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A case study of land slide in Assam hills

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सार – 24 जुलाई 1999 को तड़के व्यापारिक नगर गुवाहाटी के समीप पहाड़ी ढाल वाले क्षेत्रों में प्रलयंकारी भूस्खलन हुआ। इस भूस्खलन का मुख्य कारण 23 और 24 जुलाई को उत्तरी पूर्वी क्षेत्रों में दूर-दूर तक हुई भारी वर्षा और गुवाहटी क्षेत्र में हुई लगातार वर्षा थी, जिससे संपत्ति की हानि के अलावा मौके पर ही दस व्यक्तियों की मृत्यु हो गई। इस शोध-पत्र में इस भूस्खलन के लिए उत्तरदायी विभिन्न मौसम वैज्ञानिक और भूवैज्ञानिक कारकों के विषय में चर्चा की गई है।

ABSTRACT. A devastating land slide occurred on the early hours of 24 July, 1999 in the hill slopes close to downtown Guwahati. Widespread rain over the NE region and incessant rains over Guwahati area on 23 and 24 July was main reason for the slide which claimed ten(10) human lives almost instantaneously besides damage to property. The various meteorological and geological factors responsible for the land slide have been examined in this study.

Key words – Gravity erosion, Toe support, Deforestation.

1. Introduction

The phenomenon of movement of earth material under the direct influence of gravity is generally termed as a land slide. Land slides are caused by various natural events such as wave action, earthquakes, heavy rains, artificial excavation, violent earth movement due to nuclear explosion etc., when land slide occurs it results in some translocation of earth material from a higher to a lower elevation. Gravity erosion occurs when force caused by the weight of the materials exceeds forces of resistance provided by friction or shearing of the material. Water being the erosive agent by way of removing the toe support of slopes or decreasing strength of cohesive material causes common land slides. Continuous/ prolonged heavy rainfall causes faster erosion of earth material on hill slopes leading to land slides.

Though land slides are one of the natural disasters which can be predicted with a reasonable degree of accuracy, at times they are silent killers and death comes almost instantaneously. One such land slide occurred on the early hours of 24 July, 1999 in the Kalapahar hills near Guwahati city. Three big rocks measuring upto 200 cubic feet rolled down the hill slope from a height of about 100 feet and smashed houses at the feet of the hills. Two thatched houses were damaged beyond recognition and one brick walled house was badly damaged. Five persons died instantaneously and eleven persons severely injured of whom five breathed their last in the hospital.

During the same time landslides were also reported from nearby Navagraha and Kharghuli hills causing injury to persons. In Khanapara hills of Meghalaya adjacent to the Guwahati city three labourers working in a stone quary were washed away by on-rushing waters due to failure of a dam of a privately owned water reservoir built in between hillslopes for fishery. This was also caused due to heavy rainfall during the period over the region.

2. Data

All the data have been collected from RMC Guwahati observatory, located at the Airport and State Govt. observatory at Khanapara near the Guwahati city, local news paper reports have also been referred to extensively.

3. Analysis – causes of the land slide

3.1. *Geological*

Physical inspection of the site at Kalapahar hill area demonstrate that the loss and damage occurred due to rolling down of three big blocks of rock, (the largest one was of volume about 200 cubic feet) through a height of more than 100 feet and smashing the houses. The hill slope is very steep (about 70 degree) and practically no trees are left on the hill slope due to indiscriminate deforestation. Scattered shrubs and grass covers are present here and there with evidence of abundant land erosion. The top soil and the surface earth cover are

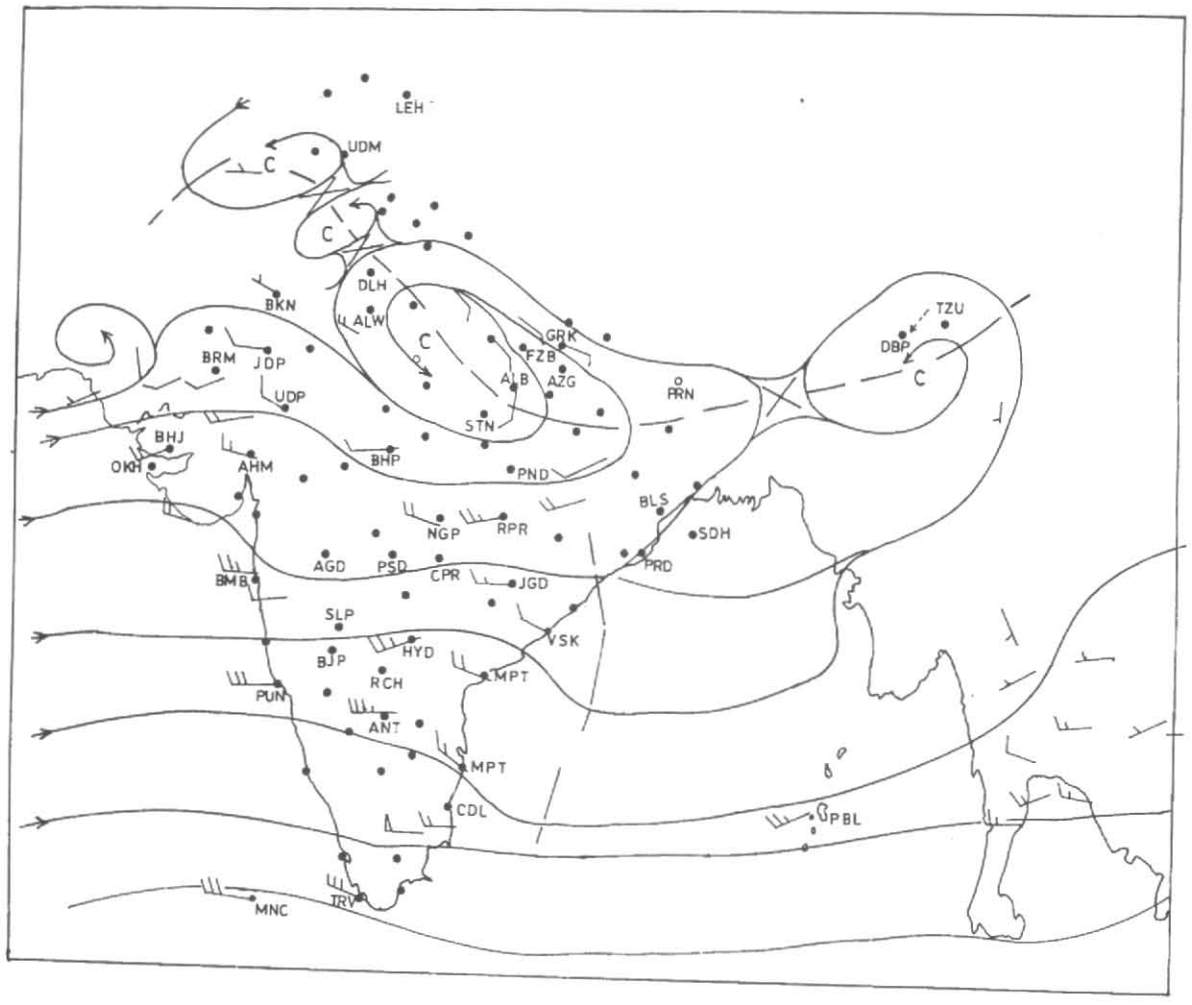

Fig. 1. Lower tropospheric flow pattern at 900 hPa

washed away and the layers of rocks are exposed and weathered. At places the blocks of rocks have come out completely, probably due to gully erosion around them and are resting precariously on the slope of the hills. Loss of frictional resistance during heavy rain and action of gravity can bring them down with recurrence of such disastrous event. Houses are constructed on the slope of the hills by cutting out terraces here and there and building kutcha steps up from the road level for accessibility.

3.2. *Meteorological*

3.2.1. *Synoptic meteorological situation during 20 - 25 July, 1999*

During the period the axis of the monsoon trough on sea level chart was running from the Punjab/west Rajasthan to NE Bay, NW Bay, east central Bay and the central Bay while a secondary trough was extending from Bihar plains to northeast Assam on 20 and 23 July, 1999 and from Bihar Plateau to Central Assam on the 22. An upper air cyclonic circulation was lying over coastal gangetic West Bengal, Orissa and adjoining Bay upto mid tropospheric levels on 21 and upto 4.5 km and 3.6 km a.s.l on 24 and 25 July, 1999 respectively. Fig.1 depicts the lower tropospheric flow pattern at 900 metres above mean sea level. The position of the monsoon trough parallel to the Brahmaputra Valley supported by the upper-air cyclonic circulation over coastal gangetic West Bengal brought in cupious supply of moisture into the valley. This situation is generally conducive for heavy rainfall in the lower Brahmaputra Valley as can be seen in the quantity of rainfall over Guwahati on 23 and 24 of July (Table1).

3.2.2. *Rainfall distribution*

Distribution of rainfall was widespread over the entire region on 20 July and over Nagaland, Manipur and Mizoram on 22 and 24. It was fairly widespread over

TABLE 1

Analysis of weather and rainfall during 15-26 July

Date	Maximum temperature (°C) (Guwahati Airport)	Minimum temperature (°C) (Guwahati Airport)	Rainfall (mm) (Guwahati Airport)	Rainfall (mm) (Khanapara)
15 July 1999			8.6	0.0
16 July 1999			0.0	4.3
17 July 1999			Tr	57.8
18 July 1999			51.4	86.4
19 July 1999			31.8	19.6
20 July 1999	28	24	21.0	17.4
21 July 1999	27	25	14.0	4.8
22 July 1999	32	27	0.8	27.4
23 July 1999	33	25	8.4	4.3
24 July 1999	32	26	31.5	167.4
25 July 1999	33	26	6.9	5.8
26 July 1999			Tr	12.4

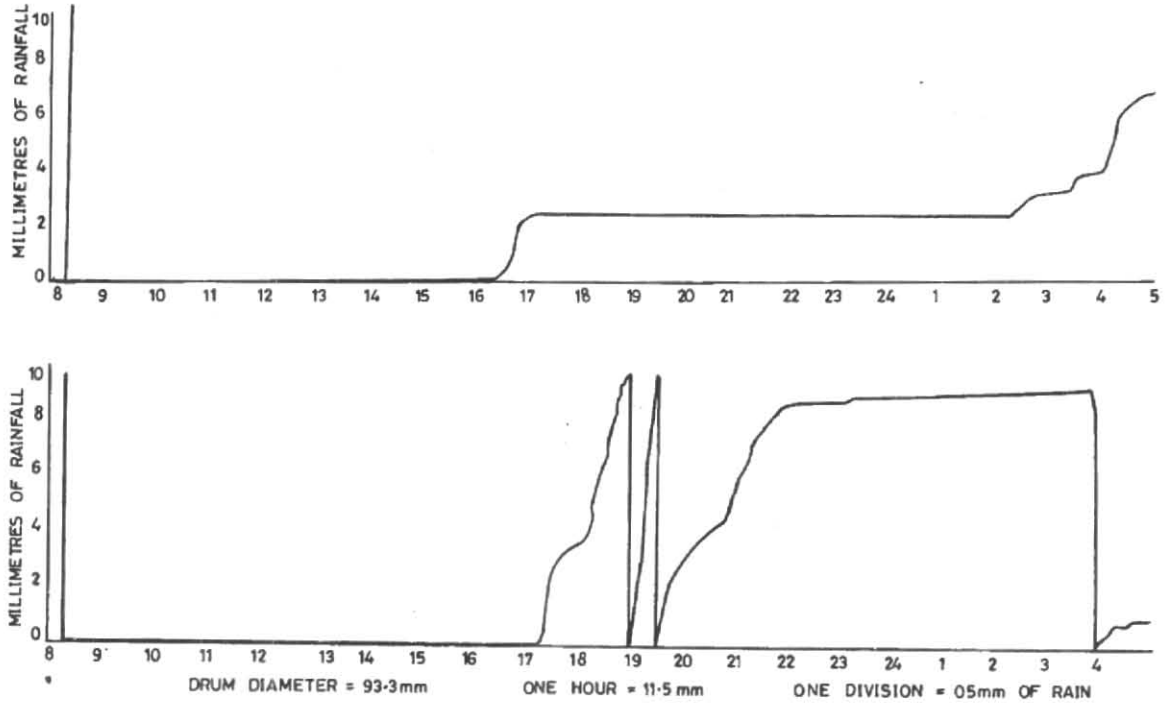

Fig. 2. Records on the self recording on 23 and 24 July, 1999

Arunachal Pradesh on 23., Assam Meghalaya from 22 to 24 and Nagaland Manipur and Mizoram on 21 July. Rainfall was isolated to scattered over the rest of the NE region on different days. From Weather Radar observations thunder storm activity over and around Guwahati was found very high in the evening hours of 22 and 23 July, 1999 and thunderstorm activity continued during the night also.

3.3. *Weather over Guwahati area*

At Guwahati airport thunderstorm with rain started at 0225 hrs (IST). Thunderstorm ceased at 0440 hrs (IST) and rainfall ceased at 0615 hrs (IST). Daily rainfall recorded at 0830 hrs (IST) on 23 July 1999 was 8.4 mm. From 0530 hrs (IST) to 1430 hrs (IST) 6 to 7 octa low and medium clouds were reported. On 23 minimum temperature recorded was 25°C and maximum Temperature recorded was 33°C. Hence, considerable amount of insolation was received during the day.

3.4. *Radar observations*

Significant convective echoes were first observed on weather radar at 1545 hrs (IST) 40 km southwest of the station. At 1615 hrs one cell was observed just to the west to NW of Guwahati Airport (270° /007 km to 340° /15 km) in formative stage and another patch to the south 150/040, 210/040, 240/040 and 180/022 in their early stages of formation. At 1705 hrs the two patches merged together with scattered moderate to intense cells on 360/010, 150/030, 180/020 and 240/015 at 1851 hrs. Broken moderate to intense cells were observed on 360/010, 150/030, 180/020 and 240/015.

3.5. *Rainfall*

An analysis of weather and rainfall during 15 to 26 July have been tabulated and presented in Table 1. Fig.2 illustrates the self recording rainguage chart at RMC Guwahati observatory for 23 and 24 July, 1999.

Rainfall started at Guwahati Airport at 1700 hrs (IST) on 23, thunderstorm with rain commenced at 1715 hrs (IST) and continued upto 2340 hrs (IST). Rainfall ceased at 0700 (IST) hrs on 24 July. As per SRRG records 4.0 mm of rainfall was recorded upto 1800 hrs, 10.0 mm upto 1900 hrs, 22.8 mm upto 2200 hrs and 26.2 mm upto 2100 hrs. Daily rainfall recorded at 0830 hrs (IST) on 24 July, was 31.5 mm.

Guwahati city experienced rainfall from around 1900 hrs (IST) and significant rainfall continued upto 2300 hrs (IST) with spells of heavy shower from 2030 hrs (IST) to 2230 hrs (IST). Daily rainfall recorded at 0830 hrs (IST) on 24 July was 167.4 mm at Khanapara in the campus of the Directorate of Agriculture, Government of Assam. Though the rainfall amount was moderate in Guwahati Airport it was exceptionally heavy in the Guwahati city. Continued heavy rainfall for more than one week has resulted in land slides at a number of places over the area on 24 July 1999.

4. Conclusion

It was observed that land slides in the hills of north-east India are almost always associated with heavy rainfall over the area. Very heavy rainfall recorded in the recent times (160.90 mm on 15 October, 1991) was associated with severe landslides near Dispur on 15 October, 1991. Fifteen (15) persons lost their lives and several houses collapsed. Unplanned land usage, deforestation and earth cutting along the hill slopes contribute heavily towards land slides in the NE, specially in the Brahmaputra valley areas.

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