Journal of Bangladesh Institute of Planners ISSN 2075-9363
Vol. 7, December 2014, pp. 1-17, © Bangladesh Institute of Planners

Landslide in Chittagong City: A Perspective on Hill Cutting

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Abstract

Hills are our resources. Plundering of hills is a crime; a crime against our environment and sustainability. Chittagong has already lost a number of hills to the land grabbers due to massive hill cutting. A number of undulating hills located in Chittagong but hills which have already been cutting for housing purposes can no longer to residential area development. Unplanned hill cutting in the Chittagong city has become a major humanitarian issue when it occur landslides. Every year landslide is causing death of valuable lives and property loss. Strategies are adapted for hill preservation in Chittagong city master plan and detail area plan (DAP) but lack of inter-organizational coordination sustainable land management is not carrying out activities related to hill cutting. City is expanded as hill cutting in city area is also increased. The present paper focuses on the land cover changing profile and hill cutting scenarios of Chittagong city corporation area and how hill cutting sequenced landslide. The landslide tragedies in Chittagong city are the examples of law enforcement failure. Once lost, it won't be able to get them back so planning intervention is necessary.

Keywords: Hill cutting, landslides, land cover changing.

Background of the study

Landslide is a geological phenomenon which includes a wide range of ground movements, such as rock falls, deep failure of slopes and shallow debris flows (Rahman, 2012). Landslide is often promoted by large accumulation of soil water from rainfall, spring, or melting snow. This adds to the weight of the soil and as pore water pressure increased (Brand, 1984).

The world's urban population was estimated at 3 billion in 2003 and is expected to rise to 5 billion by 2030 (UN, 2004). Population pressures are increasing in most of the world today and will certainly accelerate in the future (UNDP, 2009). These pressures have resulted in rapid urbanization and development, much of it on hillsides. This urban expansion will disturb geological materials and people are attracted to building on hill area (Rahman, 1985). Much of this disturbance will create landslide as to slope failure.

Bangladesh is one of the most disaster prone countries in the world (Khan, 2008). Due to the deforestation and unplanned urbanization, manmade disaster is now become one of the talked of topic. For the settlement development these people are cutting hills and forests for rapid residential area development, which causes environmental degradation and responsible for natural disaster. Presently Landslide is occurring frequently in the hilly regions of the country (Alam et al, 2005).

Due to port, district headquarter and metropolitan commercial area the vital city- Chittagong is the second largest city of Bangladesh located by the Bay of Bengal in the eastern part of the country (Osmany, 2013). The city terrain is undulated and the major hills of the country are located in this region (Begum, 2007). Chittagong city corporation (CCC) area is highly vulnerable

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to landslide hazard (Mahmood and Khan 2008). All the major landslide events occurred as a much higher rainfall. Moreover rapid urbanization, increased population density, improper land use, alterations in the hilly regions by illegally cutting the hills, indiscriminate deforestation and agricultural practices are aggravating the landslide vulnerability in Chittagong city area (Bayes & Yiaser, 2013).In the recent land slide in Chittagong 86 people died, over 100 were injured and 22 families are directly affected. Many houses are damaged and Domestic animal died in that landslide. Also the roads are blocked and transportation hampered. 72 families are displaced from their houses and they bound to take shelter another safe location and about 200 families are permanently displaced (The Daily Star, 2007).

This study presents the land cover changing of Chittagong city corporation area during 1989 to 2013 by remote sensing approach and loss of hills with respect to the build up area increased. This study also presents hill cutting scenarios and how hill cutting causing landslide.

Objective and Methodology

The methods used in the study area were characteristically involved data collection, data processing and field checking. A number of primary and secondary data were collected from various sources. These included base map from Chittagong Development Authority (CDA) and satellite image of LANDSET 7. A field survey was carried out in landslides vulnerable area. The experience, observations, analysis of the data and information logical interpretation in a systematic manner largely received to achieve the goal. Existing planning interventions(Master plan and DAP), journals, published and unpublished books, articles, newsletter by GOs (CDA, CCC, and LGED) and some NGOs newsletter were used literature review. The paper present on land cover changing profile and hill cutting scenarios of Chittagong city corporation area and how do hill cutting sequenced landslide.

Study Area Profile

The city lies 21° 54′ North to 22° 59′ north latitude and 91° 17′ east to 92° 14′ east longitude and extend north bank of the Karnafuli river to west bank of the Halda river (Mahmood and Khan, 2008). Chittagong City Corporation Area is 185 square kilometers (60 Sq. Miles) and contains forty one wards and 285 clusters. It has a total population of 25, 63,293 people in the area (BBS, 2011).

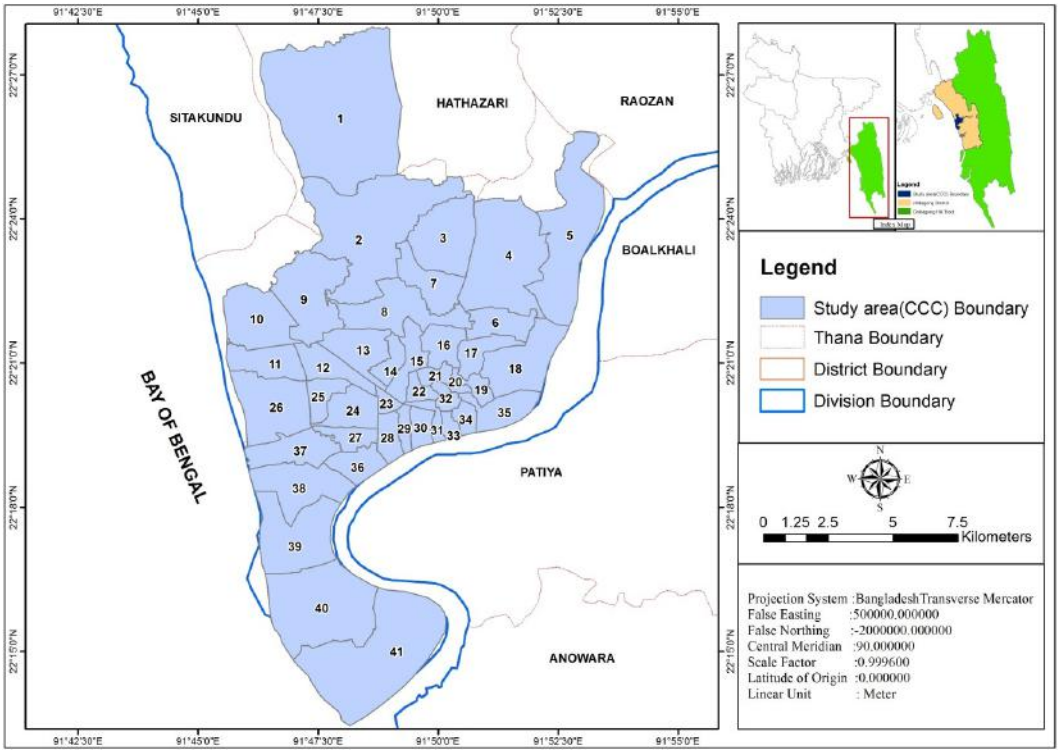

Fig. 1: Location of study area (Chittagong City Corporation)

Source: Product by author

The study area is Chittagong City Corporation (CCC) area shown in Figure-1. The city is known for its vast hilly terrain that stretches throughout the entire district and eventually into India. Climate condition is warm-humid weather where average temperature 29°C and rainfall 250 cm (CCC, 2015).

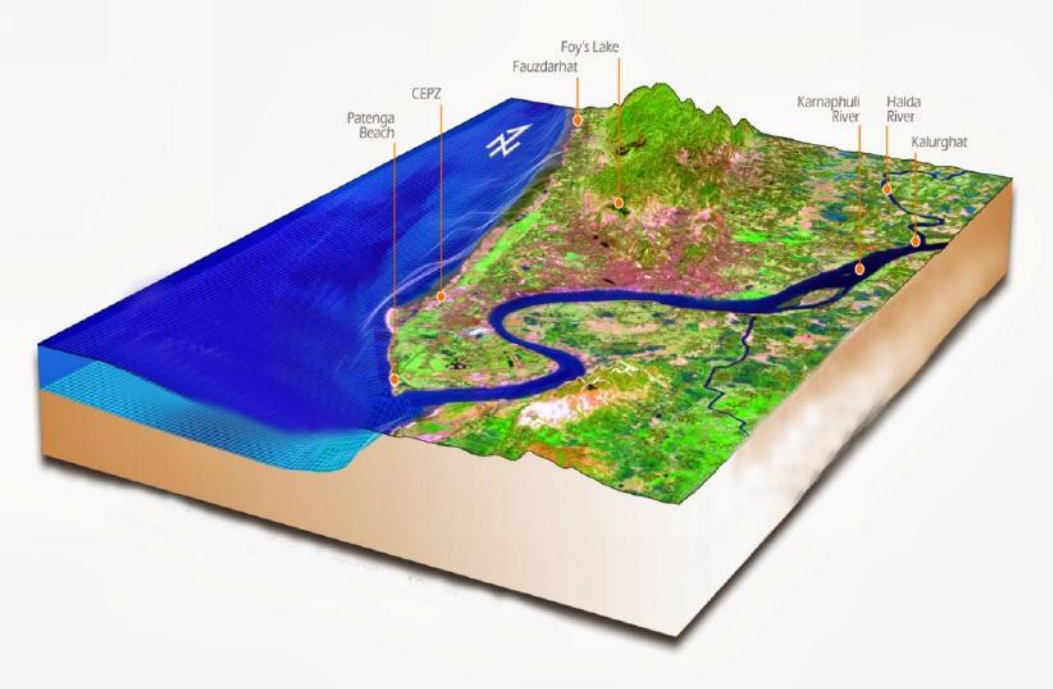

Fig. 2: 3d model of Chittagong city

Source: Product by Sayedur R Chowdhury

The city also comprises area of small hills and narrow valleys, bounded by the Karnaphuli to the south, the coastal plain and the Bay of Bengal to the west and the floodplain of the Halda to the East (Figure 2).Maximum soil is the mixer of brown sandy silt and clay silt. The soil particles of the coastal area in the south consist of the silt clay driven by the tidal waves. Maximum hills are made of lime stone with thin stratum of acidic earth (Brammer, 1996).

Existing Land Use of Chittagong City

Among the built-up area, pucca structure occupies 29.82%, semi pucca-58.16% and the rest 12.02% is kutcha structure. Low lying area between Rajakhalikhal and the river Karnaphuli is about 14.49 hectares and occupies 24.69% of the study area. Built-up area is about 56.57% of the study area, and Khals and water bodies occupy the remaining 18.74% of the study area (Ashraf and Chowdhury, 2009). The existing land use of Chittagong is given figure 3.

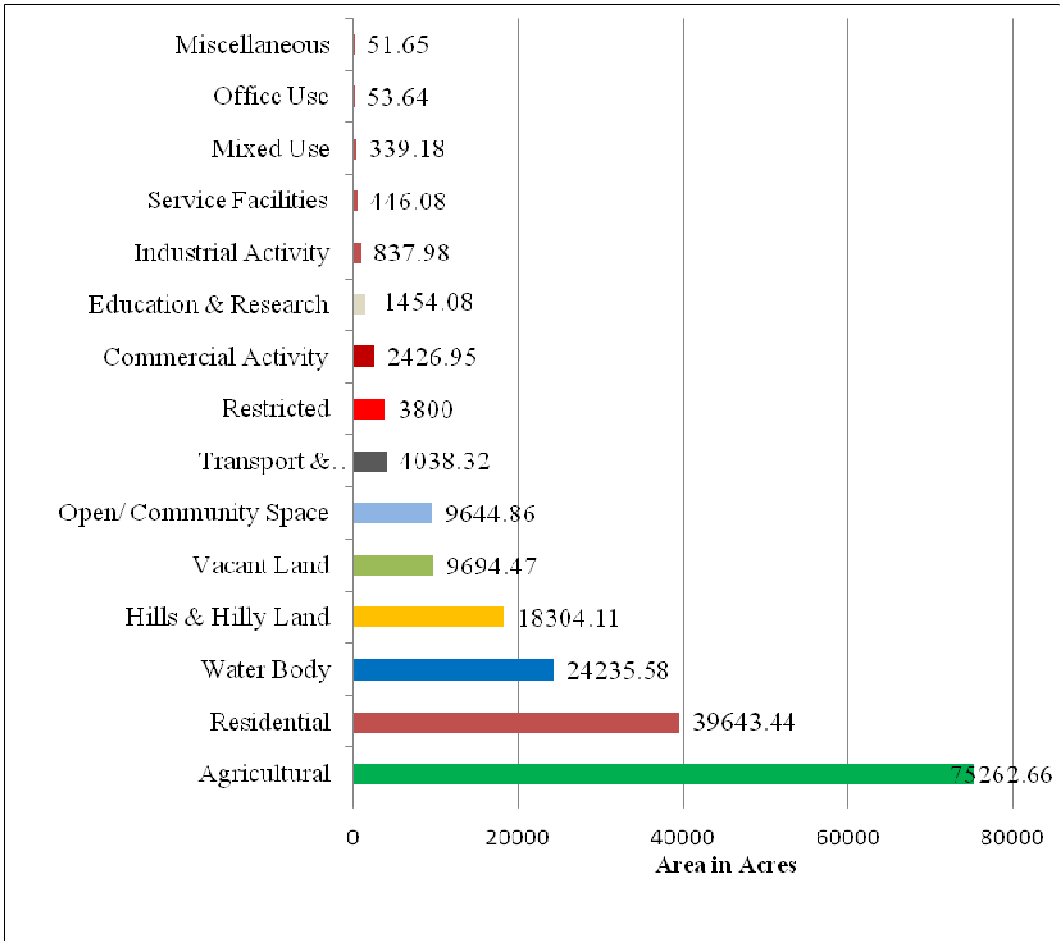

Fig. 3: Existing land use of the Chittagong city corporation area.

Source: Chittagong City Corporation, 2001 and Product by author

Chittagong City Land Coverage Changing from 1989 to 2013

By remote sensing approach, figure 4 is shows the change of build up area, water body, vegetation and sand in different time of Chittagong city. Change detection tool of remotes sensing was used in to find out the change of different land use. Manipulated data shows about 9%, 21% and 32% lands were used as build up area in 1989, 2001 and 2013 years respectively where about 47%, 37% and 27% lands were used as vegetation area (figure 4). Vegetation has been decreasing and build up area has been increasing rapidly over different time periods. It also indicates that land use change from other use to build up from 989-2001 was 76% and 2001-2013 was 72% apex (figure 4).

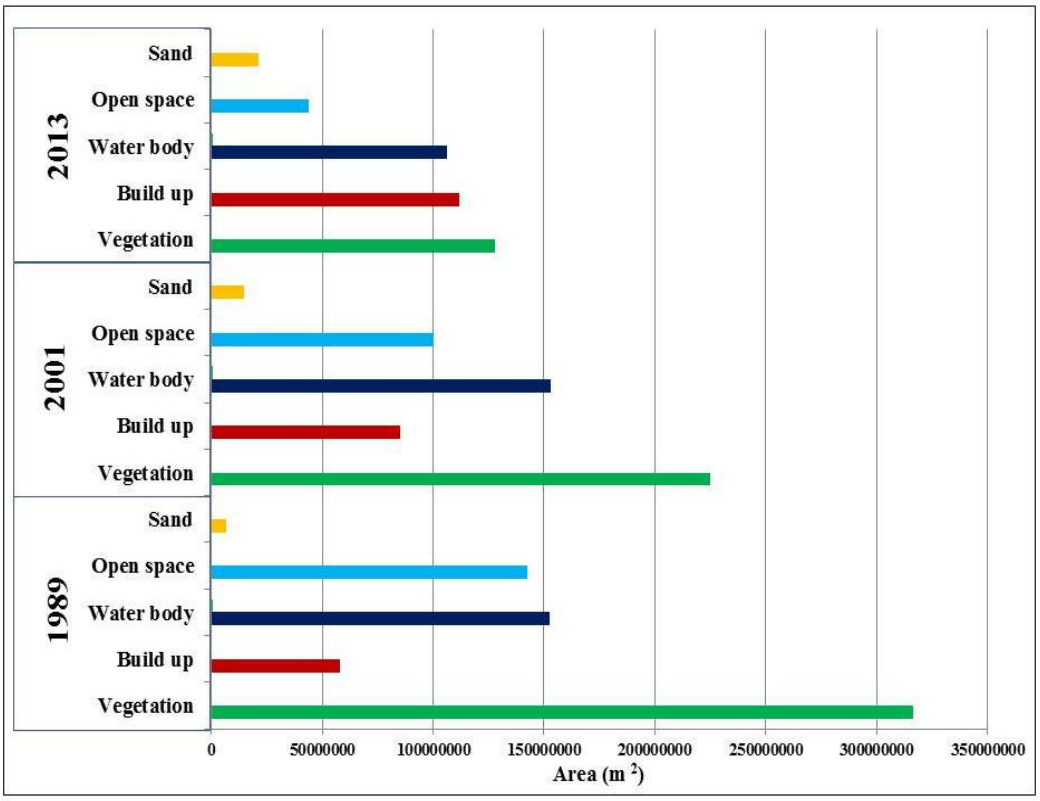

Fig. 4: Compares of Land coverage changing

Source: Product by author

At present time, the growth trend of Chittagong city in on the north east corner of the city. By considering the growth center, growth poles of Chittagong city such as Hatazari, Anowara, Raozan, it is found that growth trend of the Chittagong city is on the north east direction. On the south side it is no possible because of the presence of Patenga sea beach which defines the last boundary of the city area.

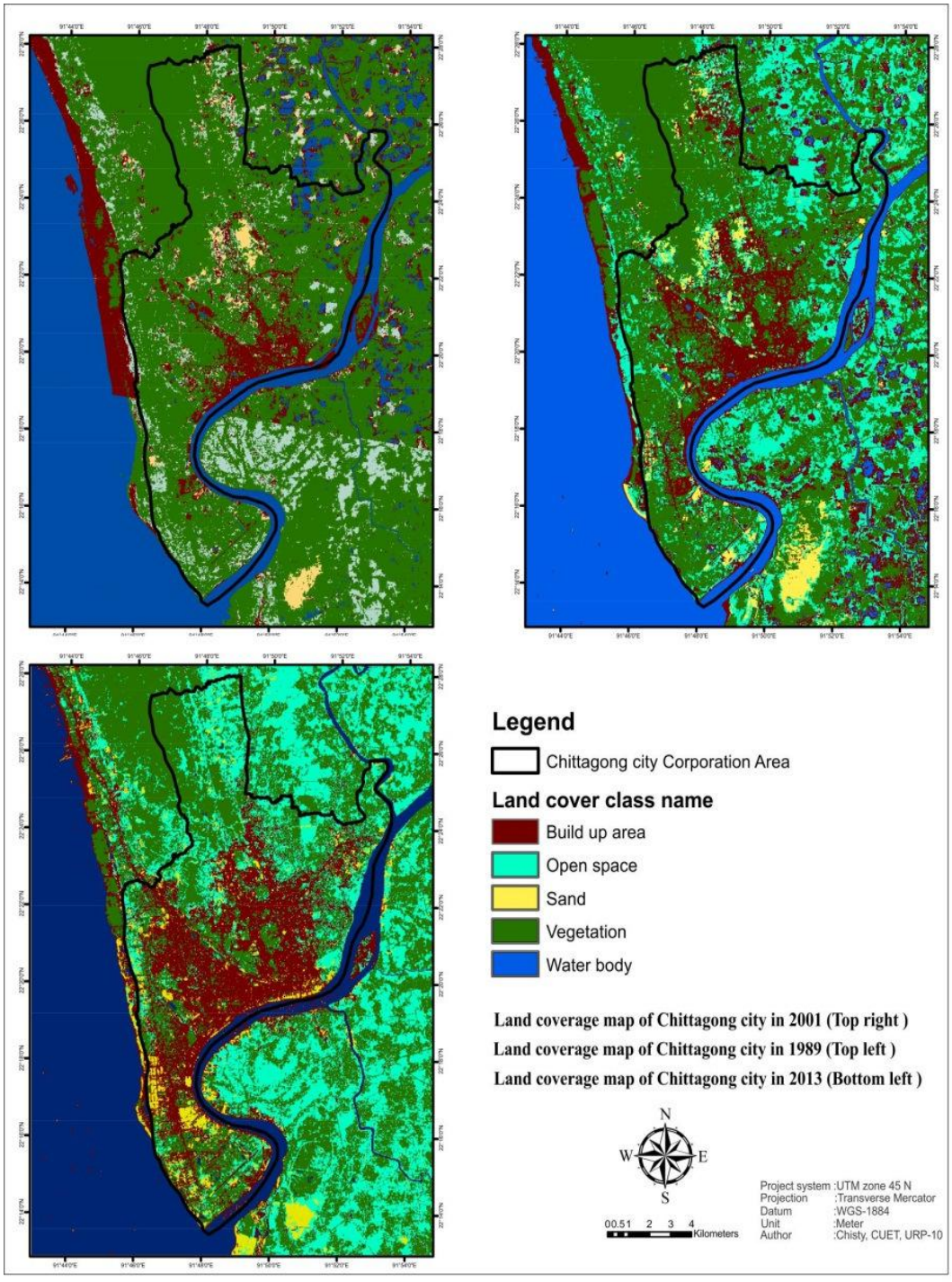

Fig. 5: land coverage changing of Chittagong City Corporation from 1989 to 2013

Source: Product by author

Existing Hills in Chittagong

Most of the hilly areas are found in the Chandgaon, Double Mooring, Pahartali, Khulshi and Bayezid Bostami Thanas. Hills around the Foy's Lake area are the most famous hilly area within the city. Besides, Tiger Pass hill, Battali Hill, CRB hill, Moti Jharna Hill, Court hill, DC hill etc are widely known as the hilly areas of the city (table 2).

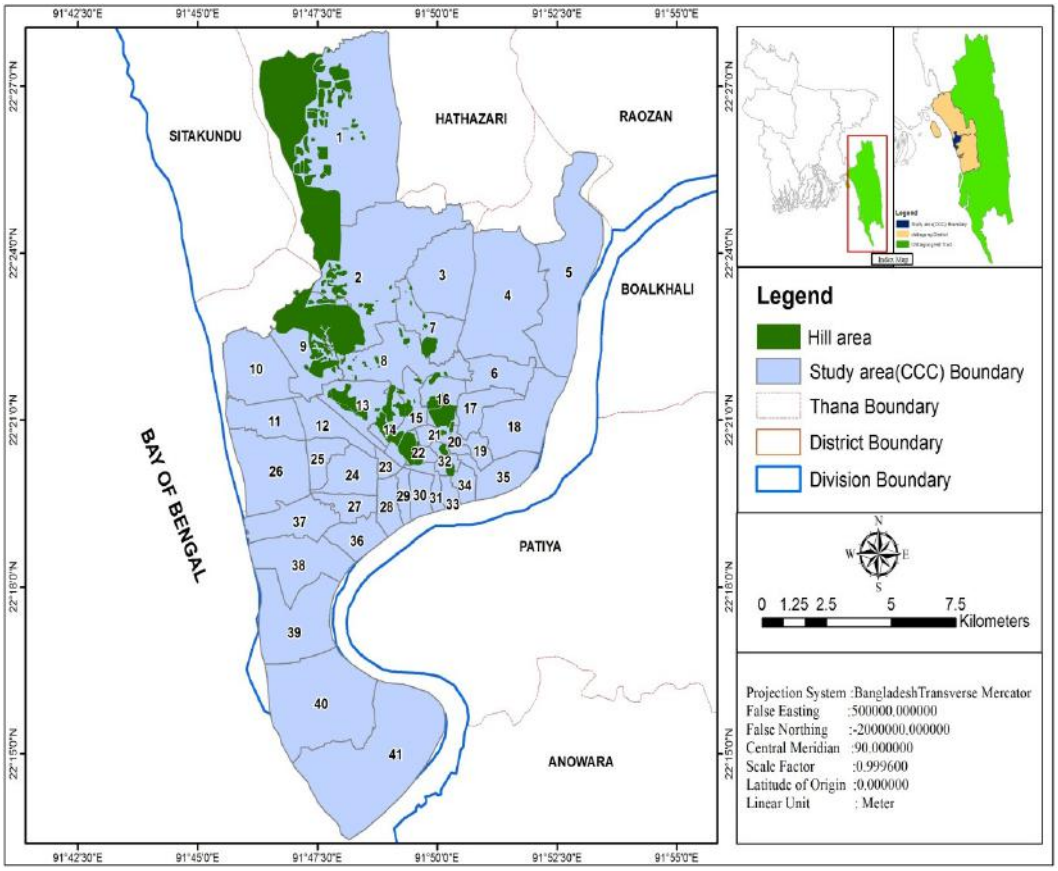

Fig. 6: Existing Hilly Area in Chittagong City Corporation (CCC)

Source: Chittagong Development Authority and Product by author

According to the Chittagong City Corporation, the hill range from Fauzderhat to Sitakunda is the highest of all. The average height of these hills is 500 feet with maximum height of 1015 feet (Chandranath Hill). Height of the hills within the city is relatively low. Battali hill, situated at the centre of the city, is 281 feet high and hill near Foy's Lake at the north-west corner of the city is 270 feet (Mohajan, 2011). The soil of the hills is brown and sandy with acidic character. The strata of the soil are very thin and loose. Out of 14 Thanas of Chittagong district all but Shandwip Thana are enriched with the hills. 28% of the total area of Chittagong district is hilly land. Eighty eight hills in the study area which cover 18304.11 acre of total city corporation area. Different categories hill are given below in table no 1.

Table 1: Different categories hill in Chittagong

Hilly Area in Acre	No of Hill		Area (Acre)	
	No	%	No	%
Lowest Through 4 acres	33	38.78%	65	0.53%
4.0 Acres – 11.9 Acres	20	23.13%	146	1.18%
12.0 Acres – 36.9 Acres	19	21.77%	410	3.27%
36.0 Acres – 107.9 Acres	9	8.88%	443	3.40%
Through Highest 108 Acres	7	7.48%	2854	91.62%
Total	88	100.00%	3918	100.00%

(UNDP, 1995)

Table 2: Hills in Chittagong city corporation area

Name of hill	Location	Area (Acre)
ParirPahar/ Court Hill	32 no. ward, Anderkilla	2.535
DC Hill	32 no. ward, Anderkilla	2.754
Khulshi Hill	14 no. ward, Lalkhan Bazaar	6.6
Kata Pahar	14 no. ward, Lalkhan Bazaar	0.566
Probortak Hill	16 no. ward, Chawk Bazaar	2.139
Foy,s Lake	09 no. ward, North Pahartali	8.594
Forest Hill	07 no. ward, West Sholashahar	6.811
Hill View	15 no. ward, Bagmoniram	0.671
Chatteshori Hill	16 no. ward, Chawk Bazaar	16.635
Jilapi Pahar/ Batali Hill/ Tankirpahar	14 and 15 no. ward, Lalkhan Bazaar and Bagmoniram	22.388
CRB Hill	22 no. ward, Enayet Bazaar	41.052
Police line Hill	15 no. ward	5.563
Goribulla Shah Mazar Hill	14 and 15 no. ward, Lalkhan Bazaar and Bagmoniram	5.563

Source: Field Survey, 2014

Others hills include Intraco CNG Hill at 7 no. ward in Pahartali and Tigerpass area, Kushumbag R/A Hill at 13 no. ward in Pahartali, Dampara and GEC circle, Ispahani Hill at 13 no. ward in Pahartali, South Khulshi, Lake city Hill at13 no. ward in Pahartali area. The hills of Chittagong City are owned by different government, autonomous and private organizations, and elite individuals. Bangladesh Railway is the largest owner of the city hills. Public Works Department,

Chittagong City Corporation (CCC), Chittagong Development Authority (CDA), Chittagong Water and Sewage Authority (CWASA), and Bangladesh Army are other large hill owners in Chittagong city. Besides, some big private companies namely AK Khan Group, Ispahani Group, James Finley; and some elite individuals have also owned a portion of the hilly lands (Islam, 2008); (Murshed, 2013). Again, Batali Hill is over populated and inhabited by slum; Intraco CNG Hill is inhabited by Bamboo type structures along slope; Kushumbag R/A Hill and Lake city Hill are also over populated with Moderate high & low rise structures .

Developing City through Cutting Hills

It is highly difficult to unearth the exact history of hill cutting in Chittagong. But the record says that it was English who first started to develop the area by cutting the hills and clearing the vegetation in 1760 (Islam, 2008). So it may be stated that before then, the hills of Chittagong were almost virgin. Chittagong city was established in the early 9th century. Chinese Burmese and Arabians had business by using the port from 1517 AD. This port was very famous to the Portuguese. They used to call it **"Porte Grande"** which means the grand (big) port. East India Company captured the city and started living there in 1760. It is anticipated that they first introduced cutting hills to prepare liveable land. In 1872, the Chittagong city was inhabited by only 18,780 people (Murshed, 2013). The number of city people started to increase very rapidly after the division of the sub-continent in 1947 from when Chittagong Port started to treat as an important sea port of the then East Pakistan now Bangladesh. To accommodate the increased people, hills of the Chittagong city were needed to cut or sized. In 1950, industrialization started to expand at a rapid pace in the hilly areas of Nasirabad, Pahartali, Foujdarhat and Bhatiary areas of Chittagong city (Ahmed and Rahman, 1962). However, the scale of hill razing was limited at that time and it was not considered as threatening to the environment.

The Chittagong city is a densely populated area. For accommodation people build house on the top of the hills or on slope or on the foot of hills without following the existing rules and regulations. Greedy influential people and muscle-men invaded the government hills and building temporary houses on them to earn money by renting them to the poor people. The steep slope of the hill cannot bear the mass weight of the wet soil or mud that results the landslide. The recent landslide in Chittagong city was the result of hill cutting and steep slopes of the hills. The most affected areas because of indiscriminate hill cutting are Khulshi, Panchlaish, Sholoshahar, Baizid Bostami, Foy's Lake, Lalkhan Bazar, Pahartali, Kattali and Polytechnic area (Mahmood and Khan, 2008).

Among all the causes the most important matter is to level the undulating land or filling the low land for dwelling. Developers play an important role in creating land this way. Statistics reveals that around 36% of the respondents, when asked about hill cutting, believe that levelling land for construction of building is the main cause of hill cutting.

Moreover, the percentage of city population, in terms of total population, is also increasing gradually (Figure 7). The present urbanization rate of Chittagong is 41.39% (BBS, 2011).If this trend continues, then the city population will reach approximately 10.8 million in 2050 (Bayes & Yiaser, 2013).

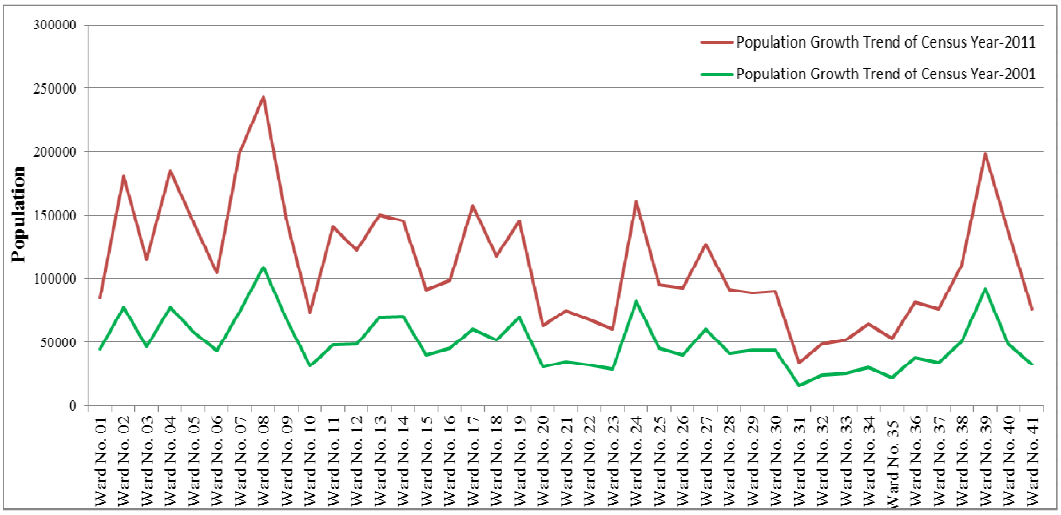

Fig 7: Population Growth Trend of Chittagong City Corporation

Source: Product by author

Rapidly growing demand for urban services as a result of continuing rapid urban population growth. Supply of infrastructure development creates pressure on land when it is scared. In Chittagong city corporation area overall increased population create more pressure on land development and this land development because hilly cutting especially low income people in Motijorna hill). Rich people also cutting hill for their apartment building construction in Khulshiarea.

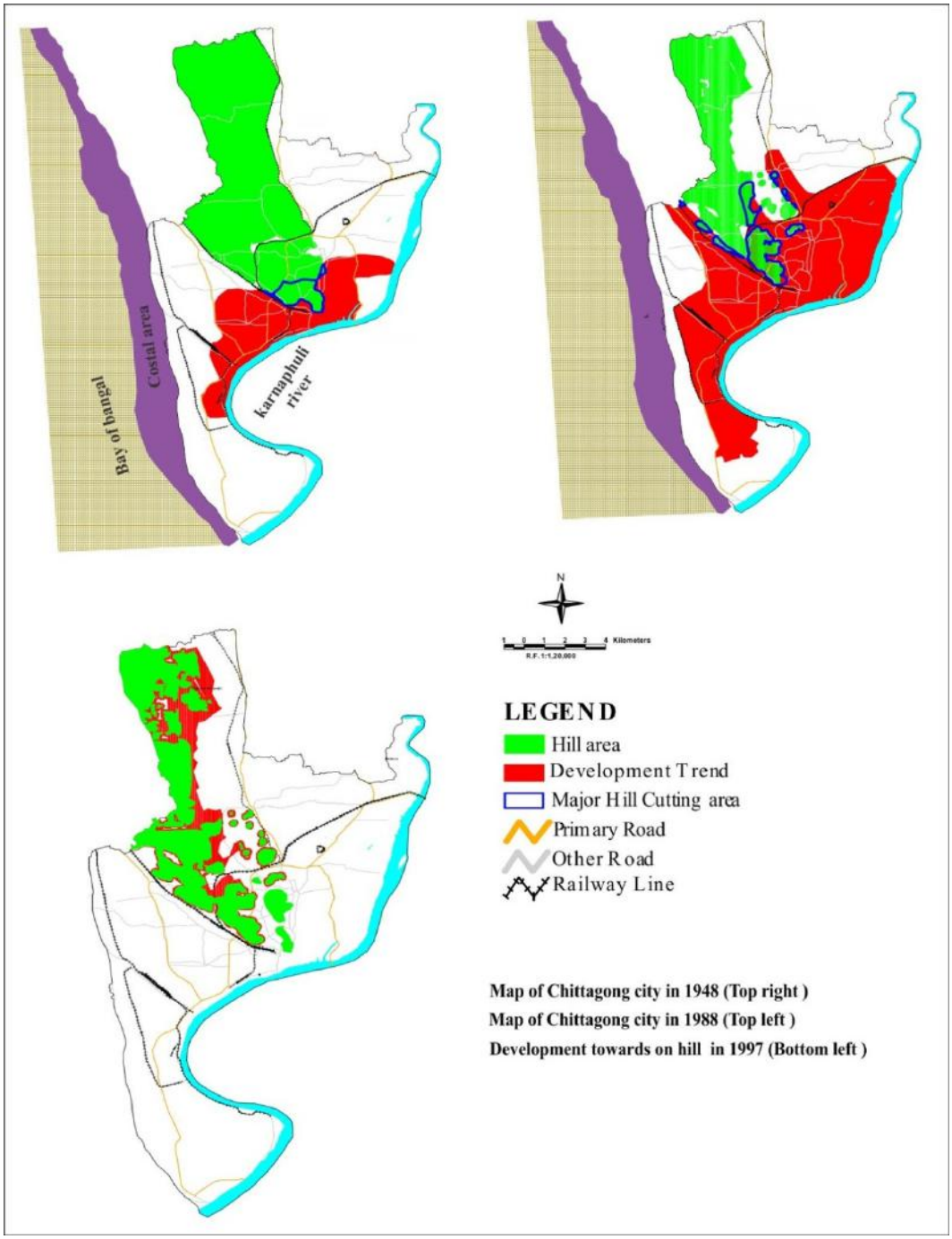

Fig. 8: Developing City through Cutting Hills

Source: Chittagong Development Authority and Product by author

Development trend of city through cutting hills from 1948, 1988 and 1997 is given figure 8. The finding from the questionnaire reveals the fact that from the beginning of the decade of 70's, the tendency of hill cutting increased and it reached to the pick in the decade of 80's. Probably the propaganda initiated by the governmental and non-governmental organizations about the adverse effect of hill cutting minimizes the pace of this devastating work during 90's (Mohajan, 2011). Again, Hill cutting is a social problem but people to be honest to the use of hills for a good example of a road near Polo Ground area and local court building constructed on the hilly land in the imperial period (Ashraf, 2012).

Hill Cutting Creating Landslide

Despite a government ban indiscriminate hill-cutting is not stopped. Presently hill cutting is one of the major causes of landslide in Chittagong city. Hills of Chittagong is being cut for building construction, develop residential/housing area, clay and sand mining and developing road network. The Chittagong city is a densely populated area. For accommodation people build house on the top of the hills or on slope or on the foot of hills without following the existing rules and regulations (figure 9). Greedy influential people and muscle-men are invading the government hills and building temporary houses on them to earn money by renting them to the poor people. Poor people who live in those houses are highly vulnerable to landslide. Because of hill cutting, the slopes become instable. The hills of Chittagong were cut with slopes of 70-80 degrees (Mahmood and Khan 2008).

Fig 9: Showing the housing development happened on hill by hill cutting in Motojorna area.

Source: Field survey, 2014

When it rains, water dissolves the minerals of the soil of the hills that loosen its compaction. Soils of the hills also become heavy by absorbing rainwater. If rain intensity is too high, minerals of soil dissolve very quickly and the soil turns into mud and becomes very heavy. The steep slope of the hill cannot bear the mass weight of the wet soil or mud that results the landslide. The recent landslide in Chittagong city was the result of hill cutting and steep slopes of the hills. The most affected areas because of indiscriminate hill cutting are Khulshi, Panchlaish, Sholoshahar, Baizid Bostami, Foy's Lake, Lalkhan Bazar, Pahartali, Kattali and Polytechnic area (Mahmood and Khan 2008).Not only Chittagong illegal hill-cutting also happened in Cox's Bazaar, Khagrachari, Rangamati, and Bandarban districts for accommodation purpose. Now some question arises-What holds the hills together? Secondly, cutting the hills destroys their integrity, making landslides more likely. Hundreds of hills, even those owned by publicor private, who are influencing to cut downhill? Thirdly, stemming the growing influx of ethnic Bengali migrants to the area, whose construction methods are invasive, and rehabilitating those buildings is constructed. Will the critical action in reducing the disaster threat posed by landslides? A table of some landslide that occurred by hill cutting has giver below (table 3).

Table 3: Some landslide that occurred by hill cutting

Location of land slide occur	Total landslide occur	Last landslide	Injured	Died	Total people now in danger	Course
Railway society Foys lake	3	2008	13	17	94	Hill cutting + precipitation
Red hill, AS majar	2	2011	25	4	105	Hill cutting for housing
Foys lake observation tower hill	2	2011	20	10	no	Hill cutting for development + precipitation
AK khan hill panchlaish	1	2007	3	1	80	Hill cutting

Source: Product by author

Besides this statistics (table 3) , According to DOE and district administration some 30 hills are at risk30 hilly areas in Chittagong as risky, 2000 families are at high risk, 4000 to 6000 families are at medium to low risk and the families and the people to be evacuated far(DoE, 2010), (Ashraf, 2012).

GovernmentInitiatives for Hill Preservation

The legal base of preventing illegal hill cutting is the Building Constriction Act which was enacted in 1952 with a view to preventing haphazard erection of buildings, excavation of tanks and cutting of hills and hillocks in Bangladesh. But later on, the government amended the 1952 Act twice in 1987 and in 1990 (Rahman, 2012). In the Building Construction (Amendment) Act of 1990,

amongst other, section 3C and 3D were inserted into the 1952 Act. As per section 3C of the Act no person is allowed without the previous sanction of the authorized officer to cut or raze any hill. As per this section no such sanction should be granted unless the authorized officer or such other authority as the government may specify is satisfied that-the cutting or razing of the hill shall not cause any serious damage to any hill, building, structure or land adjacent to or in the vicinity of the hill, obstruction to any drain, stream or river, loss of life or property. The Act not only contains the permission procedure and criteria but also contains specific provisions for punishment and legal actions against the persons transgressing the law (Murshed, 2013). To prevent environmental degradation in the country Bangladesh Environmental Conservation Act 1995 was formulated. But the act contained no provision regarding illegal hill cutting, but later on in 2010 the Act was amended giving additional power to the law enforcers. Nobody is allowed to cut and/or raze hills/tillas without prior permission of authorized officer, otherwise according to law he will be punished 10 years imprisonment or 10-lakh taka [$15,400] monetary punishment or both. In addition to that the Ministry of Forest & Environment issued a circular against hill cutting in 2002. It is yet to be framed into an Act. This government directive is now being used to prevent hill cutting (GoB, 2010).

In 1995, Chittagong Development Authority prepared a comprehensive **Master Plan** for the city with the technical assistance from United Nations Centre for Housing and Settlement (UNCHS). One of the components of this plan is the Structure plan. In this plan, six guidelines have been stated considering the issues of environmental degradation related to manufacturing activities, solid waste disposal, noise and air born pollution, hill cutting and loss of vegetation coverage to enhance the environmental quality of the city (UNDP, 1995).In the Master plan of Chittagong City prepared in 1995, particular attention has been given for the protection and improvement of urban environmental quality.

Chittagong Development Authority has prepared a set of detailed development guidelines for Chittagong city called **Detailed Area Plan** for Chittagong City 2007 (Rahman, 2012). In this planning report, the whole city has been divided into 12 zones named Detailed Planning Zone (DPZ). Of these 12 zones, 6 are within the City Corporation Area. Out of them only 3 zones consist of hilly areas (Mohajan, 2011). The detailed Area Plan has classified the hills in to several categories depending on the level of their destructions and forest covering. Consequently the guidelines or the suggestions given in the report regarding hills are predominantly about protection of lives and property of the city people.

Recommendation and Conclusion

Hills and hilly regions are ecologically and environmentally sensitive areas needing special attention at the planning stage of development. It is a responsibility to develop Chittagong City by conserving its natural environment. Hill cutting is a social problem focused on the overall development strategy adopted by different Governmental organizations for the city. Hill cutting is one of the key factors to be addressed to overcome the development constraint of the city. It is not a matter of necessity but the lack of planning intervention in the process of physical and environmental development of the city, the hills should be conserved. Although excessive rainfall and hill cutting are considered to be the main causes of landslide, but it has a diversified dimension as to why landslide takes place. To reduce landslide vulnerability, forest cleaning of the hills with stiff slope (more than 30°) should stop, more consuls to develop green coverage with tree plantation in the previously demolished hills, should take proper engineering measures to protect these demolished parts of the hills and should stop residential development as well as

collection of sands for construction. The landslide tragedies in Chittagong city are the examples of law enforcement failure. It is crystal clear that it is not the deficit or insufficiency of law rather the non-application or poor application of law which destroys the hills and causing the death of hundreds of people in Chittagong. Again, the strict law enforcement is not the only solution to get rid of this situation rather proper implementation of laws can save the unique hills of Chittagong city. It is easy to cut and level a hill. But it is not that easy to rebuild a hill. Once beautiful and aesthetically pleasing, Chittagong City is losing all its charm because of indiscriminate cutting and levelling of hills. Rangamati, Cox's Bazar, Bandarban, Khagrachari and Sylhet are also following it. Once lost, it won't be able to get them back. These are the places where planning intervention is necessary. Planners are dream merchant who have the august responsibility of shaping city future by judicious planning, development control and implementation.

Acknowledgement

For this paper, at first I want thank Almighty Allah, the most gracious and merciful who gives me the strength to finish this paper. I want to give special thanks to Bayes Ahmed sir, former-lecturer of department of urban and regional planning, Chittagong university of engineering and technology (CUET), Chittagong-4349, Md. Shahinoor Rahman sir, Assistant professor, BUET-Japan institute of disaster prevention and urban safety, Bangladesh university of engineering and technology (BUET), Dhaka -1000, and Debashis Roy Raja sir, Assistant professor, department of urban and regional planning, Chittagong university of engineering and technology (CUET), Chittagong-4349 for their continuous support, guidance, help and instructions and I also want to thank my parents who always inspire me and help me to keep it up. At last I want to thank all my friends who encourage and help me to finish this paper.

Conflict of Interest

The authors declare no conflict of interest.

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