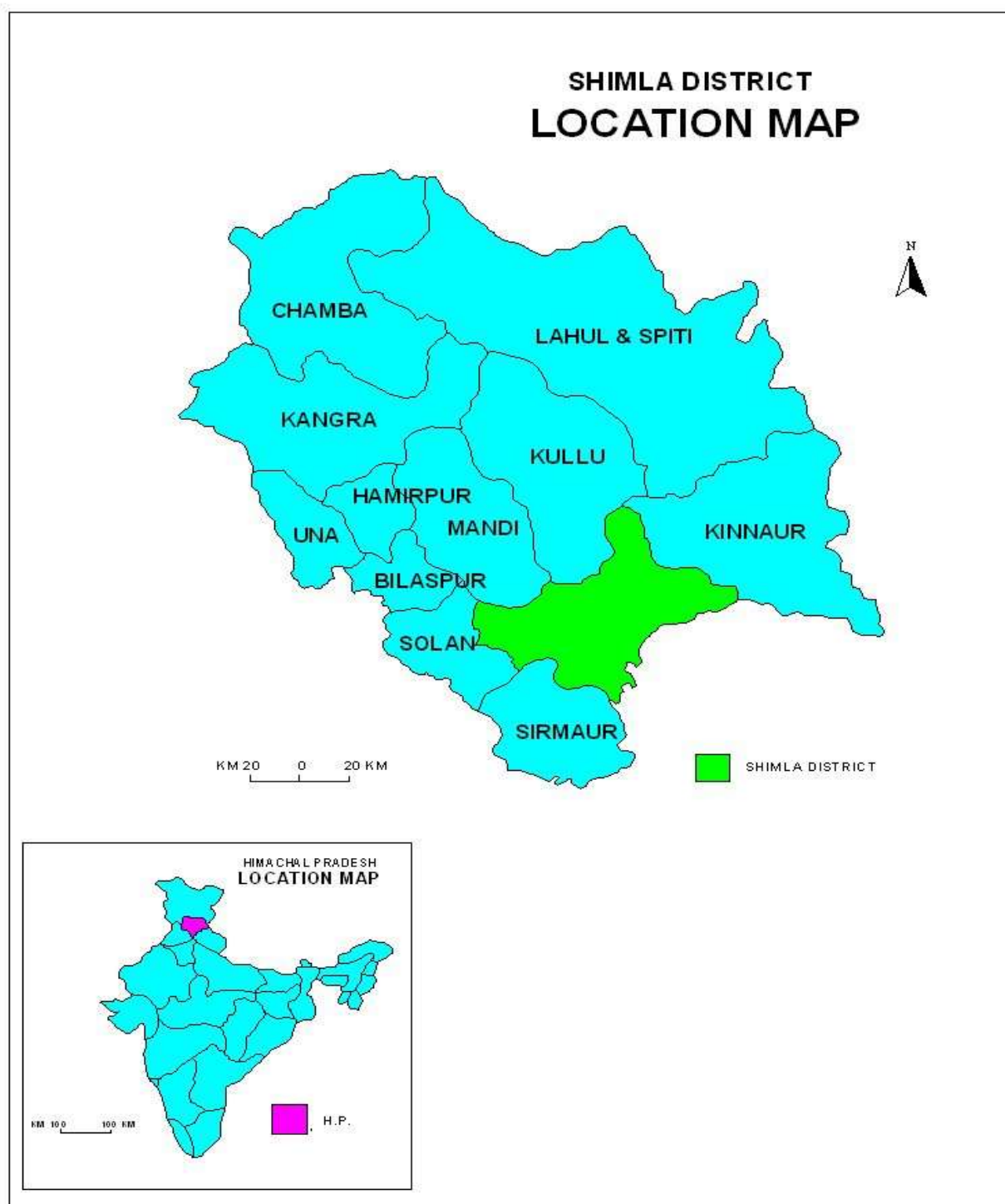


Figure-1

METHODOLOGY

The study is almost entirely based on primary data collected by personal survey in the field. Different landslide sites in the Shimla district are visited to study these hazards. A great deal of information about landslides are collected by personal interviewing the local residents, laborers of concerned Public Work Department (PWD), stone crushers and even grazers at different places in the study district. Some secondary data have also been obtained from geological maps produced by Geological Survey of India, topographical sheets published by Survey of India and satellite imageries produced by Remote Sensing Cell and from the newspaper reports of the daily issues of the regional newspaper The Tribune. Each newspaper has been scanned through.

TOPOLOGY OF LANDSLIDES IN SHIMLA DISTRICT

The Shimla district is a region characterized by numerous features of mountain environments such as steep slope, fragile and faulted geology, folds, tensions and processes of mass movement which are alternated and accelerated by different human induced activities such as construction of roads and buildings, quarrying and mining and deforestation. The above factors altogether cause different types of landslides. A brief description of landslides found in the Shimla district is given below: (Table-1)

1. Fall

Falls are generally associated with steep slopes. A fall involves falling of the dislodged material of rock or soil from an overhanging cliff or a steep slope under the influence of gravity. It is the vertical displacement of materials or rocks without the involvement of water. A fall can be classified in rock fall, debris fall and earth fall.

2. Slide

Slide is a movement which is parallel to the planes of weaknesses and parallel to the slopes. Slides are the most important and significant movement of all other types of mass movements. A mass movement wherein a mass of rock or weathered debris moves downhill along discrete shear surface is called as a slide. Rock slide, debris slide and earth slumping are the types of slide.

Table-1

A Simple Classification of Landslides in Shimla District

Type of Movement	Type of Material		
	Rock	Coarse Material	Fine Material
Fall	Rock Fall	Debris Fall	Earth Fall
Slide	Rock Slide	Debris Slide	Earth Slumping
Flow	Rock Flow	Debris Flow	Mud Flow
Creep	Rock Creep	Soil Creep	Soil Creep

3. Flow

Flow involves the plastic deformation of the material. It deforms without rupturing downward due to gravity force. Flows are more common in those areas where sufficient water or ice is available to lubricate the

movement of rock debris. A flow is a landslide of wet material, which may contain rock, soil, and debris, combined with water. A flow can be divided into rock flow, debris flow and mud flow.

4. Creep

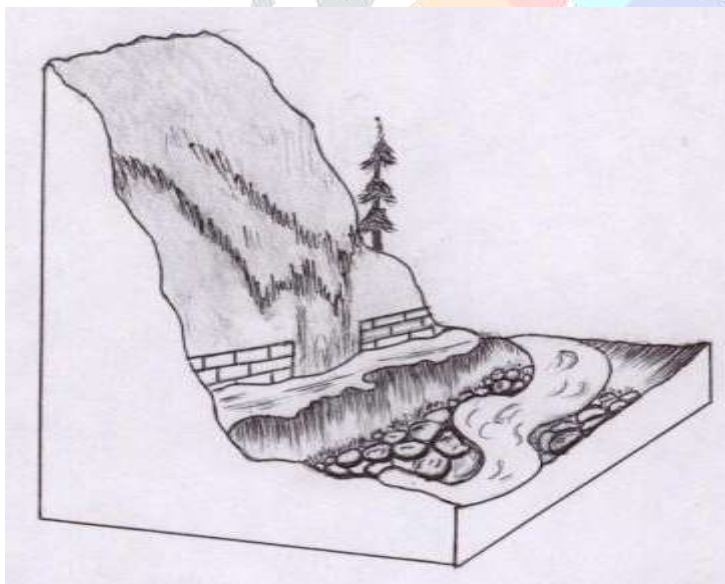
Creep is a very slow downhill movement of soil and regolith. Creep is so slow as to be imperceptible to observe. Creep is the most widespread, persistent and effective of all forms of mass movements. The movement of colluvium is very slow. It may be only a few millimeters annually. It occurs on almost every slope. Its effects can be seen after a long time period. Rock creep and soil creep are the different types of creep.

CAUSATIVE FACTORS RESPONSIBLE FOR LANDSLIDES IN SHIMLA DISTRICT

The occurrence of landslides includes a number of mechanisms. These mechanisms are affected by a number of factors. The major factors responsible for causing landslides in the Shimla district are given below:

Toe Erosion:

Roads in Shimla district run parallel to the river channels and hence are extremely sinuous. Toe erosion of the river on the concave sides often cause the road to overhang which ultimately leads to collapse due to tremendous increase in the gravitational pull. The road near Rampur has affected extensively due to toe cutting by the Satluj leading to landslides and has affected the communication and telecommunication in the last few years (Fig-2).



A generalize sketch shows toe erosion by river Satluj along the National Highway-22 near Rampur

Fig-2

Rainfall:

The landslides in Shimla district are always caused by rainfall. Climatically the area is under the influence of the monsoons and heavy rains occur during June to September. The study area lies in the Lesser Himalaya hence it receives orographical type of rainfall. Thus, rainfall and slope aspect play important role for the occurrence of landslides. In July 2020, a slide near Barrier at Boiluganj was the result of heavy rainfall in which a rain shelter collapsed caused the death of one person and injury to another person. A similar example of

heavy rainfall witnessed near Sabji Mandi at Dhalli where a landslide buried hill side of Sabji Mandi resulted into the loss of apples in the month of August 2020.

Slope Cutting for Road Construction:

In the Shimla district excavations for road construction in geologically sensitive belts have triggered massive landslides. The National Highway-22 has been affected extensively due to landslides. Several hundred hectares of forests were denuded by road construction in the last few decades along the National Highway-22. The construction of highways in the study district is common activities to reduce traffic conjection. The construction of such bypasses has removed hundreds of trees on the steep slopes and enhanced the possibility of the occurrence of landslides. Kufri, Theog, Narkanda and Rampur are the worse affected areas for the occurrence of landslides along the National Highway - 22 .

Deforestation:

Since Shimla district is a hilly area and it remains severely cold for about six month, people are dependent entirely on forests for their basic needs like wood for heating and cooking and also for construction their houses. In the deforested area, the soil receives all rainfall produced by rainstorm. The raindrops reach the ground with full intensity and smash the tiny soil particles. As a result, soil surface becomes hard and compacted as its pores area clogged with fine particles produced due to splash. Rainwater does not infiltrate and runs down the slope as surface runoff causing landslides.

The Shimla district which has now become famous for apple production and the demand for apple in the country has enriched the people. The people having good amount of money in their pockets have exploited the forest wealth to a very large extent. Kufri, Theog, Narkanda, Jubbal, Kotkhai, Kotgarh, Chopal, Rohru, Rampur are such areas of study district where the hotels, restaurants and houses of people are mainly made up of wood especially extracted from devdar trees. The race to show elite status in the society, a large patch of devdar trees has been removed which has increased the landslide activities.

CHRONOLOGICAL HISTORY OF DEADLIEST LANDSLIDES IN SHIMLA DISTRICT

Landslide has been proved as a deadliest event in the past history of Shimla district. The district had frequently been shocked by landslides. It has engulfed the life of thousands of people and rendered other grieved and has caused innumerable damages both to private and public property.

Landslide occurrences are the worldwide phenomena particularly in the mountainous regions. This is a menace in several nations.

In the Shimla district, landslides are very frequently occurring. They kill a large number of people and animals and cause huge damages each year. Landslides are the most prevalent along the roads and the rivers. Falling and sliding of rock, soil and debris which flatten the houses, the fields, men, property and trees are the common features. Material that scattered on the roads and railway tracks causes disruption of traffic, accidents and sometimes fatalities.

Some of the past deadliest landslides in the region's history have been narrated in the following paragraphs on the basis of researcher's past experiences and from the reports of The Tribune.

The deadliest landslide in the region's history in the last 35 years occurred

in September 1978 in Samolhi village, about 150 kilometres from Shimla. The incessant rain soaked layer of soil and gravel. The material eventually began traveling down the mountain sides gathering debris as it went. The muddy torrent buried 24 persons alive.

The year 1978 proved very unfortunate for the district. The memory of the September 1978 incidence of landslide which claimed 24 lives has suddenly been revived among the people of the district, following the landslide in the Rauni village which was one of the worst-hit villages in the district, where 10 persons were buried alive on Saturday 19, 1978. Samolhi in Rohru tehsil, Sawra in Jubbal tehsil and Nauli in Rampur were among the other badly affected villages in the district where landslides had taken a heavy toll.

In several areas houses have developed major cracks rendering them unsafe. Cultivable land had also suffered badly on account of landslides. Within a distance of 10 kilometres from Kotkhai six saw mills have been damaged. The central power sub-station at Kotkhai has also been damaged.

Most of the destructive impacts of landslides are due to human activities. Many landslides occur on slopes that have been altered for various construction purposes. The construction for various purposes is dangerous on slopes which are geologically weak and prone to landslides. In 1993 near Fingask Estate the excavation at the base of the building destabilized the terrain and the multistoried building collapsed just like the playing cards. Twenty seven persons buried alive below the debris. This was one of the deadliest landslide event ever witnessed by the people of the district

The huge damages were once again witnessed in 2004 (Clip-1)

9 LABOURERS BURIED ALIVE IN LANDSLIDE NEAR SHIMLA

Shimla:-

As many as nine labourers were buried alive and three injured in a huge landslide near Mugli Bridge on the Basantpur-Kingle road, 115 km from here, today.

All deceased and the injured persons belonged to Jharkhan. They were

working for a Chandigarh-based contractor, Mr. K.C. Sharma, on a link road.

In all 14 labourers were sleeping in makeshift shelters by the roadside at the time of the incident. They did not get any time to move out as the massive landslide triggered by continuous three days of incessant rain...

Source: [The Tribune](#), 15 October 2004

Clip-1

MITIGATION MEASURES

To protect the study district from the landslide hazards, the following mitigation measures are needed to be introduced therein.

1. There should be small drainage channel on road side and water collected from such drainage should be jointed to the underground system of drainage to minimize the road side erosion.
2. The plantation of quick growing grass and shrub species such as *Pennisetum purpureum* and *Ipomoea carnea* should be planted on the slope devoid of vegetation.
3. The deposition of debris on the slope and in the seasonal nallas should be checked by authority.
4. The slope angle should be below 40 degrees for the construction of buildings.

5. The construction of retaining structure is a very effective remedial measure to lessen the occurrence of landslides.
6. Prior to construction endeavor, the carrying capacity of the land should be calculated by the geologists.
7. The knowledge among the people should be spread related to landslide hazard and its prevention.

Conclusion:

Thus, it can be summarized that Shimla district experiences large number of landslides incidences particularly during the monsoon season. Both natural as well as anthropogenic factors are responsible for the occurrences of landslides. The man has proved as an important factor for enhancing the occurrences of landslides due to his developmental activities in the Shimla district. The awareness among the people about the preventive measures is of utmost priority.

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