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Environmental degradation through hill cutting in Chittagong district of Bangladesh

Mohammad Maksudul Hassan[1], Shamim Ahmed[2], Nizamul Haque Patwary[2], Labony Yeasmin[3], Shah Muhammad Shahidullah[2], MA Sattar[1]

[1]Department of Environmental science, Bangladesh Agricultural University, Mymensingh, Bangladesh
[2]Department of Agriculture Extension, Ministry of Agriculture, Government of the People's Republic of Bangladesh
[3]Department of Biotechnology, Bangladesh Agricultural University, Mymensingh, Bangladesh, Bangladesh

ABSTRACT

Causes of hill cutting, utilization of hill cutting areas, use of hill cutting soil, plant biodiversity status of the area, and overall impacts of hill cutting on environment was investigated in Chittagong region of Bangladesh. The research work was accomplished by collecting data from three persons for 20 locations in 2005. The study indicated that the non-government ownership hills were cut down fluently than government ownership hills. Fourteen responsible reasons were identified for hill cutting of which the establishment by real estate businessmen, individual settlement, low land filling, use of hill soil in brick kiln were the major causes. The maximum percentage of hill cutting area was found in Chittagong city at Khulshi (63.6%) and lowest from Chowdury Hat (20.0%). Maximum duration of this hill cutting phenomena was 20 years and the lowest time ranged 5-8 years. The respondent (60-80%) identified that raising plot and low land filling was the major utilization of hill cutting soil. The results of biodiversity study indicate that there were 25 woody plants, 19 fruit plants, 16 medicinal plants and 16 rare and endangered plants species were listed from the study area. Maximum respondent (86.67%) opined that deforestation was the major environmental problem created by hill cutting. The results also indicate that 89 people died by landslide during last seven years. Establishment of industries as well as brickfield by hill cutting causes different type of health hazards to the local people. Forty four ponds in and around the city of Chittagong have been filling up in the last couple of years. The district has lost its natural beauty through hill cutting. The study recommended a permissible guideline of hill cutting to protect the environmental degradation.

Key words: Hill, environmental degradation, Chittagong, Bangladesh.

*Corresponding author.
E-mail address: maksud_81@yahoo.com (MM Hassan)

INTRODUCTION

Hills and mountains are an important part of the natural ecosystem of a country. They are the sources of forest resources, biological species, minerals and agricultural products. Since hills represent the complex and interdependent ecology of the planet, they are the most sensitive to climate changes. Because of their vertical dimensions they create gradients of temperature, precipitation and insulation. A given hill slope may include several climatic systems- such as tropical sub-tropical, temperate and alpine each of which represents a microcosm of a larger habitual diversity (Salahi, 2002). Chittagong is considered as the commercial capital of Bangladesh. The port of Chittagong is the gateway of Bangladesh and daughter of the east. Chittagong district comprises with the area of 5282.98 sq km and the hilly area of the district is 667.12 sq km. Among the 14 upazillas of the Chittagong district, except Swandip most of the upazillas are hilly. The hilly areas are more at

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Mirsharai, Fatikchai, Sitakunda. Despite of the government ban on hill cutting, a vested group has been carrying on the business of hill cutting, establishment of residential area by real estates, individuals, establishment of industries through hill cutting in the district of Chittagong for few years posing a threat to ecological balance and sound environment. The hilly picturesque of Chittagong has become a mere dream to the people. Many of the hills in the district and the city have already been distorted through hill cutting (Islam, 2003). The indifference of the concerned authority to take prompt actions against the perpetrators has encouraged the vested interest in continuing the hill cutting.

The Chittagong Metropolitan City was surrounded by almost 200 small and big hills before 30 years. Many residential areas were constructed by cutting more than 100 hills after independence. The planning of luxury banglos construction was started since Pakistan period. One class capitalist of Chittagong were encouraged buying hill by force since 1960 to see the beauty of that luxury buildings. Most of the residential area was started to construct since 1980 (Alam et al., 2005). The existence of hill has maintained behind the naming of resident. Many thousands of people habited rubbing against the body after destruction of hills. Thousands of slums have been rising in that habitation which are destroying the balance of environment. As the impact of destroying the natural ecosystem, the region is recently experienced different type of natural disasters. Extensive land erosion, forest fires, the loss of soil fertility, wildlife and biodiversity and unusual flash floods are all combining to turn the districts green hills into a barren wasteland. It has been said that the region could become uninhabitable within the next two decades if steps are not taken to halt the damage (Islam, 2003). Demographic pressure on the land and its resources means that the hills are being denuded through tree felling, hill cutting and the extraction of stones, and the wildlife is being killed especially when animals such as wild elephants threaten the inhabitants.

The indiscriminate hill cuttings have been gradually causing some other environmental damages and adverse soil erosion e.g. gulling and rill formations siltation and filling up of the natural marshes in the district of Chittagong. This degradation of damages has obvious effects on the environment as well as on the socio-economic situations. Indiscriminate and ruthless removal of earth materials form the smaller hills in different parts of the districts have appeared as one of the most alarming environmental problems. Therefore, the present study was conducted to assess the causes of hill cutting, and the impact on environment.

MATERIALS AND METHODS

Study area and locations

The study was carried out in Chittagong district of Bangladesh with an area of 5282.98 sq km which is bounded by Feni district and Tripura (Indian state) on the north, Cox's Bazar district on the south, Bandarban, Rangamati and Khagrachari districts on the east and Noakhali district and the Bay of Bengal on the west. The hilly area in the district is 172759.21 hectares. Twenty spots from 14 upazila of Chittagong district except Swandip were selected for this study (Table 1).

Table 1
Selected location of studied hill area in Chittagong district of Bangladesh.

Study Area	Location
Chittagong City	Zalalabad, Sholoshar, Khulshi, Foy's Lake, Nasirabad, Pahartali, O-R Nizam road, Punchlish, Lallchan bazaar, Bayzid Bostami
Sitakunda	Banshbaria, Sonaichari, Kumira, Selimpur
Hathazari	Mirzapur, Fatehpur, Chowdury Hat
Fatikchari	Daulatpur, Sundaipur, Rangamata

Collection of data

Questionnaire interview was conducted to 60 inhabitants from 20 selected areas. The questions were explained and clarified wherever any respondent felt difficult to understand them. The studied hill areas were measured by a measuring tape in meter. The ground areas of the hill finally converted in hectare. Identification of the existing biodiversity was done by the help of rural aged people, local journalist and with the consultation of Bangladesh Forest Research Institute, Chittagong. Most of the species were finally

identified with the help of biodiversity related reference books. In addition to the formal survey, informal discussions were hold with the Environmental Journalist, Professor of Geography Department of Chittagong University, eminent old persons of the study area to get information and knowledge about hill cutting, their uses, problems and species identification, suggestions and overall attitude towards the environmental degradation. The data were collected for hill ownership, causes of hill cutting, cutting intensity and time, utilization of hill cutting areas, utilization of hill cutting soil, plant biodiversity of the studied areas, biodiversity of woody plants, biodiversity of fruit and medicinal plants, rare and endangered plants and environmental impacts of hill cutting. Climate data was collected from local weather station. Secondary data were collected from different sources according to needs. Data and information were collected from different daily news paper, Magazine, Department of forest and Environment, search from Internet and previous research and survey report.

RESULTS AND DISCUSSION

Climate of the study area

The tropical monsoon climate is observed in the district. Three seasons are strongly observed in this district. The rainy season, generally stay from May to October where the rainfall stands about 90%. The winter season begins in November and ends up in February. Very dry and cold condition remains in this month and little rainfall occurs in a while. March and April are called the summer or pre-rainy season and the air stands very hot in this time. The average annual rainfall is 2687 mm. The maximum and maximum temperature is 32.5 and 13.5 °C, respectively. Extremely hot temperature (36.2 °C) is observed in April or May whereas extreme cold temperature (13 °C) is found in January. The average rainfall in winter season is 86 mm (Harun, 2004).

Ownership of studied hills

Most of the hilly areas in Chittagong were going under private sector day by day. Out of 20 hills government and private hills were as 5 and 15, respectively (Table 2). Most hills were the land area of 5-8 ha, although small (2 ha) and large hills (10-11 ha) were observed. About 90% hills showed the height of 25-30 m, although Rangamata govt. hill was quite high (45 m). From the field observation it was found that some hills under the Chittagong city corporation are in control of individual owner and company ownership. Most of the privately owned hilly areas are vanished. Private owners cut and sell soils of hills under their control and later they construct residential buildings or sell the area for commercial purposes. Some private owned hills such as Jalalabad Housing Society at Jalalabad, Khulshi Housing Project at Khukshi, and Dreamland Housing Society at Pahartali were cut and vanished. The studied hill at Selimpur govt. *Khas* hills were illegally owned by landless people for their settlement and Rangamata the govt. *Khas* hills were remained as wastage after hill cutting.

Causes of hill cutting

Hill cutting is common phenomenon in the hilly area which disrupts the environment in our country. Regarding the causes of hill cuttings 60 people responded, and each gave 5-8 such causes where 60-70% answers were similar and the summarizing with regarding studied locations (Table 3). It was found that all causes were not fit for all location, but it was found that individual settlement, establishment of real estate building, low land filling and raising of plot, low value of hill soil, and extension of urbanization were the major causes of hill cutting. Alam et al. (2005) also reviewed that seven categories of people; local terrorists, influential political leaders, truck businessmen, earth carrying contractors, owners of the brick kilns, housing estate companies and public officials, have been involved in the hill cutting

Cutting intensity and time

The hill cutting situations of studied locations of Chittagong region (Table 4). The rate of hill cutting is increasing gradually with the time. The recorded cutting areas of hill were measured from 0.7-7 ha where 2 ha observed from 6 hills, 3-5 ha from 6 hills and 7 ha from Khulshi. Percentage of hill cutting was calculated by using following formula.

$$\% \text{ of hill cutting} = \frac{\text{cutting hill area (ha)}}{\text{studied hill area (ha)}} \times 100$$

It was found that, the maximum percentage of hill cutting area was found in Chittagong city at Khulshi (63.6%) and the lowest from Lallchan bazar (33.0%). In Sitakunda, the highest percentage of hill cutting area was observed at Selimpur (50.0%) and lowest in Sonaichari (35.0%). In Hathazari the maximum percentage of hill cutting area was detected at Fatehpur (62.5%) and the lowest from Chowdury Hat (20.0%). In Fatikchari the highest percentage of hill cutting area was in Rangamata (60.0%) and the lowest in Sundaipur (30.0%). The hill cutting has been going on for the last 20 years at Pahartali and 8 years at Bayzid Bostami in Chittagong city. In Sitakunda the duration was maximum at Selimpur (10 years) and lowest at Kumira (8 years). In Hathazari the duration was maximum at Fatehpur (12 years) and lowest at Mirzapur (8 years). In Fatikchari the duration was highest at Rangamata (10 years) and lowest at Daulatpur (5 years).

Utilization of hill cutting areas

According to the questionnaire of 60 people in the study areas, 70% of the respondent informed that most of the hilly areas were utilized by real estate businessmen and 58.33% respondent informed that individual settlement also established in the hill cutting area. 51.66% respondent opined that industrial establishment also developed in hill cutting areas, 36.66% respondent identified that hill cutting areas were used for communication purpose and opinion of the 21.67% respondent it was identified that some hill cutting area remain as wastage land (Table 5). As table 5 shows, the highest rank of the utilization of hill cutting areas were planned establishment of real estate businessmen and the lowest rank was hill cutting areas remained as wastage land.

High urban population growth demands increasing housing facilities in the commercial city of Bangladesh. As a result, real estate businesses in recent times are getting high priority in the city areas. The present field survey shows that hill cutting areas are primarily used by real estate businessmen for planned settlement purposes and also by individual settler (Table 5).

Table 2
Ownership, height and area of the studied hills in Chittagong district of Bangladesh.

Study Area	Location	Ownership	Height of the studied hill (m)	Studied hill area (ha)
Chittagong City	Jalalabad	Private	30	5
	Sholoshar	Private & Govt	25	6
	Khulshi	Private	20	11
	Foy's Lake	Govt.	25	5
	Nasirabad	Private	20	4
	Pahartali	Private	20	7
	O-R Nizam road	Private	25	2.5
	Punchlish	Private	18	8
	Lallchan bazaar	Private	15	3
	Bayzid Bostami	Private	30	10
Sitakunda	Kumira	Private	20	7.5
	Sonaichari	Private	25	2
	Banshbaria	Private	22	5
	Selimpur	Govt.	25	3
Hathazari	Mirzapur	Private	25	2
	Fatehpur	Govt	30	4
	Chowdury Hat	Private	30	5
Fatikchari	Daulatpur	Private	25	8
	Sundaipur	Private	20	5
	Rangamata	Govt.	45	5

Table 3
Causes of hill cutting in 20 studied hill spots in Chittagong district of Bangladesh.

Causes of hill cutting	Location[z]
Individual settlement of people	1, 2, 3, 5, 6, 8, 10, 14, 17, 19
Establishment of residential building by real estate businessmen	1, 3, 5, 6, 7, 8, 10
Establishment of industries in hill areas	5, 7, 11, 12, 13, 14
Low land filling by hill soil and raising of plot	1, 2, 3, 4, 5, 6, 7, 8, 9, 14, 18, 20
Use of hill soil for brick kiln	1, 3, 12, 13
Selling of hill soil	9, 10, 15, 16, 19, 20
Low value of hill soil	6, 8, 9, 12, 13, 17, 18, 19, 20
Different development program by government and NGO	2, 3, 4, 6, 7, 11, 16, 17
Establishment of tourist resort	4, 6
Road construction	15
Structural development of hilly areas	1, 3, 5, 6, 10, 14, 16
Sand and stone collection from the hill	15, 18, 19, 20
Extension of urbanization	11, 12, 13, 14, 15, 16, 17
Preparation of plain land for agricultural purpose	11, 15, 16, 18, 19, 20

[z]1= Jalalabad, 2= Sholashahor, 3= Khulshi, 4= Foy's Lake, 5= Nasirabad 6= Pahartali, 7= O.R. Nizam Road, 8= Punchlish, 9= Lallchan Bazar 10= Bayzid Bostami, 11= Banshbaria, 12= Sonaichari, 13= Kumira, 14= Selimpur, 15= Mirzapur, 16= Fatehpur, 17= Choedhury Hat, 18= Daulatpur, 19= Sundaipur, and 20= Rangamata.

Table 4
Hill cutting intensity and duration in the studied area of Chittagong district of Bangladesh.

Study Area	Location	Hill cutting area (ha)	Studied hill area (ha)	% of cutting	Duration of hill cutting (year)
Chittagong City	Jalalabad	2	5	40.0	10
	Sholoshar	3	6	50.0	15
	Khulshi	7	11	63.6	15
	Foy's Lake	2	5	40.0	10
	Nasirabad	2	4	50.0	15
	Pahartali	4	7	57.1	20
	O-R Nizam road	1	2.5	40.0	12
	Punchlish	5	8	62.5	10
	Lallchan bazaar	1	3	33.0	12
	Bayzid Bostami	5	10	50.0	8
Sitakunda	Banshbaria	3	7.5	40.0	5
	Sonaichari	0.7	2	35.0	8
	Kumira	2	5	40.0	7
Hathazari	Selimpur	1.5	3	50.0	10
	Mirzapur	1	2	50.0	7
	Fatehpur	2.5	4	62.5	12
	Chowdury Hat	1	5	20.0	8
Fatikchari	Daulatpur	4	8	50.0	5
	Sundaipur	1.5	5	30.0	6
	Rangamata	2	5	60.0	10

These hill cutting areas are now using for residential and commercial purposes such as Jalalabad Housing Society in Jalalabad areas (Figure 1 A). Besides, Bangladesh Cooperative Housing Society in Bayzid Bostami, Khulshi Housing Project in Khulshi (Figure 1 B), Garibullah Housing Society in Lallchan Bazar, and Dreamland Housing Society in Pahartali (Figure 1 C) are developed through cutting of hill in those areas. For the establishment of industries the hills were cutting in Nasirabad (Figure 1 D).

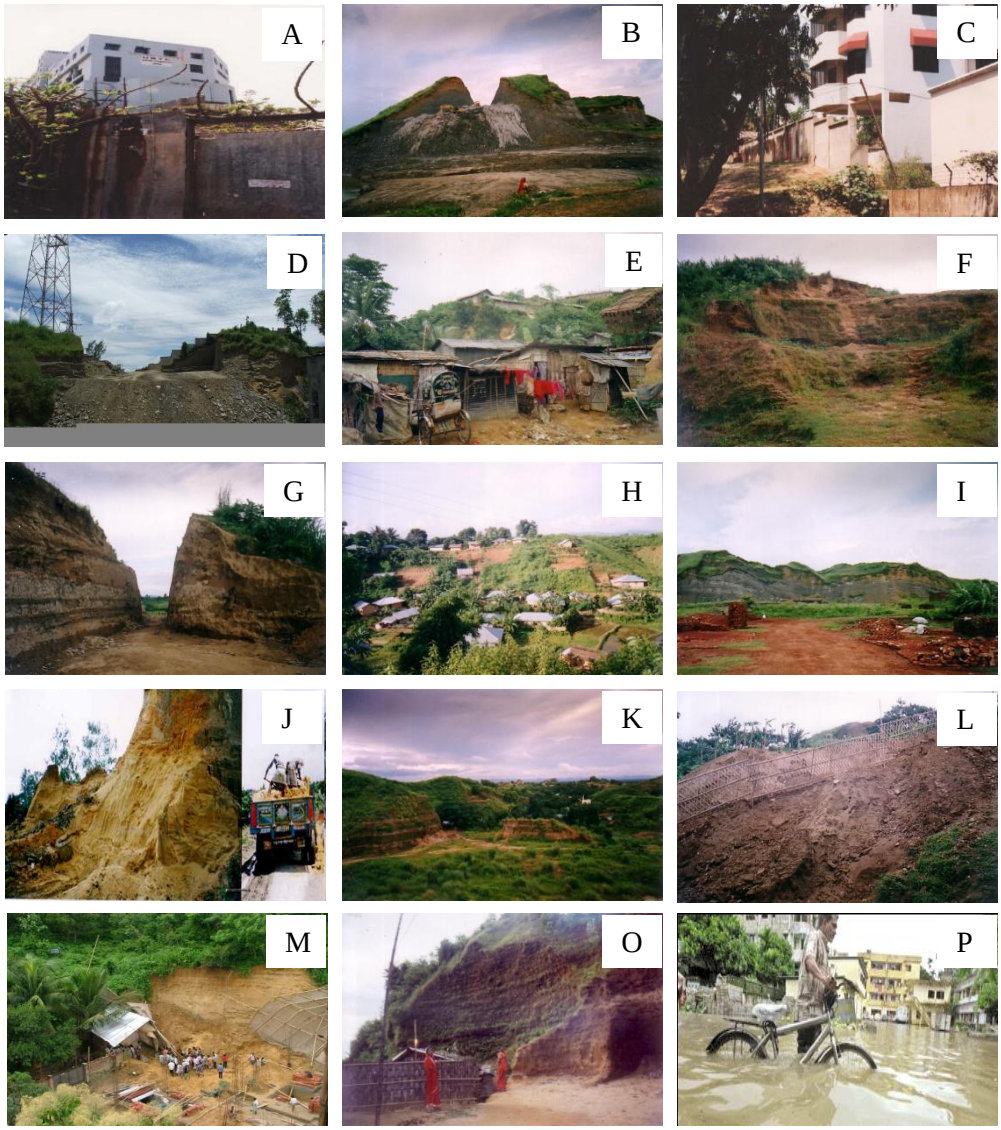

Figure 1

Utilization of hill cutting in the studied area of Chittagong district, (A) Building of Jalabad Housing Society at hill top at Jalalabad, (B) Hill were cutting to establish real estate building by Khulshi Housing Society in Khulshi, (C) Building of Dreamland Housing Society's at Pahartali was established by hill cutting plot, (D) Development of industries in Nasirabad area by degradation of hill, (E) Slum area developed at Sholashahar in Chittagong City, (F) Wastage land after hill cutting at Rangamata in Fatikchari, (G) Cutting of hill top for road construction work at Mirazapur in Hathazari, (H) Establishment of individual settlement at Selimpur hilly area in Sitakunda, (I) Hill were cutting for brick field in at Sonaichari in Sitakunda, (J) Loaded truck by hill cutting soil for selling purpose at Sundaipur, (K) Hill were cutting for making housing plot at Chowdhury Hat in Hathazari, (L) Erosion of soil at Foy's Lake areas, (M) Landslide were occurred at O. R. Nijam road due hill cutting, (N) Hill cutting area may causes for landslide at Daulatpur in Fatickchari, (O) Waterlogging condition at Bayzid Bostami in Chittagong city during rainy season.

Table 5
Utilization of hill cutting areas in Chittagong district of Bangladesh.

Nature of uses	Frequency (n= 60)	%	Rank of uses
Planned establishment by real estate businessmen	42	70.00	1
Individual settlement development	35	58.33	2
Industrial establishment	31	51.66	3
Road constructions	22	36.66	4
Wastage land	13	21.67	5

From the field observation it was found that in Sholoshahor the hilly areas authorized by railway authority and private authority. The area that are authorized by railway authority there a slum area was established (Figure 1 E). The observation was similar to Mamun (2002) who stated that the Chittagong city has got at least 12 points where hill cutting is going on unabated. The areas are Oxygen, Nasirabad, Polytechnic Institute, Sher shah Colony, Eghdnagar, Shahinagar, Hamjarbabh, Roufabad, Fatayabad, Jakir Hossain Road, Khulsi and Foy's Lake. Sixty percent of the city's hill areas, including Khulsi and Nasirabad, have already turned into residential areas. Field observation also reveals that settlements besides the hills were expanded by cutting of hill in the nearby areas. The field observation was supported by the findings of Chowhan (2002) who reported that the dimension of the Chittagong Metropolitan city is 60 square mile. Among them, 30 sq miles are hilly area, 5% hill peak is filled with multi-floored Govt. private office and residential area; 5% hills empty without forest and unutilized and rest 20% hill are under owner of private and government.

From the field survey it was also identified that cement factory in Banshbaria was established by hill cutting. Modern brick field in Sonaichari, Golden brickfield in Kumira leading to destroy of the hill of those areas. Fatehpur near of the Chittagong University the hill areas of there are going to diminish by the brick field, establishment of residential area and development of commercial sites. Rangamata in Fatikchari it was observed that hills were cut just for the selling of soil and the cut area remain as a wastage land (Figure 1 F). Cutting of hill for road construction at Mirjapur in Fatikchari was observed during the field survey (Figure 1 G). At Selimpur in Sitakunda Govt. Khas hilly area illegally owned by landless people and were established their resident through hill cutting (Figure 1 H).

Utilization of hill cutting soil

According to the personal interview of local people of the study area it was found that among the interviewees 76.77% people identified that hill cutting soil were used for raising of plots in the study areas, 63.33% of the respondent opined that hill cutting soil were also used for filling up of low lands. Hill cutting soil were used for brick kiln purpose identified by 46.67% respondent, 40.00% respondent opined that road construction was another utilization of soil and 18.33% respondent marked that hill were cutting for selling of soil (Table 6).

Field surveys indicate that hill cutting soil are mainly used for raising residential plot, filling up low lands roads construction and brick kiln purposes (Table 6). Some hilly areas had already been destroyed in developing residential areas while the rest of the hills are gradually being destroyed for the same purpose. The brick kilns in and around the Chittagong city are using soil of hill cutting. Golden brick field at Goramara in Sonaichari involved in hill cutting with the help of local terrorist and destroy the hill for utilization of hill cutting soil for brick kiln purpose (Figure 1 I).

Table 6
Types of uses of hill cutting soil in Chittagong.

Nature of uses	Frequency (n=60)	%	Rank of uses
Raising plot areas	46	76.67	1
Filling up of low lands	38	63.33	2
Brick kilns	28	46.67	3
Road constructions	24	40.00	4
Selling purpose	11	18.33	5
Other	5	8.33	6

Chowdhury (2003**)** also reviewed that brick field is an important cause of hill cutting and environmental degradation in Chittagong. Many of the brick fields in the city and around the city are illegally established. In Pahartali there are 30 brick field those are completely depend on the hill cutting soil. At Sundaipur in Fatikchari hill were cutting for the selling purpose of hill soil (Figure 1 J). Rising of plot and the high value of plain land was also a cause of hill cutting in Chowdhury Hat (Figure 1 K). The situation was same at Kumira, Fatehpur. During the field investigation, it was observed that brick kiln and hill cutting are going hand by hand in the studied hilly areas.

Biodiversity of plants

The hill areas are the natural source/ main sources of plant. In the study area there are two types of forest were found such as tropical moist evergreen and tropical semi evergreen. Data of woody plants, fruit plants, medicinal plant, and rare and endangered plants were collected during the field survey.

Biodiversity of woody plants

A total number of 25 timber yielding plants were recorded under 11 families (Table 7). Dipterocarpaceae and Meliaceae (5 species) has the highest number of timber yielding plants followed by Moraceae, Lythraceae, Celastraceae, Papilionaceae and Rubiaceae with single genus of single species. Through the degradation of hill by cutting, tree felling, use of tree in brickfield, timber business were the causes of biodiversity depletion of the studied area.

Biodiversity of fruit plants

From 20 hill regions studied a total number of 19 fruit yielding plants were recorded under 13 families (Table 8). Anacadiaceae has the highest number of fruit yielding plants. The common fruit plants were mango, kanthal, jam, amra, coconut, and jalpai. As there was no knowledge for the importance of fruit plants and lacking of fruit plant conservation plan, the status of fruit plant biodiversity become poor.

Table 7
List of woody plant species observed from 20 studied hill spots in Chittagong district of Bangladesh.

Common name	Scientific name	Family
Baitta garjan	*Dipterocarpus scabber*	Dipterocarpaceae
Telia	Dipterocarpis	Dipterocarpaceae
Dhulia	Dipterocarpis.	Dipterocarpaceae
Telsur	Hopea odorata	Dipterocarpaceae
Boilum	Anisoptera scapula	Dipterocarpaceae
Bara	Swietenia	Meliaceae
Choto	Swietenia	Meliaceae
Chickrashi	*Chickrassia*	Meliaceae
Rangi/Toon	Toona ciliata	Meliaceae
Pitalj	*Aphanomixis*	Meliaceae
Sil koroi	Albizia procera	Mimosaceae
Kalakoroi	Albizia lebbeck	Mimosaceae
Sesra Koroi	Albizia Chinensis	Mimosaceae
Raintree	Albizia precera	Mimosaceae
Civit	Swintonia	Anacardiaceae
Bhadi	*Lannea*	Anacardiaceae
Chapalish	Artocaropus	Moraceae
Teak	Tectona grandis	Verbenaceae
Gamar	Gmelina arborea	Verbenaceae
Simul	*Bombav ceiba*	Bombaceae
Burma	*Ceiba pentandra*	Bombaceae
Lohakat	*Zylia dolabiformis*	Papilionaceae
Raktan	*Lophopetalum*	Celastraceae
Jarul	*Lagerstroemia*	Lythraceae
Kadam	*Anthocephalus*	Rubiaceae

Biodiversity of medicinal plants

From the 20 hill spots studied, a total number of 16 medicinal plants were recorded under 11 families (Table 9). Meliaceae and Combretaceae have the highest number of medicinal plants (3 species). The most common medicinal plants were neem, horitoki, bohera, champa, sonalu, arjun etc.The medicinal plants of the studied area was become endangered due to poor knowledge for the conservation of medicinal plant to the local people. BFRI in Chittagong has taken conservation plan for the medicinal plants.

Table 8
List of fruit plants observed from 20 studied hill spots in Chittagong district of Bangladesh.

Common name	Scientific name	Family
Mango	*Mangifera indica*	Anacardiaceae
Jangliam	*Mangifera sylvatica*	Anacardiaceae
Amra	*Spondias pinnata*	Anacardiaceae
Jam	*Syzygium cumini*	Myrtaceae
Dhkijam	*Syzygum gaunde*	Myrtaceae
Jamrul	*Syzygium samrangense*	Myrtaceae
Amloki	*Phyllanthus embelica*	Euphorbiaceae
Kanthal	*Artocarpus heterophyllus*	Moraceae
Dewa	*Artocarpus lacucha*	Moraceae
Khejur	*Phoenix sylvestris*	Palmae
Coconut	*Cocos nucifera*	Palmae
Jalpai	*Elaeocarpus floribundus*	Elaeocarpaceae
Boroi	*Zizyphus jujiba*	Rhamnaceae
Gab (Deshi)	*Diospyros peregrine*	Ebenaceae
Gab (Bilati)	*Diospyros discolor*	Ebenaceae
Chalta	*Dillenia indica*	Dilleniaceae
Katbadam	*Terminalia catappa*	Combrefaceae
Litchi	*Litchi*	Sapindaceae
Hargoza	*Dillenia pentagvna*	Vitaceae

Rare and endangered plants

From the 20 observations it was found that a number of plant species has become endangered in the study area (Table 10). Medicinal plants, woody plants and also fruit plants have in the list of rare and endangered plant species.

Effect of hill cutting on environment

According to the answers of the respondent it was found that the environment of Chittagong was degraded day by day through hill cutting. Among the respondent maximum respondent (86.67%) opined that deforestation was the major environmental problem created by hill cutting (Table 11). 75.00% respondent opined that cutting of hill accelerate declination of wild life species. 50-60% respondent opinion was that land erosion and landslide/ human injuries, and drainage congestion increased by hill cutting. 20-35% respondent opined that silting of low areas, ponds, lake and rivers, loss of natural beauty, natural disaster also increased respectively through hill cutting. Only 8.33% respondent opined that health problems also created by hill cutting (Table 11). On the basis of ranking of effect of hill cutting deforestation was in rank one. The present conditions of the hilly area are very dangerous for plants. Many plants are going to disappeared from the hilly area. Establishment of resident, industries, brickfield, selling of soil, the studied hill areas Chittagong has become in endangered condition for the plants

Table 9
List of medicinal plants observed from 20 hill regions in Chittagong district of Bangladesh.

Common name	Scientific name	Family
Neem	*Azadirachta indica*	Meliaceae
Goraneem	*Melia azedavach*	Meliaceae
Bokain	*Melia sempervirens*	Meliaceae
Arjun	*Terminalia arjuna*	Combretaceae
Bohera	*Termindia bellirica*	Combretaceae
Horitoki	*Termindia chebula*	Combretaceae
Sonalu	*Cassia fistula*	Caesalpinaceae
Pituli-pata	*Pheynium imbricum*	Marantaceae
Ghritakumari	*Aloe barbadensis*	Lilieceae
Ulat-chandal	*Gloriosa superba*	Lilieceae
Sarpogandha	*Rauwolfia serpentina*	Apocynaceae
Chatim	*Alstonia*	Apocynacae
Moniraj	*Cycas pectinata*	Cycadaceae
Nageshwarchapa	*Messua ferria*	Guttiferae
Raktapadk	*Pterocarpus santalinus*	Papilionaceae
Champa	Michelia	Mimosaceae

Table 10
List of rare and endangered plant species observed from 20 studied hill spots in Chittagong district of Bangladesh.

Common name	Scientific name	Family
Chikrassia	*Chickrassia tabularis*	Meliaceae
Pitraj	*Aphanomixis Polystastachya*	Meliaceae
Telsur	Hopea odorata	Dipterocarpacea
Civit	Swintonia	Anacardiaceae
Jangli am	*Mangifera*	Anacardiaceae
Ghritakumari	*Aloe barbadensis*	Lilieceae
Ulat-chandal	*Gloriosa superba*	Lilieceae
Agar	*Aquilaria agallocha*	Thymelaceae
Mohua	*Bassia latifolia*	Sapotaceae
Tamal	*Diospyros cordifolia*	Ebenaceae
Moniraj	*Cycas pectinata*	Cycadaceae
Nagershwarchapa	*Messua ferria*	Guttiferae
Sarpogandha	*Rauwolfia serpentina*	Apocynaceae
Pituli-pata	*Pheynium imbricum*	Marantaceae
Hargoza	*Dillenia pentagvna*	Vitaceae
Lohakat	*Zylia dolabiformis*	Papilionaceae

From the field observation it was found that many plant species have disappeared from the studied hill areas (Table 12). It was found that Telia garjan, Civit, Chapalish, Chatim, Chickrashi, Bohera, Telsur were the major plant species disappeared from the studied areas. Local people opined that many plant species already decreased in the Khulshi, Pahartali, Foy's Lake, Sonaichari, Kumira, Banshbaria, Fatehpur, Chowdury Hat, Daulatpur, Mirzapur, Rangamata areas due to loss of hills. According to the opinion of local people once the hilly areas was full of forest resources with many woody plants, fruit and medicinal trees. Due to loss of dense forest areas, medicinal species of plants were lost in the district of Chittagong. Thus it seems that hill cutting is accelerating ecological imbalance in the region.

According to the respondent (75%) it was found that wildlife decreased markedly (Table 11). Local people of the studied hill areas at Khulshi, Pahartali, Foy's Lake, Sonaichari, Kumira, Banshbaria, Fatehpur, Chowdury Hat, Daulatpur, Mirzapur, Rangamata, Selimpur, Sundaipur areas opined that due to loss of hills some wildlife were extinct. Few years ago the hilly areas was full of forest resources with wildlife habitat. From the opinion of local people of the study area, discussion with local environmental journalist, consultation with a professor of Geography department of Chittagong University it was informed that due to loss of dense forest areas wild life species were lost in the area of Chittagong

Table 11.
Environmental degradation through hill cutting in the studied hill areas in Chittagong district of Bangladesh.

Nature of degradation	Frequency (n=60)	Percentage	Rank of degradation
Deforestation	52	86.67	1
Decline of wild life species	45	75.00	2
Land erosion and landslide/human injuries	36	60.00	3
Drainage congestion	32	53.33	4
Silting of low areas, ponds, lake and rivers	21	35.00	5
Loss of natural beauty	14	23.33	6
Natural disaster (Flood, tidal surge, earthquake)	12	20.00	7
Social problems (Quarrel, eviction, social unrest)	8	13.33	8
Health problems (etching, diarrhea and nerve problems)	5	8.33	9

Table 12
Disappeared plant species from the studied hill area in Chittagong district of Bangladesh.

Study Area	Location	Disappeared plant species in hill cutting areas
Chittagong City	Jalalabad	Champa,Telsur, Chapalish, Sil koroi, Chickrashi, Ghritakumari, Somraj, Ulatchandal, Mango, Jackfruit
	Sholoshar	Champa, Telsur, Chapalish, Sil koroi Chickrashi, Jackfruit, Mango, Mehogoni
	Khulshi	Raktan, Jarul, Dhakijam, Pitali, Gamar, Dumur, Jakfruit, Sarpogonda, Pitraj
	Foy's Lake	Raktan, Jarul, Dhakijam, Dumur, Chatim, Amra, Bohera, Jackfruit, Gora neem, Arjun
	Nasirabad	Simul, Dewa, Hargoza, Amloki, Gamar, Dumur, Menda, Boilum
	Pahartali	Dhakijam, Chapalish, Sil koroi, Haldu, Hargoza, Udal, Sarpogondha
	O-R Nizam road	Bohera, Amra, Dewa, Hargoza, Chapalish, Coconut, Mango
	Punchlish	Chapalish, Jarul, Chatim, Menda, Gamar, Chickrashi, Ulatchandal
	Lallchan bazaar	Baitta garjan, Telia garjan, Dhulia garjan, Raktan, Hargoza, Udal, Sarpogonda, Moniraj
	Bayzid Bostami	Chatim, Jarul, Haldu, Dhakijam, Champa, Boilum, Ulatchandal, Jangli am
Sitakunda	Banshbaria	Telia garjan, Dhulia garjan, Sheora, Jarul, Chickrashi, Telsur, Civit
	Sonaichari	Telia garjan, Sheora, Jarul, Chickrashi, Telsur, Dumur, Bohera, Chatim
	Kumira	Telia garjan, Dhulia garjan, Sheora, Jarul, Chickrashi, Telsur, Civit , Sarpogandha, Tamal, Hargoza
	Selimpur	Telia garjan, Dhulia garjan, Sheora, Jarul, Chickrashi, Telsur, Civit
Hathazari	Mirzapur	Telsur, Civit, Telia garjan, Chapalish, Gamar, Chickrashi, Kamdeb, Raintree, Lohakat, Pitraj
	Fatehpur	Chapalish, Dhakijam, Telsur, Kanak, Dhulia Garjan, Champa, Horitoki, Bohera
	Chowdury Hat	Civit, Sil koroi, Dumur, Gamar, Jarul, Jhau, Telia garjan, Chickrashi, Kadam
Fatikchari	Daulatpur	Telia garjan, Dhulia garjan, Sheora, Jarul, Chickrashi, Telsur, Civit
	Sundaipur	Jarul, Chickrashi, Telsur, Dumur, Bohera, Chatim, Telia garjan
	Rangamata	Dhulia garjan, Jarul, Telsur, Chickrashi, Civit, Udal, Hargoza

Bengal leopard cat, Jungle cat, Leopard, Monkey, Tiger, White elephant, rock python, Indian alligator, cobra are going to be disappeared from the hill area. Thus it seems that hill cutting is accelerating ecological imbalance in the Chittagong. Islam (2003) also reviewed that it is now dream to the people of Chittagong that once the region was habitat of Tiger, Monkey, Cobra, White elephant, Python etc. The food chain of the region are breaking down which accelerate the ecological imbalance of the region.

It was reported by local people (60% respondent) that soil erosion in hill cutting areas were a major problem for the environment of Chittagong (Table 11). They opined that due to hill cutting the areas were remained exposed to the wind, rain flash etc. and the land were susceptible for the degradation.

The erosion of soil depend some factors and hill cutting facilitate this factor for erosion. The slope of the studied hill area was 30-45^0 which can easily drain out the water from the hill. But due to the hill cutting the covered vegetations of hill were destroyed. The condition of soil erosion were in dangerous condition at the study area of Jalalabad, Foy's Lake (Figure 1 L), Khulshi , Pahartali, O-R Nizam road, Sonaichari, Kumira, Fatehpur, Rangamata.

Landslide was another problem reported by respondent (60%) which was mainly created by hill cutting. According to the source of Alam et al. (2005) last 7 years (1998-2004) there were 89 people was died and 408 people were injured by landslide in Chittagong (Table 13). It was found that the number of death and injured people with time. The highest number of people died and injured in the year of 2004 and 2003 respectively (Figure 2)

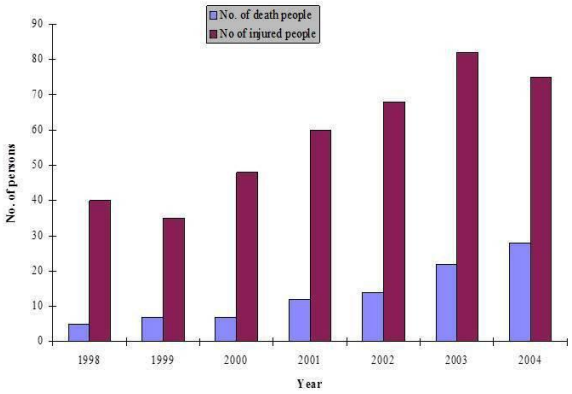

Figure 2
Graphical presentation of affected people by landslide in Chittagong.

Table 13
Affected people by landslide in Chittagong during 1998-2004.

Year	No. of death people	Total	No of injured people	Total
1998	5		40	
1999	7		35	
2000	7		48	
2001	12	89	60	408
2002	14		68	
2003	22		82	
2004	28		75	

Table 14
Filled up ponds from 20 studied areas in Chittagong district of Bangladesh.

Study Area	Location	No. of filled up ponds	Total
Chittagong City	Jalalabad	5	25
	Sholoshar	4	
	Khulshi	4	
	Foy's Lake	3	
	Nasirabad	2	
	Pahartali	4	
	O-R Nizam	-	
	Punchlish	2	
	Lallchan	-	
	Bayzid Bostami	2	
Sitakunda	Banshbaria	3	8
	Sonaichari	-	
	Kumira	3	
	Selimpur	2	
Hathazari	Mirzapur	-	7
	Fatehpur	6	
	Chowdury Hat	2	
Fatikchari	Daulatpur	3	4
	Sundaipur	1	
	Rangamata	-	
		Total =	44

In the study area of Pahartali, Jalalabad, O-R Nizam road (Figure 1 M), Lallchan bazaar, Nasirabad, Kumira, Banshbaria, Selimpur, Chowdury Hat, Mirzapur, Fatehpur, Rangamata, Daulatpur (Figure 1 N) due to the hill cutting the slope of the hill was become 90^0. In rainy season gravitational force to the land causes landslide. Local people of the survey areas opined that the death and injury cases of hilly area by landslide were created by hill cutting. The view of local people was that cutting of hill create a trap for injuries or death.

During the field survey it was reported by the respondent (53.33%) that the drainage congestion in the city areas was resulted by eroded hill cutting soil (Table 11). There were open drainage system in Chittagong city and they are connected with five lakes of the city. The studied hills of the O.R. Nizam Road, Foy's lake, Bayzid Bostami, Lallchan bazar, Sholoshar, Pahartali, Khulshi,

Punchlish were a remarkable example of partly hill cutting area and in the rainy season soil erosion from this cutting area were filling up the drainage and sewage system of the city and causing water logging condition during the rainy season (Figure. 1 O). Khan et al. (1996**)** reviewed that there are 780 km sewage drain in Chittagong port city faces a chronic water logging in most of its parts as drains are silted by file sands and mud flowing from hills during the rainy season, Chittagong City Corporation has to engage its people to collect huge sands from the city drains.

From the opinion of local people it was found that about 44 ponds in the study areas were found filled up due to hill cutting problem. The highest numbers (25) of ponds were filled up in the city areas (Table 14). These ponds had been using for fire fighting in the city for long time. Ponds, lake, marshy areas and rivers in and around the city were filled up by hill cutting soil. Alam, et al., (2005) also stated that over the last forty years, about fifty ponds, a number of canals and a few marshy areas have been filled up by hill cutting soil in the city of Chittagong.

From the field survey it was found that lakes, chanel, rivers of the studied areas were faced siltation problem through hill cutting soil (Table 15). There were five lakes in Chittagong city such as Majirghat lake, Namunabazar lake, Monohorkhali lake, Firingibazar lake and Chaktai lake and all of the lake directly connected with the Karnafuly river. Besides, soil erosion was another common problem in these partly hill cutting areas. Thereafter the silt was going to the Karnafuly river and the navigability of the river decreasing which was threatened for the ship movement in Karnafuly Chanel. In Sitakunda the eroded hill cutting soil from the Banshbaria, Sonaichari, Kumira, Selimpur were going to the Swandip channel which were degrading the aquatic habitat of this channel. It was also observed during the field survey that Sitakunda Paurasava were also affected by the eroded hill cutting soil in rainy season due to the fill up of drainage and sewage system. Water condition was the major problem in rainy season. Halda river of Hathazari was losing its navigability by siltation of the river from the eroded soil of Mirzapur, Fatehpur, Chowdury Hat hill cutting area. Poragoli, Jalalabad hills, Rajbaijja hillock Nochoinnah hillock canal were also degraded by the eroded soil from the hill cutting area (Table 15). From the field survey the similar result was found in Fatikchari, Dhurung river were losing its navigability by siltation of the river from the eroded soil of the hill cutting area.

Table 15
Affected lakes, channels, and river by siltation in Chittagong through hill cutting soil.

Study Area	Silted lakes/chanel	Silted river
Chittagong City	Majirghat lake, Namunabazar lake,	Karnafuly river
Sitakunda	Swandip chanel	-
Hathazari	Poragoli canal, Jalalabad canal, Rajbaijja hillock canal, Nochoinnah hillock canal	Halda river
Fatikchari	-	Dhurung river

According to the answers of the respondent (23.33%) it was found that the natural beauty of the areas was degraded with time (Table 11). They opined that once the hill areas were a great source of plants and animals. The green hill was the main beauty of this region. But due to hill cutting the areas were lost many plant species (Table 12). The scenic beauty of this region was depleted with the degradation of hill.

Frequency and intensity of natural disasters in the Chittagong district also increases due to lost of hilly areas and vegetation. The hill of the study area was a barrier of natural disaster such as earthquake, tidal surge, cyclone etc (Hossne, 2002). The opinion of local people was that due to the filled up of Karnafuly river, Dhurung river, Halda river of the study area by siltation of eroded of hill soil (Table 15). According to the opinion of local people the areas were affected by tidal surge, flash flood certainly. The aged and conscious local people opined that in some areas climatic change resulted from the loss of hilly areas and natural vegetation and is adding to the city's temperature day by day. In recent years, severity of cold and heat has increased due to loss of hill and vegetations. Islam (1999) also stated that about 20 sq. miles are flooded at low rainfall due to hill cutting and 6 lakh peoples are victimed of flood. The flow of Karnaphully river has been decreasing due to storage of hill cutting soil. Excessive

storage of sand and soil in river water, the productions of chemical workshop and engineering workshop are facing obstruction. The Bangladesh Observer, 2004 reported that the hill ranges that stretches from Mirersharai to Teknaf are not only the bounties of nature but also physical barriers against natural disasters like earthquake, cyclone and tidal surge.

Among the respondent 13.33% respondent reported that there were a group of people who conduct hill cutting in Chittagong district. They opined that sometimes quarrels occurred among power groups and day laborers during hill cutting. In some cases affluent group conflict to capture hilly areas for the need of soil and low economic class fight with each other for their residential needs after hill cutting is done. Besides, hill cutting also creates social unrest, quarrel, eviction that was reported by local people (Table 11).

Among the respondent 8.33% of respondent of the studied area reported that sometimes hill cutting also causes health problems on the basis of utilization of the cutting areas. They opined that hill cutting soil were used for the raw materials of brick kilns that unhealthy brick kilns in turn pollutes environment in the surrounding areas. According the opinion of local people it was find out that the inhabitants residing the neighboring brick kilns are faces serious health disasters. The local people opined that polluting brick kiln's environment creates etching, diarrhea and nerve problems in these areas (Table 11). The local people of Nasirabad, Zalabad, Sonaichari, Kumira, Fatehpur, are facing these health problems. From the field survey it was found that the brick fields at Kumira, Sonaichari, Fatehpur, and cement industries in Banshbaria are destroying the hill environment causes pollution of the area which creates health disaster to the local people.

CONCLUSION

It can be concluded that hill cutting situation was going to unabated gradually with the time. The private ownership hills were highly vulnerable. Hills were cutting for various purposes where human settlements, establishment of industries, brickfields, low land filling were the major causes reported by the maximum respondent. The degradation through hill cutting was harmful for plant and animal biodiversity. Many plants and wildlife species disappeared from the study areas. Most of the respondents opined that deforestation of the areas were the result of hill cutting. Through the siltation of drainage system, ponds, lakes, canal, river it created a threatened problem for the environment. Landslide, natural disaster, health hazards and loss of natural beauty also caused by hill cutting. A number of people lost their life by landslide from the study areas. So, hill cutting is a major environmental issue of the studied areas. To check the environmental degradation it is necessary to stop the hill cutting.

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