Temporal Variation of the Landside Occurrences: A Case Study of Shimla District

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Abstract: *The occurrence of landslide is a common phenomenon and experienced every year in the Shimla district. The Shimla environments are under great pressure. Of the many pressures the main pressures include expansion of tourism, recreation, and increasing population. With expanding urbanization and more construction enterprises of highways and buildings many sites are vulnerable for the occurrences of landslides. Because of these pressures the incidences of landslide have been increasing every year. 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 landsides is an acute problem in the Shimla district and over the last few decades the number of landslides and subsidence 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 Town. The results of the study bringing out the causative factors and mechanism, together with the suitable preventive measures have been presented in this paper.*

Key Words: landslide, subsidence, fragile geology, vulnerable, urbanization.

Introduction

The occurrence of landslides is not a new phenomenon rather it has its roots in the past. Throughout human history, landslides remained an important part of human life, specially, in the Shimla district. The Shimla district of Himachal Pradesh experienced unusually heavy rainfall in the monsoon season. This unusual incessant rainfall causes landslides as well as soil erosion at many places. The landslides of various types like soil creep, rock slides, rock falls and debris slides were recorded at various sites. Most of the landslides occurred from July to September were disastrous in the history of Shimla district (Sharma, Anurag 1993). Therefore, destruction caused by these landslides were huge and irreparable.

Objectives of the study

The study of the paper is based on the following objectives:

1. To investigate the seasonal variation of landslide occurrences.
2. To investigate landslides during pre-1985 period and post-1985 period.

Methodology

In general, the present study has been based on morphometic analysis, photographic work and field survey. The study has been almost entirely based on primary data collected by personal survey in the field and secondary data based on the reports collected from The Tribune. Different landslide sites in Shimla have been visited to study landslides.

Analysis and Interpretation

The data based on the reports collected from The Tribune reveal wide variations in landslide occurrences with time. In the pre-1985 period (1970-1985), the magnitude, intensity and frequency of landslides were less as compared to today. Technological developments play an important role in the frequency of landslides. At the same time it has developed some methods to mitigate landslides.

The scanning of newspaper reports reveal that the frequency of landslide occurrences is high during rainy seasons. During winter season from November to March when the precipitation occurs mainly in the form of snow the number of landslide occurrence is less. It shows a close association between rainfall and landslides. Most of the landslides are reported during July to September.

A. Seasonal Variations of Landslide Occurrences
B. Landslides during the Pre-1985 period and Post-1985 period

A. Seasonal Variations of Landslide Occurrences:-

Seasonal variations have been found in the landslide occurrences in the study area. The frequency and magnitude of landslide occurrences are more during monsoon seasons (from mid-June to mid-September) and less in the winter season.

In the study area the rainwater enhances the susceptibility of landslide occurrences in many ways:

1. Pore Water Pressure:-

The weight of dry soil is less than the weight of the saturated soil. When water enters in the rocks through joints, fissures, and cracks, it gets accumulated. When it finds no way to escape, it exerts pressure on the pore boundaries (Engelbert, Phillis 2001). The pressure exerted by water is so high that it breaks the rock strata. The shear strength gets

disturbed and destabilized rock mass under the influence of gravity move downhill. This results in landslides. For example a slide of MLA hostel at cart road, Shimla.

2. Lubricant:-

The water also acts as lubricant. The intrusion of water in the jointed rock dissolves the weathered soil particles and carries it out. Thus, left the rocks empty along the plane and become the cause of the landslide (Singh, Vir 1998). This activity can be seen in sedimentary rocks where weathered material is soluable. A slide due to lubrication occurred in Chhotta Shimla. About 6-8 devdar trees uprooted and a resident building below the slide damaged.

3. Saturation of weathered material:-

The dry weathered material has less potentiality to move than the saturated weathered material depending on the nature of the slope (Sinha, P.C. 1998). The saturated weathered material becomes heavier and move down slope under the influence of gravity and cause of landslide. A slide at Rampur near Hanuman Mandir shows such type of landslide.

4. Rain water:-

Rain water itself is strong enough to break the soil particles. Heavy and large drops of water falling on the surface of the earth loosen the soil particles. Thus, it helps to remove the vegetative cover. This enhances the runoff and causes the debris flow.

The study district is situated in the Lesser Himalayas. The precipitation is in the form of rainfall during monsoon seasons and is snowfall during winters. During monsoons Shimla district experiences larger number of landslides (Table 1).

For the analysis of landslide occurrences in the study area some of the parameters are selected to show that landslide occurrences and rainfall are strongly associated:

1. Newspaper Reports:-

In the present study, the issues of The Tribune, were scanned to collect the data on landslide occurrences in Shimla district. Newspapers are an important source about the landslide occurrences despite some limitations. The issues report more landslides during July to September, the monsoon months. They mention rainfall as the main cause for the occurrences of landslides.

Field observations also reveal that Shimla district is severely suffered from landslide activities during rainy season every year. The National Highway - 22 is more vulnerable for landslide occurrences. Some reports from The Tribune show that rainfall has affected the district badly in terms of human lives and property loss. (Clip 1 and 2)

Table 1
Torrential Rainfalls between 1970 and 2004 that Triggered Landslides in the Shimla district

Day/Month/Year of Landslide reported	Area	Landslide location	Rainfall amount in Millimeters	Number of Landslides	Casualties	Damages
10 July 1990	Shimla	Lakkar Bazar	319.1	1	3	-
14 July 1991	Shimla	Kasumpti and Kachi Ghati	149	2	1	-
13 July 1994	Kufri	Kanor Nullah	368	1	3	-
31 July 1995	Rampur	Mushbhari Village	205.3	1	1	-
3 September 1995	Theog	Devi Mod	305	1	-	-
9 August 1999	Shimla	Jakhu	228.8	1	-	-
16 July 2000	Rampur	Bali	338.9	1	8	-
26 June 2001	Theog	Devi Mod	240	1	1	-
10 August 2001	Rohru	Naigala	168.7	1	3	-
26 July 2003	Rampur	Teory	264	1	2	Three trucks and three houses buried
3 August 2003	Shimla	Cart Road	387.1	1	-	-

Source : Based on The Tribune reports.

TRUCK DRIVER DIES IN LANDSLIDE

Shimla, June 26

One person was killed as monsoon remained active in parts of Himachal Pradesh since last night, triggering landslides at certain places in the region.

The driver of a truck was killed and three others, including two constables, were injured when it was hit by a landslide and fell into a gorge near Devimod in Shimla district last night. The truck was carrying the bodies of five persons killed in an accident earlier. Moderate to heavy rain pounded the capital town of Shimla and its adjoining areas last night and today, bringing considerable fall in the temperature. The rain caused landslides at a few places on the 320-km Hindustan-Tibet road. However, traffic was playing normally on the road.

Upper areas of Shimla district, including tourist places of wildflower Hall, Kufri, Naldehra and Narkanda and the key tourist place of Manali in Kullu district also experienced rainfall.

Source: The Tribune, 26 June 2001
Clip 1

LANDSLIDES DISTUPT TRAFFIC IN SHIMLA

Shimla, July 15

Normal life in most parts of the state was disrupted as widespread heavy rain caused numerous landslides, blocking roads at several places during the past 14 hours The upper areas of Shimla district were cut off as a major landslip blocked the Kotkhai road near Gumma. The Kotkhai, Jubbal and Rohru bound buses were terminated at Gumma and Chhaila.

The National Highway - 22 was blocked at Kalimitti and Jhakri as a result Kinnaur district was completely cut off. The Shimla-Karsog road was blocked near Churag, but the traffic was restored by the evening. The ongoing widening of road between Kingal and Odi blocked drainage as a result of which storm water inundated some house and agricultural fields.

The traffic on the Junga-Chail road, Mahsobra-Khatnol and several other link roads was disrupted. The local depot of the state road transport corporation had to suspend bus services on 14 routes.

The local roads leading to Annandale helipad and Bharari were also blocked by

landslides. There is a demand for handing over the Annandale road to the Public Work Department as the local municipal corporation has allegedly not been able to maintain it properly. The Shimla-Bilaspur road also	remained affected for some time due to landslide at Tutu. Meanwhile, the city recorded 135.9mm rain, followed by Dharamsala (109mm), Sundernagar (86.1mm), Sunni (77mm), Rampur (42.8mm) and Pandoh (34mm).

Source: The Tribune, 16 July 2005
Clip 2

Table 2 and figure 1 which are based on The Tribune reports, give a detailed account of landslide occurrences in different months within the Shimla district. Table 3 gives a comprehensive idea of the seasonal occurrences of landslide hazards in the Shimla district. More than 88 per cent of the total landslides have occurred during rainy season and about 9.5 per cent have occurred during winter season. On the basis of this it can be said that landslide occurrences are mainly the result of heavy rainfall.

Shimla town has experienced more than 92 per cent of the total landslides during the monsoon season and of the total 91 per cent have been reported for Rampur alone.

C.D. Blocks of Shimla district that is Chirgaon, Rohru, Jubbal/Kotkhai, Narkanda, Mashobra, Theog and Chaupal have experienced landslides during monsoon seasons. The precipitation in these regions in the winter season is mainly in the form of snowfall.

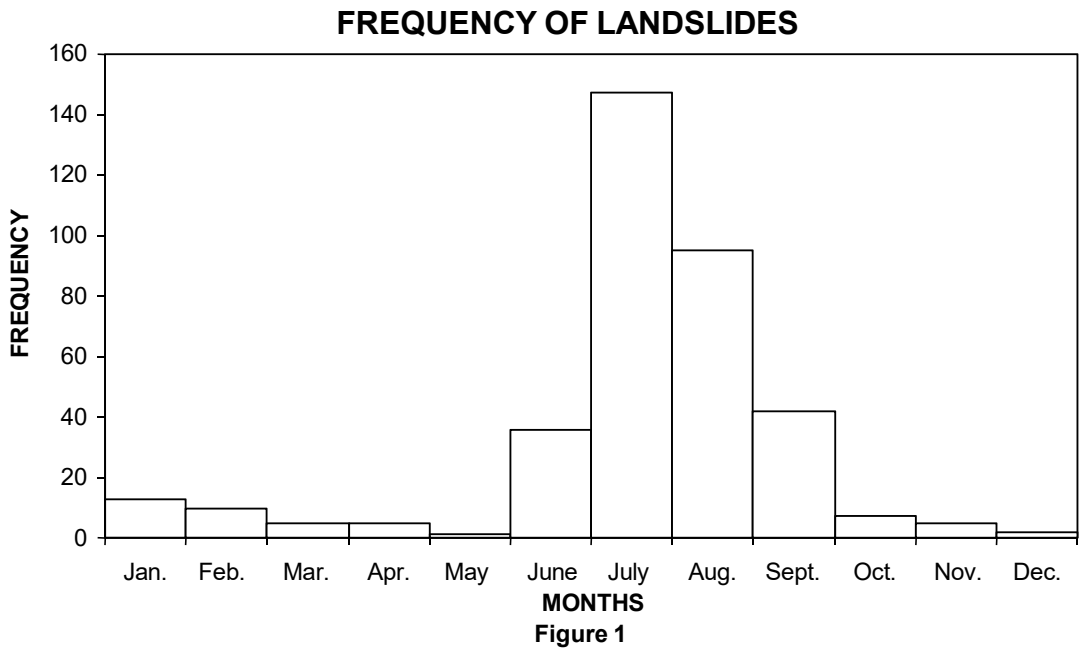

Figure 1

Source : Based on The Tribune reports.

Table-2

Distribution of Landslide Occurrences (Month Wise)

Blocks	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Rampur	1	1	2	1	0	9	31	19	10	2	1	1	78
Chirgaon	0	0	0	0	0	1	4	3	1	0	0	0	9
Rohur	1	0	0	0	0	2	11	8	3	0	0	1	26
Jubbal & Kotkhai	0	0	0	0	0	6	5	7	2	1	0	0	21
Narkanda	2	3	0	2	1	3	14	9	3	0	1	0	38
Mashobra	4	3	2	0	0	8	68	37	14	2	2	0	140
Theog	5	3	1	2	0	7	5	8	6	0	1	0	38
Copal	0	0	0	0	0	0	9	4	3	2	0	0	18
Total	13	10	5	5	1	36	147	95	42	7	5	2	368

Table 3
Seasonal Occurrence of Landslides (1970-2004)

Blocks	Monsoon	%	Winter	%
	Jan.-Oct.		Nov.-Mar.	
Rampur	71	91.026	6	7.692
Chirgaon	9	100	0	0
Rohur	24	92.308	2	7.692
Jubbal & Kotkhai	21	100	0	0
Narkanda	29	76.316	6	15.79
Mashobra	129	92.143	11	7.857
Theog	26	68.421	10	26.32
Copal	18	100	0	0
Total	327	88.859	35	9.511

Source: Based on The Tribune reports.

Rainfall Data:-

The rainfall data of selected station, for the selected years reveal the close relationship between rainfall and landslide hazards in the study area. The high concentration of rainfall had been recorded in the monsoon month from June to October. Within these months higher number of landslides were recorded. The data present a strong and direct relationship between landslide occurrences and rainfall.

Table 4 and Figure 2 show that rainfall throughout the year is high during monsoon season than during the winter season. The greater concentration of rainfall during the monsoon season indicate more occurrence of landslides between June and October.

Figure 2 shows that rainfall and landslides are closely associated. As the rainfall increases the occurrence of landslides also increases.

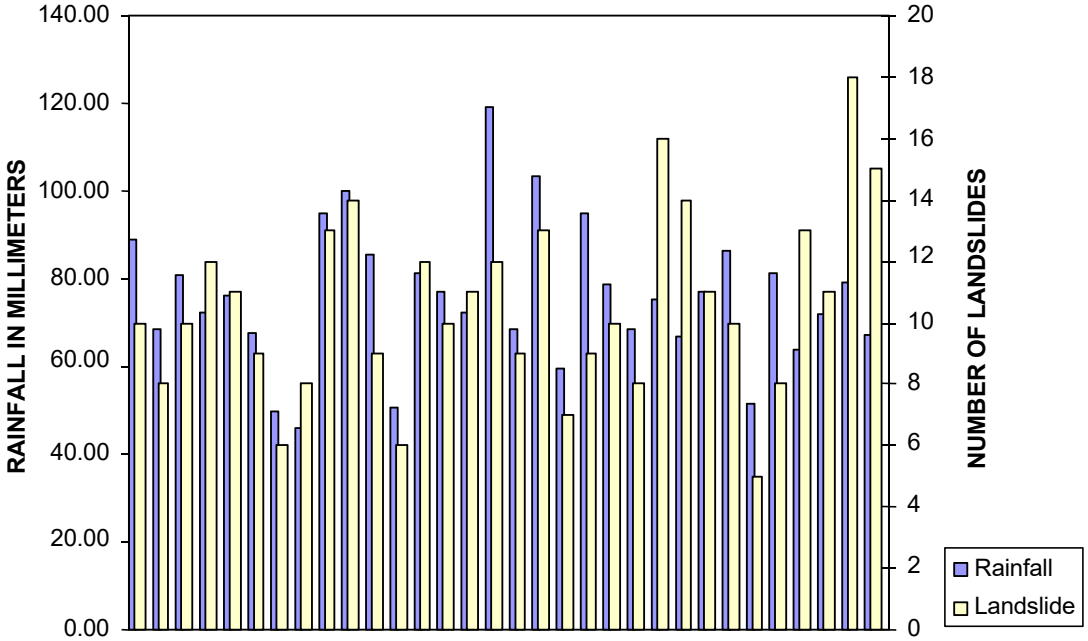

Figure 2

B. Landslides during the Pre-1985 and Post-1985

In the present study the pre-1985 period extends from 1970 to 1985 and the post-1985 period extends from 1986 to 2004.

The study district has experienced large number of landslides in the post-1985 period as comparison to pre-1985 period. Table 4 presents the occurrence of landslides in the pre-1985 period and post-1985 period.

The examination of Table 4 reveals that 65 per cent of the total reported landslides have been occurred during the post-1985 period. The post-1985 period experiences various development activities especially construction of roads and their widening.

The various human developmental activities such as the construction of roads, removal of vegetation and mining operations can generate the landslides.

During the field survey it has been found that mostly landslides occur along the roads particularly along the National Highway and State Highways. The roads network in the study district exhibited an abrupt increase from 1504 Kilometres to 4739 Kilometres from 1977 to 2008.

Erroneous planning and obdurate execution of construction ventures of most of these roads, has reduced stability of the hill sides through which these roads pass, generating massive debris quantity, which is thrown down the slopes. The sliding of debris causes landslides, during the rainy seasons.

Table 4
Landslides during Pre-1985 (1970-1985) and Post-1985 (1986-2004)

	Pre-1985	Post-1985
Blocks	Landslides	Landslides
Rampur	32	46
Chirgaon	3	6
Rohru	11	15
Jubbal/Kotkhai	7	14
Narkanda	14	24
Mashobra	41	99
Theog	12	26
Chopal	8	10
Total	128	240

Source: Based on The Tribune reports, 1970-2004

Conclusion

The occurrences of landslides in the Shimla district have been observed more during the post-1985 period than the pre-1985. The reasons for the increase of the incidences of landslides are due the rapid increase in population, maintenance and widening of national highways, construction of buildings.

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