



Research Paper

Landslide Hazard in Darjeeling Himalayan Region and Management

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Abstract

Geohazards, such as volcanoes, earthquakes and landslides, are the natural geological processes that present a direct risk to people or an indirect risk by impacting development. Landslide is a recurring natural phenomenon observed in mountainous terrain of Darjeeling Himalaya. It is the most pervasive of natural hazards that undermine the economic and cultural development of Darjeeling Himalaya. It brings a great loss of life and heavy damage to land and property. During landslide the materials like soil, rock, vegetation, and existing construction may move very rapidly within a second where as some may take longer time to develop. The result is livelihood security lost, socio-economic condition of people destroys and a huge amount of revenue spent with untold suffer of victims after landslide occurrences. Thus it is required to identify the landslide vulnerable area in advance. The main objective of the present study is to identify the causes of landslides, their impact and to suggest necessary measures to mitigate the hazard in the Darjeeling Himalaya. **The Darjeeling district had been experienced major landslides in July–August, 1993, May 2009 and September 2011 (Sarkar 1999). Massive rain caused landslides at Darjeeling town, Mirik, Kurseong and Kalimpong during June–July, 2015 and induced the loss of properties and lives.** The findings of the present study reveals that it is neither possible to stop the landslides nor to completely eliminate their damages but it is possible to minimize the severity of the impact and the damage potential through several structural measures and settlement policy with strong public awareness.

Keywords: Afforestation; Geo-environment aspects; critical areas; impacts; management.

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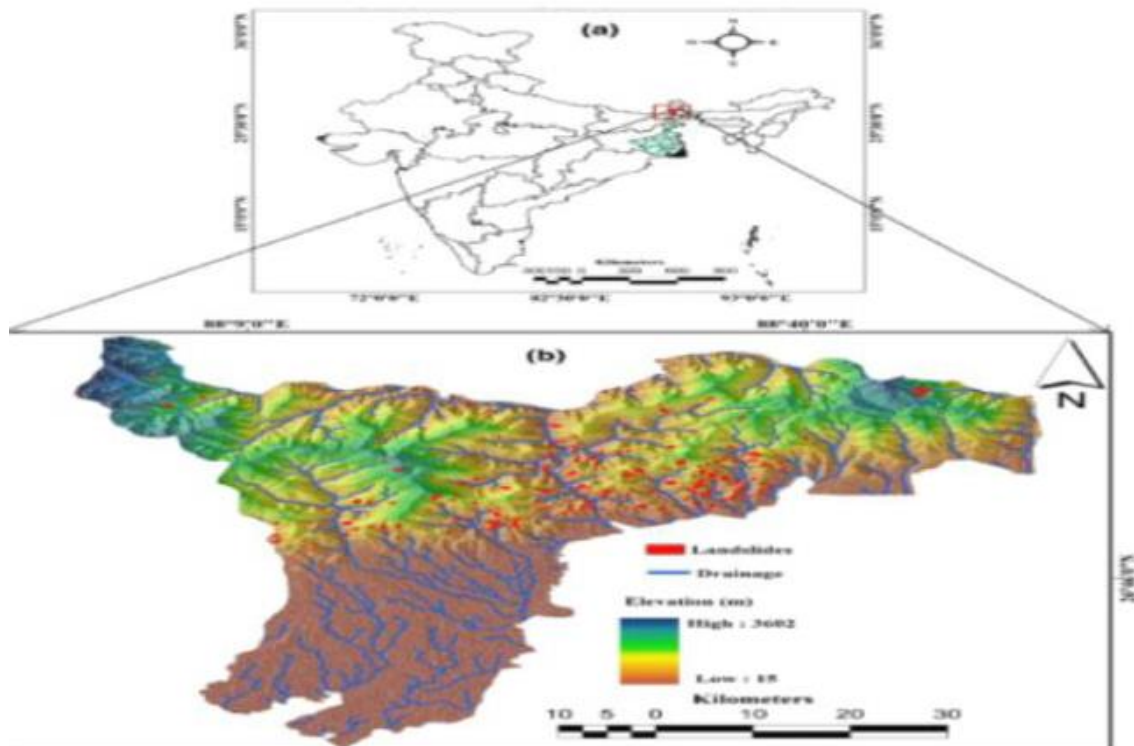
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I. INTRODUCTION:-

Geohazards, such as volcanoes, earthquakes and landslides, are the natural geological processes that present a direct risk to people or an indirect risk by impacting development. Landslide is a recurring natural phenomenon observed in mountainous terrain of Darjeeling Himalaya. It is the most pervasive of natural hazards that undermine the economic and cultural development of Darjeeling Himalaya. It brings a great loss of life and heavy damage to land and property. During landslide the materials like soil, rock, vegetation, and existing construction may move very rapidly within a second where as some may take longer time to develop.

OBJECTIVE:- The main objectives of the study are-
To identify the causes of landslides in the Darjeeling Himalaya.
To assess the critical areas and impact of landslide disaster.
To suggest necessary measures to mitigate disasters.

LOCATION MAP OF THE STUDY AREA :-



DATABASE:-

The data for this study had been obtained from both the primary and secondary sources:-

Primary Source: The research work has been incorporated of several primary data source which has been collected through primary survey in the study area.

• Secondary Source: The present study is based on secondary data generated through author's field survey. The relevant data were collected from 2.2.2015 to 8.3.2015 from the following sources:-

- i. National Disaster Management Authority, Ministry of Home Affairs, and Government of India and
- ii. Annual Reports, NDM Division, Ministry of Agriculture.

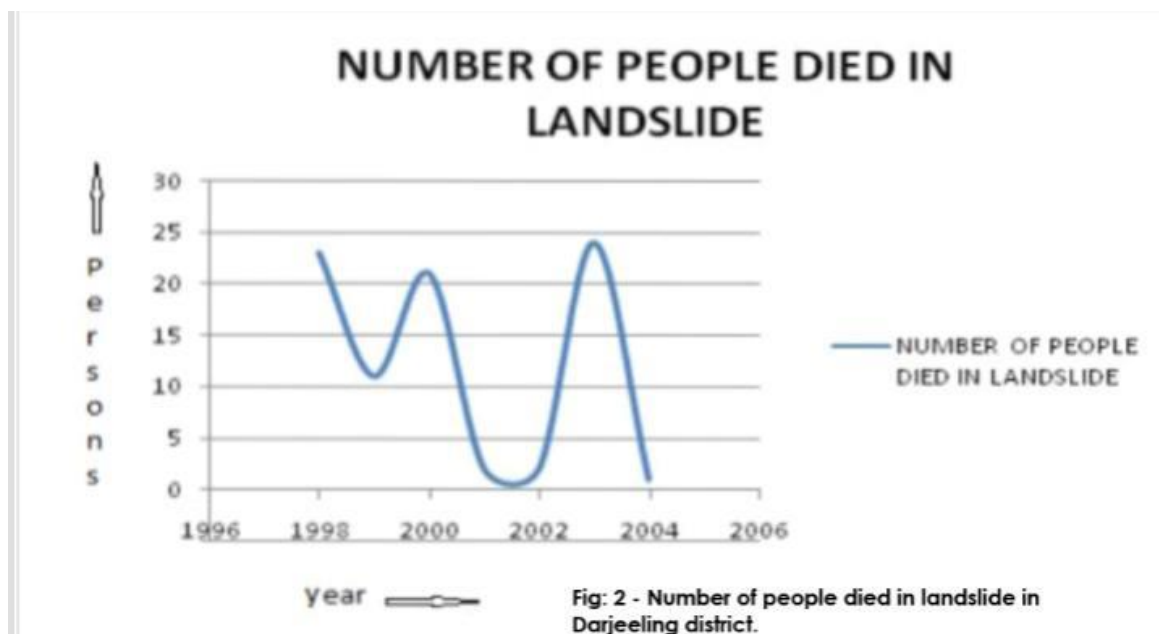
II. METHODOLOGY:-

• The present report has been prepared based on secondary sources, like literature, research papers, like administrative reports and websites. Data and information have been shown by cartographic symbols on maps or by graphical diagrams. The images have been interpreted based on findings and secondary source information collected.

III. RESULT AND DISCUSSION:-

- Landslide is the result of two primary causes in the study area. These are
 - 1. Increase in driving force
 - The following physical and manmade factors which increase the driving force on the slope in Darjeeling hill.
 - 1.1 Physical Factors
 - 1.1.1 Local shocks and vibration occur from seismic activity.
 - 1.1.2 III drainage system due to high rate of soil erosion.
 - 1.1.3 Heavy precipitation in the time of monsoon period.
 - 1.1.4 An increase of slope angle if a stream erodes the bottom of a slope.
 - 1.2 Manmade Factors
 - 1.2.1 Local shocks and vibration occur from the operation of heavy construction machinery.
 - 1.2.2 An increase of slope if the slope is steepened by building work.

- 1.2.3 Removal of lateral support by human activity such as road construction.
 - 1.2.4 Additional weight placed on the slope by dumping of waste or by building construction
 - 1.2.5 Deforestation.
 - 1.2.6 Unscientific mining and quarrying which reduce the basal support of the slope
 - 1.2.7 Heavy vehicular movement is another factor which causes local shocks and vibration.
 - 2. Decreases in shear resistance
- The following physical and manmade factors reduce the shear resistance on the slope in the study area.
- 2.1 Physical Factors
 - 2.1.1 An increase of pore water pressure in the slope materials.
 - 2.2.2 Roadways construction.
 - 2.2.3 Unscientific cultivation.
 - 2.2.4 Population pressure.
 - 2.2.5 Use of non-degradable materials (plastic) etc.



GEO-ENVIRONMENT ASPECTS THAT ENCOURAGE LANDSLIDES IN THE AREA

Weak Geological set up

The Darjeeling Hill area represents a unique geo- environmental perception. According to Mallet (1875) & Audent (1935) the tectonic units are found to be in the reverse order of stratigraphic superimposition and is represented by Siwalik and Gondwana systems. Towards the inner Himalayas, the thrust sheets of Daling and Darjeeling group of rocks are found. The foothills of Himalaya are represented by Siwalik Group of sedimentary rocks which comprises of alternate sequence of soft immature micaceous sandstone, mudstone, claystone and pebble bed. In the north the Main Boundary Fault (MBF) separates it from the Gondwana Group of sediments. The north of Gondwana is tectono- stratigraphically represented by an assemblage low grade metamorphites, known as Daling Group Geologically, the Daling rocks (phyllites, slates, schists feldspar etc.) and Damuda rocks (sandstones, shale etc) are susceptible to landslides (Sarkar, 2010) since these are immature weak rocks

Heavy rainfall

The amount of rainfall plays a very important role in causing instability of slopes. A very high intensity of rainfall within a short span of time is often common in Darjeeling hill areas. In respect of landslide hazards, the duration of rainfall is very important. Long duration along with heavy down pour may cause deeper infiltration and overland flow, which ultimately may result into the occurrence of landslides on weaker slopes. On an average 4198.8 mm of rainfalls in the southern slopes is observed. The records show some of the long continued down pour

Unstable geological structure

The trends of evolution or rising of young mountains is the basic reasons for frequent landslide hazards in the Himalayan region. This includes unstable geological structure, tectonic disturbances, parallel subsidence of Himalayan for deep of slopes.

Rapid expansion of settlements

Rapid expansion of settlements and towns especially along the roads is one of the important causes of frequent landslide hazards in the hills. Multi storied buildings without proper planning along the roads and on the steeper slope increase the load on the already deteriorated slopes.

RECOMMENDED STRATEGIES TO PREVENTION OF LANDSLIDE :-

Role of Government in hazard management

The Govt. of West Bengal has emphasized the following mitigational measures to tackle the landslide hazard in the present study area-

Structural measures

Drainage correction,

Proper land use measures,

Reforestation for the areas occupied by degraded vegetation and

Creation of awareness among local population

Structural measures

Government emphasized on the actions that involve the construction of structures to reduce the landslide hazard. Such structures include dams, levees, floodwalls, retaining walls, channel maintenance sub-drains, soil reinforcement and safe rooms or shelters.

Drainage Corrections

The most important triggering mechanism for mass movements is the water infiltrating into the overburden during heavy rains and consequent increase in pore pressure within the overburden. Hence the natural way of preventing this situation is by reducing infiltration and allowing excess water to move down without hindrance. As such, the first and foremost mitigation measure is drainage correction. This involves maintenance of natural drainage channels both micro and macro in vulnerable slopes.

Proper land use measures:-

Government has also stressed on the effective land-use regulations and building codes based on scientific research. Through land-use planning, discourage new construction or development in identified hazard areas without first implementing appropriate remedial measures.

Afforestation :- An afforestation programme has been planned in the area. Bounding of any sort using boulders etc. has to be avoided. The selection of suitable plant species is being done in such a manner that can stand the existing stress conditions of the terrain.

Public Awareness:-

Government has also emphasized on the awareness programme of landslide hazard. Public awareness is being propagated about signs that a landslide is imminent so that personal safety measures may be taken. Some of these signs include:

- (i) Springs, seeps, or saturated ground in areas that have not typically been wet before.
- (ii) New cracks or unusual bulges in the ground, street pavements or sidewalks.
- (iii) Soil moving away from foundations, and ancillary structures such as decks and patios tilting and/or moving relative to the house.
- (iv) Sticking doors and windows, and visible open spaces.
- (v) Broken water lines and other underground utilities.
- (vi) Leaning telephone poles, trees, retaining walls or fences.
- (vii) Sunken or dropped-down road beds.
- (viii) Rapid increase in a stream or creek water levels, possibly accompanied by increased turbidity (soil content).

(ix) Sudden decrease in creek water levels even though rain is still falling or just recently Stopped.

IV. CONCLUSION :-

In conclusion it is important to say that people should aware much about the landslide hazards. They should not build settlements on the vulnerable areas. So it is very necessary to create a strong public awareness. It is neither possible to completely stop landslide nor to completely eliminate landslide damages. However, it is possible to minimize the severity of the impact and damage by suggested strategies in Darjeeling Himalayan Regions.

REFERENCES:-

- [1]. Bandopadhyay, M. (1980), Progress report on slope stability of Toonsoong area, Darjeeling Town, G.S I report, 8 p.
- [2]. Basu, S.R & Sarkar, S. (1985), Some considerations on recent landslides at Tindharia and their control, Indian Journal of Power and River Valley Development, 188-194.
- [3]. Basu, S.R & Sarkar, S. (1987), Ecosystem vis-a vis landslide: a case study in Darjeeling Himalaya, proce. Impact of Development on Environment, Geog. Soc. India 2, 45-53.
- [4]. Chakraborty, et al (2006) 'Environmental Studies' (part ii, paper ix), Directorate of Distance Education, Rabindra Bharati University
- [5]. Ghosh, A.K et al (2008) 'Status of Environment of West Bengal- A Citizen's Report.
- [6]. Ende- Society for environment and development, p. 22
- [7]. Ghosh, A. M.N. (1950), Observation of landslips of the 11 and 12 June 1950, in the Darjeeling Himalaya, unpublished G.S.I report.
- [8]. Griesbach, G.L. 1899-1900, General Report, G. S. I, India.