Research Paper Geography

Landslides: A Geographical Review in and Around Pagla Jhora Region of the Eastern Himalayan Belt of Darjeeling, West Bengal

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ABSTRACT

Landslide is a rapid movement of rocks, soils and vegetations down the slope under the influence of gravity. Landslides are by far the most common natural disaster and pervasive natural problems in the Himalayan region of Darjeeling. Every year, people have to face this natural vengeance without any effective preventive measures and management system thus leading to huge loss of life and property. Darjeeling district with a geographical area of 3,149 sq km lying within the Lesser and Sub - Himalayan belts of Eastern Himalayas is one of the most vulnerable regions for the landslides and over the year frequency has greatly increased. Within Darjeeling, notably Pagla Jhora region is one of the worst affected, where such landslides occurs with the onset of monsoon cutting off National Highway 55 which connects the Himalayan region with rest of the state of West Bengal. Over the decade various preventive measures has been taken up but yet the result has not been achieved. As such, an in depth study and analysis is required regarding its causes and possible measures to stabilize it.

Keywords : Landslide, slope gradient, geological, shear stress, surface runoff, tectonic, slump, sliding

INTRODUCTION

Landslides, most significant of all type of mass movements involve down slope displacement of both types of – weathered rocks and soils. Pagla Jhora in particular has been witnessing such large scale landslides both over space and time. Every year with the onset of monsoon, landslide becomes active (from the last 5 decades), thus making adverse impacts on the people living around the region. Due to frequent landslides the situation has become such that at present the crucial link provided by NH 55 between the hill and plains is very much in critical condition. Moreover, the heritage Himalayan railway which forms an important UNESCO heritage site and main tourist attraction gets totally damaged. As such in this article, a geographical study and analysis has been attempted to find out the exact reasons of the causes and remedial measures of growing frequency of magnitude of landslides in and around Pagla Jhora region.

STUDY AREA

Pagla Jhora, which forms upper part of the Shiva Khola basin, lies near Tindharia town in the Kurseong sub division of Darjeeling district (Fig no 1 & 2). The whole basin including Pagla Jhora covers an area of about 22.12 sq km, out of which 8.967 sq km is under tea plantation, 4.31 sq km is under reserve forest and 7.48 sq km is under shrubs and scatter terrace fields. The landslides in and around Pagla Jhora i.e influence area is about of 1.67 sq km and extends between 26º 52' N - 26º 57' N and 88º18'E - 88º19' E. The crown elevation is about 1540 m with maximum width of 1055m. It intersects with NH 55 at two different locations (1130-185 m and 1230-1335m) thus affecting 3 km length of NH 55.

OBJECTIVES:

The main objectives of the study are outlined below:

- To identify and study the landslide prone zone of Pagla Jhora region.
- To find out the exact mechanism and root cause behind such frequent occurrence of landslides.
- Discuss the various parameters responsible for the menace and suggest preventive measures to mitigate the arising problems.

METHODOLOGY

The methodology taken up to make a comprehensive study and analysis of Pagla Jhora area can be postulated in the following manners:

- Field survey of the affected area with the help of checklists forms the important source of primary data.
- Use of GPS variables along with modern GIS equipments has helped to analyze the geological and tectonic stability of the slope of the regions.
- Various physical parameters are studied very carefully to understand relief, drainage, bed rocks, regolith and soils to find out its role in the occurrence of landslides.
- Interaction with the local people to get the glimpse of growing and changing economic paradox also forms an important part of the adopted methodology as anthropogenic factors has made significant contribution towards increasing landslides in the recent past.

CAUSES OF LANDSLIDES

After making intensive field survey in and around Pagla Jhora region and closely analyzing these facts, the main reasons for the gradual rise in the occurrence of landslides in this region can be summarized as follows:

1. Slope instability: The comprehensive and detail study of the geological setting of Pagla Jhora reveals that the nature of slope and its behaviour is highly unpredictable. High amplitude of relief combined with very steep valley side slopes makes the stability of slope highly vulnerable to mass movement. Any change in the equilibrium between the shear strength and shear stress results into large scale landslides (Fig no 3). The Daling series of rocks comprise of lingtse gneiss and mica schists with low permeability and low shear strength has lead to sinking of NH 55 at many intervals. As such, the onset of monsoon facilitates slope failure every year.

2. Soil: The Daling series clayey dark soils with high content of sand makes the soil very weak and thus enhance the shearing stress and decreases the soil coherence (Fig no 4). With the addition of water during long rainy season, the soil display high magnitude of expansions which in turn detaches

the soil from its situ and causes soil creeps and debris fall around Pagla Jhora region.

3. Rainfall: The heavy shower during monsoon season in consideration with other host of elements is considered as the major factor (Table no 1). In fact, Pagla Jhora is one of the wettest places in whole of Darjeeling Himalayan region. Being situated along the southern slope of Mahaldiram massif, south west monsoon winds strikes and causes plenty of rainfall. Thus, on an average 4198 mm of rainfall takes place with dry spell in between. However, some times this heavy shower lasts for 2 – 4 days, amounting to as high as 800mm rainfall with intensity reaching up to 100 mm per hour. Such severe rain lowers the slope stability and triggers sinking followed by slumping across the region.

4. Surface runoff and sub surface runoff: Pagla Jhora being a high velocity streams itself plays significant role in propagation of landslide (Fig 5). Water percolating through the joints, cracks and pores of soil supplied by Jhora increases the hydrolysis process and produces good amount of kaoline clay which act like a lubricant and aid to further sliding of superficial materials.

5. Vegetation: The apex of the slide under the study area has long been deforested and turned into cultivated terraces with crops like large cardamom, potato and ginger being uprooted every year which further disturbs cohesiveness of the soil and makes it vulnerable to erosion. Thus, the slopes remains devoid of thick vegetation for lone period of time and gets fully exposed to heavy and concentrated monsoon shower making it susceptible both to sheet and gully erosion.

6. Anthropogenic activities: The change in the land use pattern due to interference of human has acted as instrumental causative factors. Over the decades, Pagla Jhora is rampantly encroached by unplanned constructions and deforestation. The development of urban centers like Tindharia, Mahanadi and Ghayabari has brought drastic change in the morphology of land use pattern due to rapid explosion of population. Moreover, the frequency in the movement of heavy vehicles over study region has increased considerably over the past. Such large scale construction and heavy vehicle movements are triggering mild to moderate tremors which in turn amplify and increase the risk of landslides. The frequent sinking of NH 55 and development of scars and cracks in and around the steep gradient slope of Pagla Jhora is to some extent human induced phenomena (Fig no 6)

MITIGATION MEASURES

Landslides with destructive nature can create havoc and catastrophic impact with in the short span of time. In order to prevent and control successive landslide incidents, following mitigation measures can be adopted:

- Landslide Zonation mapping: It is one of most scientific and effective measures to control landsides. By identifying and mapping the landslide prone zone, drainage channels, scars and slope gradient etc, a specific mitigation strategy, emergency preparedness plan, allocation of disaster fund etc can be planned well before the disaster strikes the region. Such hazard mapping also helps to create awareness of risk and vulnerability natural disaster among the local people.
- Treatment of slope confirmation: The relative heights and steep gradients of slopes are the limiting factors in the stabilization of sliding along the Pagla Jhora. Since the area is composed of weak rocks, unfavourable rock foliations on slopes make it highly vulnerable. A protective rock fill dumped on the surface of slopes, gravel fill protective retention wall, rock bolting and rock anchors, gravel pile walls etc can helps to increase the shear strength and abort sliding of the debris and rocks.
- Maintenance of drainages: The surface drainage of Pagla Jhora is highly uneven hummocky and traversed by deep fissures. Thus, all streams and temporary water courses need to be diverted from the threatened area. Construction of surface drains to collect surface runoffs at different elevations, plugging of cracks and crevices to prevent runoffs to seep into the ground, construction of filters and drains behind the concrete and gabion walls to prevent loss of fines and safe passage of the surface runoffs will definitely lower the risk of landslides.
- Vegetative covers: This is the cheapest and most effective way of arresting landslides. The growing of grasses and afforestation in the slope areas will help to prevent the slumping and debris fall. Illegal encroaching of steep gradient slopes for terrace farming should be checked and strict monitoring system should be implemented to check further deforestation on the upper part of Shiva Khola basin which forms the Pagla Jhora.
- Expansion of settlement: Unplanned construction of concrete structures over the geologically unstable slopes of Pagla Jhora area should be prohibited. Moreover, the mining activities practiced in the region must also be stop seeing the instability of the slopes. Nevertheless, people should be made aware about risk of disaster and encourage them to expand their settlements only on stable geological and tectonic part of the area and in this regards 'SAVE THE HILL' (STH), a group of concerned citizens are organizing the landslide awareness cum relief campaign across the Himalayan region of Darjeeling.

CONCLUSION:

After above discussion, in the conclusion part it can be said that geological and lithological setting of Pagla Jhora region shows high prone to landslides not only due to operation of natural agents but also due to increasing human activities. As such comprehensive mitigation measures should be planned by the govt. and implement with all possible resources. Beside, large scale grass root level awareness campaign should be organized to tackle with this kind of natural cum man made disasters.

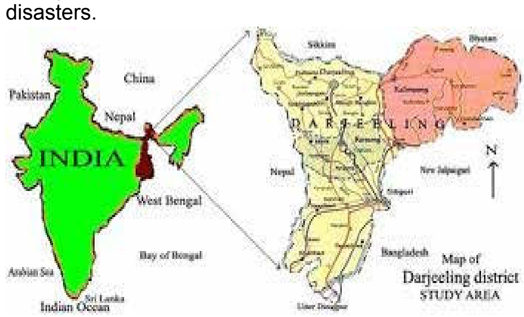

Fig no (1) Location of Darjeeling District

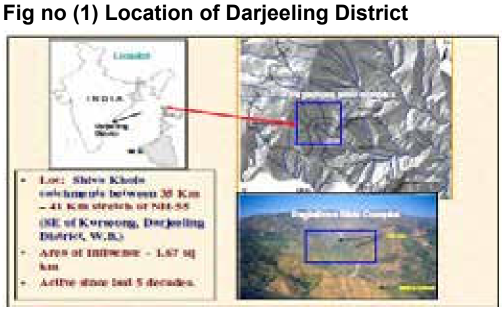

Fig no (2) Pagla Jhora (Study Area)

Fig no (3) Slope instability(souce: Telegraph July 2012)

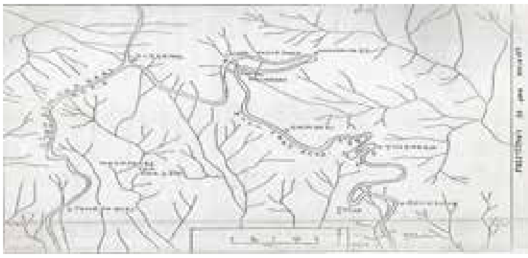

Fig no (4) Drainage network of Pagla Jhora

Fig no (5) Soil creep disturbing toy train line
(souce:Telegraph 08 Dec 2012)

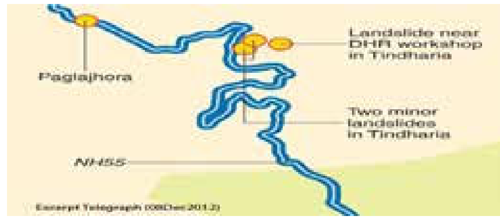

Fig no (6) NH 55 disturb by landslide
(souce:Telegraph 08 Dec 2012)

Table no. (1) Annual Rainfall and Temperature of Darjeeling
Source: hhtp://www.bbc.co.uk/weather/world/city guides/results.shmtl?tt=TT004930

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	16 (61)	17 (63)	23 (73)	24 (75)	25 (77)	24 (75)	25 (77)	25 (77)	25 (77)	23 (73)	19 (66)	17 (63)	25 (77)
Average high °C (°F)	8 (46)	9 (48)	14 (57)	17 (63)	18 (64)	18 (64)	19 (66)	18 (64)	18 (64)	16 (61)	12 (54)	9 (48)	14.7 (58.3)
Average low °C (°F)	2 (36)	2 (36)	6 (43)	9 (48)	12 (54)	13 (55)	14 (57)	14 (57)	13 (55)	10 (50)	6 (43)	3 (37)	8.7 (47.6)
Record low °C (°F)	−3 (27)	−2 (28)	−1 (30)	1 (34)	6 (43)	8 (46)	9 (48)	11 (52)	10 (50)	4 (39)	2 (36)	−1 (30)	−3 (27)
Precipitation in mm (inches)	13 (0.51)	28 (1.1)	43 (1.69)	104 (4.09)	216 (8.5)	589 (23.19)	798 (31.42)	638 (25.12)	447 (17.6)	130 (5.12)	23 (0.91)	8 (0.31)	3,037 (119.57)

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