

Locational Analysis of Hill Cutting Areas in Chittagong city, Bangladesh

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Rec Date: August 14, 2017; **Acc Date:** November 03, 2017; **Pub Date:** November 08, 2017

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Abstract

Hills, rivers, lakes and adjacent the Bay of Bengal are the main indicators of beauty in Chittagong city. Currently indiscriminate hill cutting is considered as one of the major environmental destructions in Chittagong city. Hill cutting problems are triggering deforestation and loss of biodiversity, local level climate change, increasing water logging and landslides. Remarkably, few researches are available to help identifying geographical distribution of hill cutting areas in Chittagong city, Bangladesh. This paper addresses this gap by conducting field investigations, observations and surveys in Chittagong city Corporation (CCC), Bangladesh. Through field investigations, observations and surveys, this research divides hilly areas in four categories. These include a) existing hilly areas, b) moderately susceptible hilly areas, c) highly susceptible hilly areas, and d) extinct hilly areas. The research suggests that there are still 40 hills in CCC which still are not affected by any hill cutting problems. The moderately susceptible hilly areas are located in Khulsi and Bayazid Bostami thanas. The highly susceptible hilly areas are located in Bayazid Bostami (11 Hills), Khulshi (10 Hills) and Kotowali thanas. The extinct hilly areas are mainly located in Panchlaish, Bayazid, Kotowali and Khulshi thanas. In order to stop hill cutting in Chittagong city, this research suggests six key areas of actions: (i) education and training, (ii) information collection and dissemination, (iii) formation of strong advisory committee, (iv) enforcement of laws by consisting of personnel from Bangladesh Army, Police, Ansar and BDP, (v) monitoring hilly areas by LiDAR DEM and (vi) formation of a monitoring committee to report strength and weakness of hill protection activities time to time.

Keywords: Geography; Hill cutting; Problem; Susceptible; Environment

Introduction

Chittagong city is vulnerable to a variety of natural and human induced hazards including tropical cyclones, earthquakes, tsunamis, floods, landslides, and water logging due to its geographical location. Many physical environmental parameters such as hills, rivers, ocean and lake make the city of Chittagong a beautiful one in the world. In the last one and half decades, the city experiences significant increase in landslide activity. A variety of natural and human induced reasons

has contributed to accelerating landslide events in the recent past. These include: excessive and prolong rainfall in a short period; unplanned hill cutting problems; loose soil structure in hilly areas; deforestation in the hilly areas; seismic activity and abnormal tidal flow [1-3]. Due to the presence of excessive formal and informal settlement (Figure 1) along the foothills have increased vulnerability to landslide events. Hill cutting areas have been using both for formal and informal settlement development [4].



Figure 1: The location of a house on top of a hill.

There were over 200 hills in Chittagong city in early 1910. During British colonial period, the central British government planned to set up their main administrative buildings on top of the hills considering the safety of their local administrators. For an example, the Judge Court building of Chittagong city was built on the top of Parir hill by the British government. Subsequently, many other administrative, college, and public buildings were established at that time. Following independence of Bangladesh in 1971, the commercial and business importance of the city had increased markedly. Human population of the city was also doubled in 1980. Due to both rises in human population and increases in commercial and business activity necessitated further new land development in the Chittagong city. From early 1980, there was a trend in hill cutting to accommodate excessive land demand. Since late 1990, the problem of hill cutting attracted much print media coverage due to decrease in wetland in and around Chittagong city, increase in water logging problem and landslide occurrences.

An increasing amount of research from local, regional and international institutions documented hill cutting problems and subsequent landslide occurrences in Chittagong city [5-10]. Islam et al. suggested that slope failure hazards are occurring every year due to heavy rainfall in loose soil structure in the hill cutting areas in Chittagong city. Landslide took over 400 deaths mostly in informal settlement in Chittagong city since 2000. The 2007 landslide event took 127 deaths in informal settlement. Although the government of Bangladesh identifies these informal settlers are illegal occupants, the settlers trust that they are the legal owners of these areas. This makes complexity in reducing vulnerability of informal settlers to landslides [11]. Although numerous studies were undertaken to record and analyze landslide occurrences in hill cutting areas, no systematic effort was carried out to identify current hilly areas and hill cutting areas in Chittagong city. This paper addresses this gap by conducting field investigations, observations and surveys in Chittagong city Corporation (CCC), Bangladesh. The main aim of the research is to identify hill cutting areas in Chittagong city. The specific objectives of this research are to:

1. Identify geographical distribution of existing hilly areas, hill cutting areas and extinct hilly areas in Chittagong city.
2. Identify risk management strategies relating to hill cutting in Chittagong city.

In the following sections, at first, I introduce the location of Chittagong city in Bangladesh. This is followed by methods used for this research. In the subsequent sections, I present results of this paper. Finally, I provide conclusion and make a series of recommendations for implementing risk reduction strategies.

Materials and Methods

Location of study area

The Chittagong city (Figure 2) is located in southeast of Bangladesh between 21°54' N to 22°59' N latitude and 91°7' E to 92°14' E longitude. Geologically, Chittagong occupies a part of the Western margin of Tripura-Chittagong folded belt. This folded belt is directed in the NNW-SSE direction and these folds are frequently faulted longitudinally and transversely to the strike [12]. Chittagong is located within the Tertiary hill region of folded flank of Bengal fore deep. The folded part is composed of the Tipam sandstone formation and Girujan clay formation of Pliocene age at the bottom and Dupi Tila

formation of Plio-Pleistocene age at the top [13]. The city comprises of the area of small hills and narrow valleys, lakes, rivers and flood plains. It is encircled by Karnaphuli river in its eastern and southern parts. The Bay of Bengal and narrow coastal plain are located to the west and the floodplain of Halda river on the east and south. The highest elevation of the hill in the city is approximately 60 m above mean sea level [14].

Data collection

This research was conducted within the boundary of Chittagong city Corporation (CCC). Hill cutting areas in Chittagong city was identified based on field visits, investigations, field surveys and observations. Field research of this paper was completed during January-2015 to June-2015 with the help of eight efficient data collectors. This research divides hill cutting areas into three categories based on the extent of the problem. These include moderately susceptible, highly susceptible, and extinct hilly areas. When any part of a hill is cut down, it is defined as moderately susceptible hill. If more than half of a hill is cut down, it is defined as highly susceptible hill. Where there was a hill once upon a time is defined as extinct hilly area. The name of hill is presented by local popular name of hill. Geographic Information Systems (GIS) and cartographic techniques were used to represent the existing location of hilly areas, hill cutting areas and extinct hilly areas. Secondary data sources such as research reports, peer review publications, daily newspapers about hill cutting problem were used to write up the research paper.



Figure 2: The location of Chittagong city.

Results and Discussion

Existing hilly areas in Chittagong city

Although the Chittagong city lost over 120 hills in the past forty years, field survey suggests that over forty hills were remained unaffected in Chittagong city (Table 1). Currently most of the hills are located in the Bayezid Bostami, Cantonment, Panchlaish, and Khulshi

thanas of Chittagong city (Figure 3). Despite reckless hill cutting problem in the other part of the City, these hills were unaffected due to six reasons: some of these hilly areas are located in protected part of the Cantonment thana; inaccessibility to these hilly areas obstructs setting up brick kilns, residential apartments, and other development activities; distance from the center of the City; high slope of these hills; recent strong law enforcement.

Location of hill and hilly areas	Name of CCC Word	Thana	Identification of hill by popular name	Existing establishment
Fer School Pahar	02 Zalalabad	Bayezid	West of Burma Colony	-
Kalapenia, Chakter, Betua, Bazan, Mezbanna, Eckandia and Harina Pahar	01 South Pahartali	Bayezid	Batali Colony	Few settlement
Shipping Corporation Pahar	09 North Pahartali	Khulshi	East Peroj Shah	Temple and settlement
Goal Pahar, Pravartak pahar	15 Baghmoniram	Panchlaish	Intersection of O.R. NizamRoad and Panchaish Thana	-
Chairman Bunglow Pahar (Residence of SP)	15 Bugmony village	Khulshi	C.R.B Railway Colony	Houses of railway staff
Railway Pahar	15 Bugmony village	C.R.B Railway	C.R.B Railway	Railway establishment
Zilapi Pahar (Chotto Batali Pahar)	14 Lalkhan Bazar	Khulshi	Moti Jhorna Road	-
Tunky Pahar	14 Lalkhan Bazar	Khulshi	Moti Jhorna Road	Few settlement
31 Field Ambulance Zone Pahar	01 South Pahartali	Bayezid	Zalalabad Road	Military establishment
Dula Mura Pahar	01 South Pahartali	Bayezid	Beside Oxygen	Electric Pillar
Kuri, Baighna, Adar Zora, Putu Zora, Hulod Barna, Shira, Harina Chara, Artika, Munchi Dala and Kantor Ali Pahar	01 South Pahartali	Bayezid	Military Check post, fifth Gate, Borodigir Par, Cantonment	-
Joi Pahar	16 Chawkbazar	Panchlaish	Intersection of Chatteswari road, Surson road and Jamal Khan Mure	-
DC Hill	Jamal Khan	Kotawali	Near Buddhist temple	Residence of Deputy Commissioner
Bangladesh Bank Pahar	15 Baghmoniram	Panchlaish	West of Mimi super market	-
CDA Hill	15 Baghmoniram	Panchlaish	Besides Mehidiabag housing	-

Source: Field survey, 2015.

Table 1: Existing hilly areas in Chittagong city.

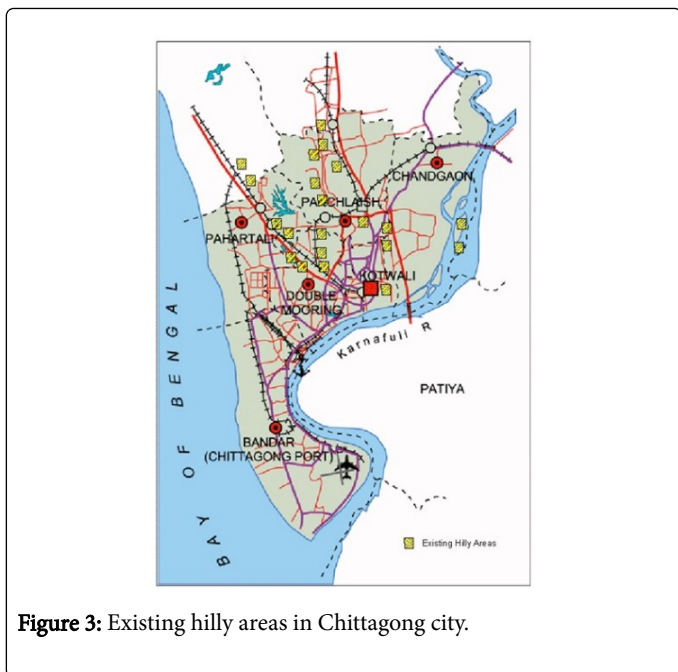


Figure 3: Existing hilly areas in Chittagong city.

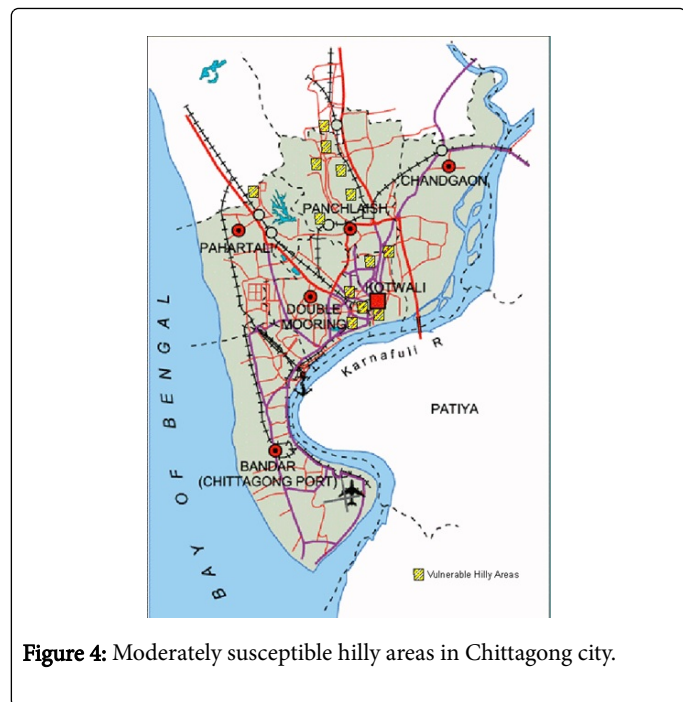
Moderately susceptible hilly areas

In this research, moderately susceptible hilly areas are defined those hilly areas have already been partly cut down or currently hill cutting is occurring. Approximately eight hills in Khulshi thana can be defined as moderately susceptible condition. Some luxurious apartment complex is going to be developed by cutting existing hilly areas. Groups of poor people also cut some part of hills and make slum-settlement beside these hills. Subsequently these foothill settlements are very susceptible to landslides. For an example, during 2002 about four people died in the Batali hill area by landslides. Poor people cut some part of hills and developed slum settlement in the foothill of the Moti Jharna Road Pahar, Tunky Pahar, Bisha Colony, Balu Pahar, etc. Moderately susceptible hill cutting areas are mainly located in Bayezid and Khulshi thanas (Table 2) (Figure 4). Five brick kilns are set up in these areas, which are using hill cutting soil as raw materials. Soil erosion is another common problem in these partly hill cutting areas. Those hills located beside the Garibullah Shah Mazar are an example of partly hill cutting area and the erosion of the hill is creating water logging in the adjacent areas.

Name of Hill	Word No	Thana	Identification	Existing establishment
Glaxo Pahar	13 Pahartali	Khulshi	Road No 1, Lane 2 Block A, South Khulshi	Luxurious building
Ispahani Pahar	13 Pahartali	Khulshi	300 Feet West of GEC	Nasirabad Housing Society
Balur Pahar	9 North Pahartali	Khulshi	Bisha Colony	Slum
Ispahani Gate Pahar	9 North Pahartali	Khulshi	Beside Panjabi Graveyard	Graveyard
Akbar Shah Mazar Pahar	9 North Pahartali	Khulshi	Akbar Shah Graveyard Road	Mazar Building
Tiltali Pahar	9 North Pahartali	Khulshi	East side of Foy's Lake	C.I. Sheet Housing
Abangali Pahar	14 Lalkhan Bazar	Khulshi	Motijarna Road West of Batali Hill	Slum
Batali Hill	14 Lalkhan Bazar	Khulshi	Beside Tiger Pass	Defence building and Tower Building
Nacini Khola Pahar	1 South Pahartali	Bayazid	No.1 South Jungle Pahartali	Low income Residence
Signal Battalion Pahar	1 South Pahartali	Bayazid	Jalalabad (Beside Oxyzen)	Military Establishment
Kata Pahar and Rasheed Saheber Pahar	1 South Pahartali	Bayazid	Cantonment checking post (No 4)	-
Nanda Gora, Korwainna Pahar	1 South Pahartali	Bayazid	Sekandor Colony, opposite to Military check post	Scattered Settlement

Source: Field Survey, 2015

Table 2: Moderately susceptible hilly areas in Chittagong city.



Highly susceptible hilly areas

Some hilly areas are highly susceptible condition. Field visits and investigations suggest that currently in CCC approximately 25 hills are in highly susceptible condition (Table 3). Over half of these hills have already been cut down. Soils obtained from these hills are using as raw materials of brick kiln and filling up low-land areas for residential or commercial building construction purposes. Similarly, hill cutting areas are mainly using for apartment development purpose. The highly susceptible hill cutting areas are located in Bayazid Bostami (11 Hills), South Khulshi (10 Hills) and Kotowali thanas (5 hills). Highly susceptible hilly areas in Chittagong city are presented in Figure 5. Local residents reported that hill cutters somehow manage local administration and political leaders for their purpose. During field investigation it is observed that brick kiln and hill cutting are closely located in the highly susceptible hilly areas. Local residents adjacent to brick kilns complain that smoke and wastage of kiln are causing diseases. Besides, due to hill cutting problem, a number of slum dwellers lost their settlement. Forest and animals of the hilly area are gradually disappearing.

Name of Hill	Word No.	Thana	Identification of hill	Existing establishment
Hatir Pahar	07 Bubabad	Bayazid	Bangladesh cooperative housing society (east of KDS Garment)	Location for dumping CCC wastage
Chera Pakirer Pahar	07 Rubabad	Bayazid	Bangladesh cooperative housing society (east of KDS Garment)	Bangladesh cooperative housing society
Miar Pahar	07 Rubabad	Bayazid	Bangladesh Cooperative Housing Society (east of KDS Garment)	West part of KDS Garments
Jalalabad Housing Society Pahar	13 East Pahartali	South Khulshi	Beside Veterinary College	Jalalabad cooperative housing society
A K Khan Pahar	13 East Pahartali	South Khulshi	South Khulshi	Luxurious apartment complex
Shahi Nagar Pahar	10 Jalalabad	South Khulshi	Back side of Bangladesh Tea Board	Asian University for Women
CDA Hill	15 Bagmoniram	Panchlaih	Some Part of Mehadibag Road	New residential buildings
Chanmari Pahar	14 Lalkhan Bazar	South Khulshi	Beside Izharul Estate Pahar	-
Shahajan Shaheber Barir Pahar	14 Lalkhan Bazar	South Khulshi	Mati Jharna Road	Low income houses
Ohabi Pahar	14 Lalkhan Bazar	South Khulshi	Garibullah Housing Society	-
Shadur Pahar	1 South Pahartali	Bayazid Bostami	South of Sandwip Colony	Brick kiln
Ball khela Paharer Math	1 South Pahartali	Bayazid Bostami	Middle of Hatiya-Sandwip Colony	-
Dev Pahar	16 Chawkbazar	Panchlaih	Beside Government Hazi M. Mohsin College	New residential building and slum area

Source: Field Survey, 2015

Table 3: Highly susceptible hilly areas in Chittagong city.

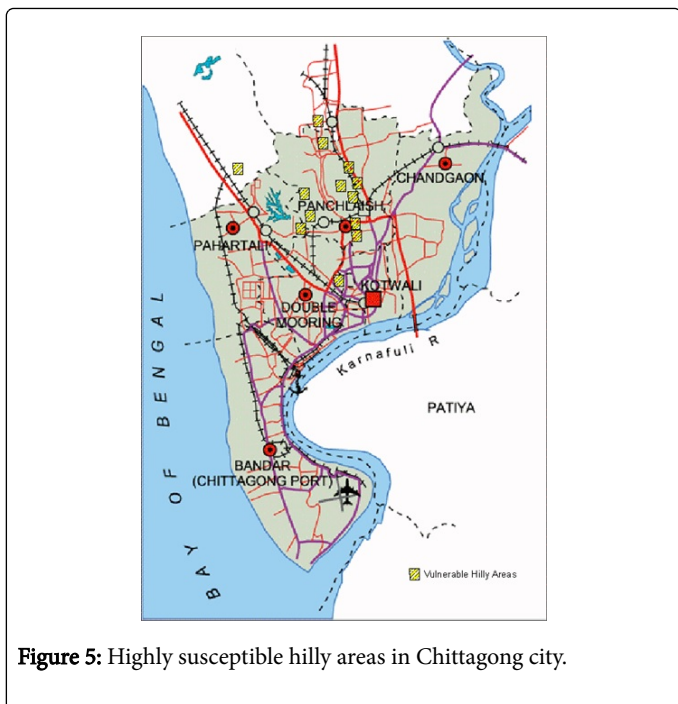


Figure 5: Highly susceptible hilly areas in Chittagong city.

Extinct hilly areas in Chittagong city

Hilly areas in Chittagong city have been facing indiscriminate cutting and unauthorized occupancy problems since 1971. Topography of Chittagong city has changed markedly due to the loss of the hills by cutting problem. The hill cutting areas are now being used for

residential and commercial purposes. For example, Taz Company Building at Chawkbazar and Jalalabad Housing Society at Jalalabad area. From their current usage, it could be very hard to guess that once there were hills in these areas. Most of the extinct hill cutting areas are located in Panchlaish, Bayazid, Kotowali and Khulshi thanas (Table 4). In last two decades, hill cutting areas are mainly being used for settlement purpose. On few occasions, brick kilns are set up in hill cutting areas.

Conclusion and Recommendation

Chittagong city has been facing uncontrollable hill cutting problem in the last four decades. The problem has been accelerated since early nineteen nineties. It is widely believed that hill cutting problem in the Chittagong city are triggering some major environmental and social problems. The includes landslide hazards and associate deaths, high flooding and prolong drainage problem in rainy season, decreasing ponds and marshy areas, hill slope failure and erosion, decreasing biodiversity, accelerating earthquake associated risk, desertification and deforestation. Islam et al. showed that most of the dry slopes may fail at medium to large earthquakes. By using community vulnerability assessment tool (CVAT), Das and Raja [15] suggested that built environmental infrastructure (i.e. roads, residential buildings and etc.) and human population are highly susceptible to landslide occurred in Chittagong city. Over fifty percent hills of the City have been lost due to hill cutting habituate. The Soils of the hill cutting areas are using for the raw materials of brick kiln and filling up of marshy areas. Hill cutting areas are using for settlement and commercial purposes. The field survey suggests that hilly areas in the heart of the city are at high risk.

Name of hill	Ward No	Thana	Identification of hill	Existing establishment
Medical Pahar (Trunky Pahar)	16 Chawkbazar	Panchlaish	Chattreschari Road, South of Medical College	Building of Taz Company
Finley Company Pahar	16 Chawkbazar	Panchlaish	Chattreschari Road	Building of Taz Company
Hashem Corporation and Taz Company Pahar	16 Chawkbazar	Panchlaish	West of Medical College	Control under Taz Company
Jalalabad Housing Society Pahar	13 Pahartali	Khulshi	Murghi farm road South Khulshi	Brick Klin and Housing Society
Bhera Fakir Pahar	07 Rubabad	Bayazid	Bangladesh Cooperative Housing Society beside KDS	Madrasha and Housing Society
Shahinagar Pahar	10 Jalalabad	Bayazid	Dhaka-Ctg. Trunk Road, Bayazid link Road	New buildings for Asian University for Women
Hatir Pahar	07 Robabad	Bayazid	Bangladesh Cooperative Housing Society Road	New houses construction
A.K. Khan Pahar	13 Pahartali	Khulshi	Road No.1 South Khulshi	VIP Housing Society
Ispahani Pahar (West and South-East Part)	13 Pahartali	Khulshi	Child Heaven School I Road, South Khulshi	Tower Building
Ball Khelar Math Pahar	01. South Pahartali	Bayazid	Sandwip Colony Chowdhury hat road	Brick Kiln
Sona Gazi Pahar	01. South Pahartali	Bayazid	Beside Nandir Hat	Brick Kiln

Dreamland Pahar	10. Jalalabad	Bayazid	Beside Burma Colony	Dreamland Housing Project
CDA Hill	16 Mehedibag	Panchlaish	Mehedibag Road	Amirbag Housing Society
Cheragi Pahar	Jamal Khan	Kotowali	Jamal Khan Road	Building by filling up Razar Pukur
Goal Pahar	Sulukbahar	Kotowali		Building
Source: Field Survey, 2015.				

Table 4: Extinct hilly areas in Chittagong city.

The environmental management authority in Chittagong city should develop current topographic map by using 5-meter contour data, high resolution LiDAR DEM for proper city planning purpose. Natural Park and forest management people need to use High Resolution LiDAR DEM. LiDAR data are widely used for resource management, urban planning, transportation planning, natural park management, habitat mapping and environmental assessments. LiDAR can extract various feature information, including building footprints, trees and forests. GIS based aerial photograph overlay technique can help to detect new hill cutting areas. This can provide data where we need to take urgent action to stop ongoing hill cutting problem. On occasions, open source GIS can help for data collection from the United States Geological Survey (USGS) and lots of free open source GIS software available for new users.

The findings of field survey and review of existing hill cutting stopping actions and practices, suggest that five programs of action can be undertaken in Chittagong city. First, this research suggests strengthening ongoing awareness, education and training for general people. All level education curriculum should include relevant environmental education and training. Second, it recommends setting up an information center to protect hilly areas. There should have scope to disseminate information to newspapers, radio, television channel and social media. Third, formation of a strong advisory committee that comprise of environmentalist, journalist, local hill loving people, mainstream political parties and representative from civil and defense administration. Fourth, the formation of a new enforcement personnel consisting of Bangladesh Army from Chittagong Cantonment and Bangladesh Military Academy), Bangladesh Police, Ansar and BDP. Fifth, formation and activation of a monitoring committee to report strength and weakness of hill protection activities from time to time.

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