

LANDSLIDE DISASTER IN BANGLADESH: A CASE STUDY OF CHITTAGONG UNIVERSITY CAMPUS

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ABSTRACT

Study on the landslide is an attempt to understand the geo-environmental characteristics of landslide disaster in the hilly areas of Bangladesh in the context of Chittagong University campus. In the University campus a total of 16 colonies of 3rd and 4th class employees have been developed in an unplanned and illegal manner at the edge of hill-slopes by cutting the hill soil. As consequence nearly every year during the monsoon period there are incidents of landfall and human casualties. The study shows that some of the colonies are highly vulnerable to landslide, due to clearance of vegetation coverage and massive hill cutting. Based on hill slope, soil characteristics and land use types, highly, moderately and low-vulnerable areas within the campus have been identified. However, after the massive landslide of 2007, the University authority has initiated to resettle the vulnerable people to some suitable locations, which could be recognized as a model attempt to resettle the vulnerable hill-slope dwellers to a safer place through institutional initiatives. The study shows that an integrated approach is necessary to mitigate landslide disaster in hill districts of Bangladesh, where GO and NGOs partnerships are necessary.

KEYWORDS: Landslide, Vulnerable Area, Particle Size, Hill Slope

INTRODUCTION

Bangladesh is a disaster prone country. The physiography, morphology and other natural condition have made her vulnerable to various disaster and environmental hazards. The common disaster of this country are flood, cyclone induced storm surges, droughts, earthquakes and river bank erosion. Moreover, landslide has become newly added burning issue. Landslide and avalanches, while historically not renowned for causing as large a death toll as other natural disasters such as tropical cyclone or earthquakes, have had just as dramatic an impact on property and lives (Bryant,1991). Worldwide record shows that China, Philippines, India, Indonesia, Nepal, Japan and USA witness the incident of landslide regularly. During the last ten years near about 25 incidents of major landslide have been recorded worldwide killing thousands of lives. Landslide is an inveterate problem for south eastern part of Bangladesh and Chittagong city is particularly highly vulnerable to this hazard with an increasing trend of frequency and demand. The landslide of 11 June, 2007 in Chittagong is the most devastation case of landfall in the history of landslide in Bangladesh (Haque, 2008).

MATERIALS AND METHODS

Study Area

Chittagong University campus lies between 22° 27' 30" and 22° 29' 0" north latitude and 91°46'30" and 91°47'45" east longitude (Momen et Al, 2006). It is surrounded by Mitha Khal with the hill tracts to the north and Balu Khal in the south, Marine science in the west and C.U Rail station in the east .The campus lies 12 miles north of the Chittagong town, about 2 miles south-west of the Hatazari thana head quarter and one and half mile west of the Chittagong Rangamati road

(Islam et al, 1979). It covers about 1753.88 acres of land and total numbers of students at the university of Chittagong are 19,568 of which 14266 are male and 5302 are female (C.U. Diary, 2012).

Objectives

The aim of this research is to identify the causes of land slide and the vulnerable areas. The specific objectives of this research are in the following:

- To identify the land use pattern and vulnerable areas of land slides
- To identify the potential causes of land slides, particularly measure the morphological characteristics and finally
- To provide some possible solution to the land slide hazard of the campus.

Study Design

For the purpose of the study details work and investigation has been carried out in two Phases. Phase-1 which includes extensive field work and Phase-2 which consists of laboratory analysis of samples and interpretation. For the purpose of research different techniques had to apply to collect information and to analyze them. A series of color satellite imageries from Goggle earth map considered scale 1: 9600, Year 2008 has been used for map analysis. On the other hand, questionnaire survey has been carried out to collect detail information of landslide. The total numbers of respondents are 250. All the respondents were divided into two categories. First categories (Category-a) 150 are affected and vulnerable people and second category (Category-b) 100 are teachers and students. For slope measurement specifically Altimeter has been used and only sieve methods has been applied for Particle Size Analysis. Different statistical techniques were used for data analysis and presentation.

RESULTS AND DISCUSSIONS

LAND USE TYPES OF THE STUDY AREA

Land use means the how lands are used naturally or by the people (Salim, 2009). On the other hand land use is the use actually made of any parcel of land, house, apartments and industrial location are land use categories (Mondal, 1982). In this study seven major types of land use have been identified. The identified land use are vegetation coverage, settlement, crop field, open field, deforestation area, road and water body (Figure 1). Table 1 represents the land use types of the study area.

LOCATION OF VULNERABLE AREA

Chittagong University situated in a hilly area. As a result landslide is a common phenomenon in this area. Landslide was not considered as a disaster in earlier times. So long it was not harmful for human settlement. Now a day's landslide is considered as disaster as because it creates sever problems for human life which is referred in last few landslide incidents, i, e. 2000 and 2007. The Table 2 represents the name of the landslide affected areas of Chittagong University campus. From the affected areas of Chittagong University campus Katapahar and adjacent area of Saheed minar are most affected.

CAUSES OF LANDSLIDE

Landslides occur as a result of changes on a slope, sudden or gradual, either in its composition, structure or in its hydrology, vegetation. The change can be due to geology, climate, weathering, land use and earthquakes (Sahni et al, 2001). The main causes of landslide in Chittagong University campus could be summarized as follows:

Slope

Hill slope of the present study area divided into four categories those are high hill steep slope $>80^\circ$, low hill steep slope $<80^\circ$, high hill slope (landslide) $>80^\circ$ and low hill slope (landslide) $<80^\circ$ (Table-3). Maximum slopes of this study area are steep slope and these are responsible for the landslide. In this aspect Nasreen, (1999) mentioned that approximately 65% of the total area of the campus covered by steep and very steep hill and 35% is valleys. Both manual observation and Altimeter has been used for slope measurement.

Soil Types (Particle Size)

The soil of the study area covering more than 60% moderately coarse to fine textured, recent mixed alluvial and alluvial piedmont sediment (Alam, 1998). For particle size analysis twenty one (21) samples have been taken from nine (9) selected areas such as P.C.N (Horizontal), P.C.N (Vertical), .K.P.N, K.P.S, S.M, I.S.C-3, G.C. and M.C. Table 4 represents the percentage of particle size distribution of this study area. From above mention table it has been observed quantity of fine sand almost in every sample area is more. Due to this reason hills of mentioned area are more prone to landslide. Because of less bondness in sand it has tendency to become loose and it displaces from its original position.

Hill Cutting

Presently indiscriminate hill cutting is one of the major causes of landslide in Chittagong city (Rahman, 2010). Hill cutting has been identified as one of the major causes of land slide in the study area. Because all settlement has been developed by hill cutting. Beside these unplanned hill cutting is going on due to sand collection, road construction and for administrative infrastructure development. Like katapahar road, Golachipa road etc. are examples of this. Remarkable hill cutting areas are:

Southern campus in the way of Forestry Faculty, Golachipa road, either side hill of Katapahar road, inside hill bottom colony, from Sorwarde square, either side hill of Social science faculty and inner part of Probashi colony in Chittagong University campus.

Deforestation

Deforestation is another major reason of landslide in Chittagong University campus. Deforestation has covered 6.11% of total landslide area. North portion of the study area is more prone to deforestation. Beside this existence of the deforested area are observed in the location of soil science and commerce faculty. Vegetation protects the soil and makes slope stable which reduce the risk of landslides. Large trees provide strong structures in the earth that anchor the soil and protect it from any erosion. In this study few areas are marked as under deforestation. These are near station behind and forward hill of teachers rest house and behind social science faculty.

VULNERABILITY ASSESSMENT

Vulnerability assessment is the process of assessing the degree of loss to a given elements at risk (Rahman, 2010). Total 16 areas (colony) have been selected as the vulnerable areas of Chittagong University campus. Each area is given with a code word and areas were visited to find out various clusters, total number of family living in the study area. It was found that total 4089 people are living over there. For the purpose of this research study areas has been classified into three categories (Figure 2) such as:

High Vulnerable Zone

Hill bottom colony (H.B.C), Islamia colony(I.S.C), Provasi colony-north(P.C.N), Provasi colony-south (P.C.S),

Soukin and Medical colony (S.C and M.C), Shanti colony (S.T.C) are classified as high risk zone, on the basis of high slope angle of the hills, sandy sediment structure and high man made deformation of the hill in this areas.

Moderate Vulnerable Zone

Marine science colony (M.S.C), Adarsha colony(A.C), Uttara colony (U.C), North campus residential colony (U.C.C) are classified as moderate zone on the basis of position of settlements.

Low Vulnerable Zone

Shahi colony (SH.C), Math colony(M.C) and Azad colony (A.Z) are classified as low vulnerable area. Because Shai colony is situated in low hilly area. Even though they can be affected by landslide of mass volume and approximately 1000 people are living over there. On the other hand, Math colony is classified as low vulnerable area, because of larger distance form hill. Although they can be effected by mud flow of landslide. Azad colony is classified as low vulnerable area for its location.

LANDSLIDE DISASTER MITIGATION

Mitigation is the use of strategies to reduce risks prior to during and post- disaster. It is related to short-term and long-term measures (Gabhok, 2004). On the otherhand landslide mitigation refers to lessening the effects of landslides by constructing various man made projects at slopes vulnerable to landslides (Wikipedia, 2012).Some significant steps for landslide disaster mitigation in this study area are as follows:

Short Term (Next 1 Year)

- **Stop Hill Cutting and Other Activities:** To protect landslide it is necessary to stop all types of hill cutting, sand collection and other activities which all causes landslide.
- **Develop a Team:** Develop consist of 5-10 members team. This team will observe the vulnerable area and will take steps to protect the vulnerable people. This team will also develop a rescue team which will be part of main team.
- **To protect the Vulnerable Zone:** Prepare a retaining wall, drain and strong wall near the hill to protect vulnerable zones.
- **Reshaping Hill:** Extended portion of vulnerable hills should be leveled by the concern authority.

Mid Term (Next 2 Year)

- **Cover the Hill:** Cover the all necked hills by herbs, shrubs, trees etc. It will protect the top soil and ultimately it control erosion.
- **Shift the Vulnerable People:** Shift the vulnerable people sequentially in a safer place.
- **Awareness Program:** To arrange different kinds of training to develop awareness. In this aspect different Non Governmental Organization and Governmental Organization will be involved.
- **Information Center:** To form a information center which will collect all types of data, photographs, related documents and information.

Long Term (Next 3 Year)

- **Develop Policy:** To develop a policy for hill management which will cover the hill cutting, land use, hill use etc.

Policy is the starting point for risk reduction activities. It sets ideas and concepts into motion and outlines the course of action to be taken.

- **Develop Fund:** Develop a fund for emergency period and develop employee's socio-economic condition. Because of poverty force people to live in dangerous and unsafe shelter.
- **Residence Project:** Take steps to create a residence project for employees (staff and officer).

CONCLUSIONS

Landslide has become a common disaster in our country. It causes death of large number of people every year. But no initiative has yet been taken by related authority to overcome this problem. Affected people are building their residence in vulnerable area when they are eliminated from effected areas. Mentioned problem will not be solved so far affected people are not provided with permanent residence. A praiseworthy initiative has been taken by Chittagong university authority to rehabilitate all those effected people. They shifted all the vulnerable people in safer place to overcome this problem. The process seems to give better output if it runs in a systematic way. Because most of the vulnerable people are within university campus and many of them are employee of the university.

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APPENDICES

Table 1: Land Use Types of Chittagong University Campus

Types	Area (Acre)	Percentage (%)
1. Settlement	609.78	34.77
a. Admin-istrative	330.97	
b. Slums	219.47	
C. Other	59.34	
2. Crop Filed	183.18	10.44
3. Open Field	122.22	6.99
4. Defore- station	107.24	6.11
5. Road	72.13	4.10
6. Vegetation	634.21	4.30
a. Hill	633.79	
b. Plain Land	0.42	
7. Water body	25.12	1.43
8.Others (unknown)	558.73	31.86
Total	1753.88	100

Source: Field Survey, 2008-2009

Table 2: Name of the Landslide Affected Area at Chittagong University Campus

Name of the Area	% of Total Answer(170)	% of Total Respondents
Near to Shahidminar	35.29	40
Katapahar	44.11	50
Gola chipa	1.76	2
V. C hill	3.52	4
Near to Botanical Garden	1.76	1.33
No Godum	1.76	1.33
Medical block	2.35	2.66
Backside of Abdur Rab hall	0.58	10.58
Nearest Hill of Commerce Faculty	0.58	0.58
Probashi Colony	2.94	3.33
Near to Samsun-nahar hall	0.58	0.58
Ismalia Colony	1.76	1.33
Adasha Colony	0.58	0.66
North Campus	2.94	3.33
South Campus	1.76	1.33
		100

Source: Field Survey, 2008 -2009

Table 3: Slope of the Study Area

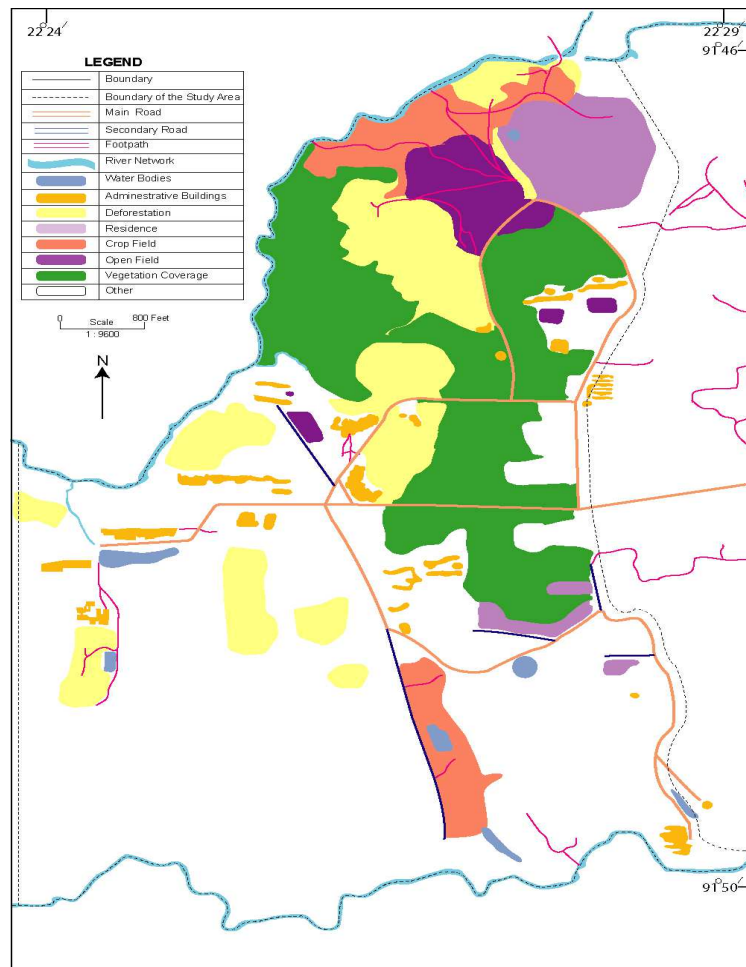
High Hill Steep Slope >80°	Low Hill Steep Slope <80°	High Hill Slope (Land Slide) >80°	Low Hill Slope (Land Slide)<80°
Hills of Kata Pahar Area, Hills of Eastern Side of Shahidminar, Galachipa Pahar, Hills of Southern Campus, Hills of Oposite Side of Social Science fecultu, Hills of Adarsho Colony and Medical Colony of North Campus, More Over Hills of Hillbottom Colony are Also Classified into this Group.	Hills of Southern Campus Beside Rest House, Hills Beside Teachers Residential Areas, Hills of Opposite Side of Golpokur, Hills of Inside Hill Bottom Colony and few Hills of Inside Godown no-3. In the case of Northern Campus Hills of Front and Back Side of Alwal Hall and Opposite Hills of Central Field.	Either Side Hill of Katapahar Road, Hills of Eastern Side of Saheed Minar, Hills Behind of NO-3 Godown, Hills of Northern Side of Probashi Colony and Hills of No-2 Road.	Few Hills of Northern Campus and few part of inside Hill bottom Colony

Source: Field Survey, 2008-2009

Table 4: Particle Size Analysis of the Study Area

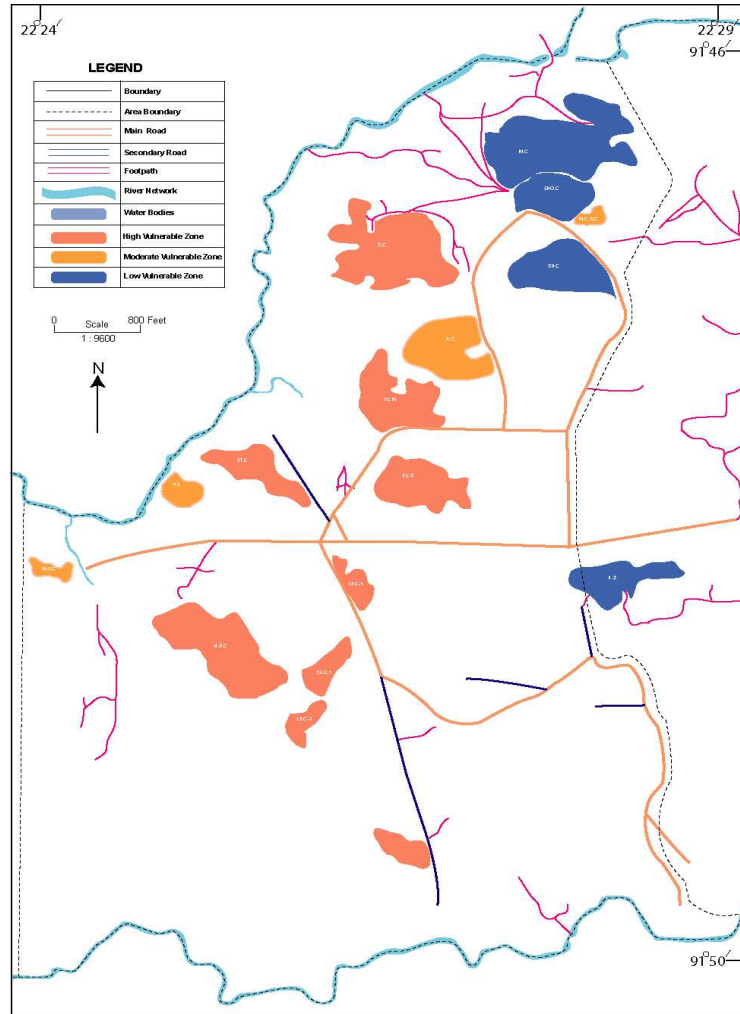
Local Name & Code	Physio - Graphy	Partical Size Analysis							
		Sample No	Wa (%) Pebble	Wb (%) Very Coarse Sand	Wc (%) Coarse Sand	Wd (%) Fine Sand	We (%) Very Fine Sand	Pan Cay & Silt	Loss
Proba-shi Colony North (P.C.N) Horizontal	Hilly	1	15.3	8.8	7.6	7.6	56.1	4.4	.02
		2	8.8	5.6	5.8	53.6	20.4	4.8	1
Vertical (P.C).N)	Hilly	3	7.5	5.6	5.8	53.6	20.4	4.8	1
		4	44.7	4.3	8.4	56.2	7.5	12	4.1
		5	4.3	6.6	5.6	37.8	4.9	0	0.4
Katap-ahar North (K.P.N.)	Hilly	6	2.55	3.45	5.6	48.55	36.1	2.9	0.85
		7	0.7	3.6	5.4	48.2	39	1.9	1.2
		8	0.05	3.1	4.6	79	11.9	0.6	0.75
Katapahar South (K.P.S)	Hilly	9	7	2.2	4.6	68.6	14.9	1.6	0.9
		10	3.8	11.4	24.6	56.7	2.6	0	
		11	53.1	4.8	5	30	7.1	0	
Shahid- minar	Hilly	12	7.2	11	6.6	42.5	25.9	4.6	2.2
		13	36.1	6.2	4	31.3	19	3	0.4
Islamia colony-3 (I.S.C.-3)	Hilly	14	00	1	7.1	63.3	19.8	7.3	1.5
		15	00	2.2	7.2	68.3	16.8	4.8	1.3
Globachipa (G.C.)	Hilly	16	11	18.2	9	23.9	32.7	5.2	
		17	74.3	2.3	0.9	12.2	7.7	1.8	0.8
Soukhin Colony (S.C)	Hilly	18	12.2	28.2	24.4	27.9	13.8	3.6	1.2
		19	13.4	20.6	14	33.4	20.4	3.4	0.8
		20	9	14.6	11.4	10.4	36.1	2.9	0.85
Math Colony (M.C)	Hilly	21	13.8	15	12.3	39.5	15.2	3.3	0.9

Source: Lab Analysis, 2008-2009



Source: Google Earth and Field Survey

Figure 1: Land Use Map of the Study Area



Source: Google Earth and Field Survey

Figure 2: Landslide Vulnerable Zone