

CHAPTER ONE

INTRODUCTION

1.1. Background

Chittagong is the second largest city of Bangladesh located by the Bay of Bengal in the eastern part of the country. This city is vital because of the three reasons; i) port ii) district headquarter iii) metropolitan city. Due to its port and other facilities the people of rural areas are always agglomerated in the city for employment opportunities and thus the city population is increasing at a growth rate of 1.57% (BBS, 2006). As a result the land price of the city is increasing for which the residential cost is increasing that ultimately makes its impact on society. As the city terrain is undulated and the major hills of the country are located in this region there is no specific regulation for housing development in hillside in the Chittagong master plan which force migrated people to live in the hill side (Begum, 2007). Rural to urban migration comprises a major proportion of the urban workforce, but most of the migrants cannot afford to buy land in safer areas, find few or no alternate formal settlements, and no government programs to provide shelter to the poor segment of urban population. As the majority of those people are illiterate, poverty makes them to cause environmental degradation. For the settlement development these people are cutting hills and forests for residential area development, which is a major cause of land slide in Chittagong. Although there is some other manmade and natural reasons which are responsible for landslide in Chittagong. These landslides and other forms of ground failure affect communities all across in Chittagong. Despite advances in science and technology, these events continue to result in human suffering, millions of dollars in property losses, and environmental degradation (Rahman, 1985). As our population increases and our society become ever more complex, the economic and societal costs of landslides and other ground failures will continue to rise. And this research particular pays attention to support slum dwellers and community organizations in building and diversifying their asset bases. This research also tries to incorporate the policy measures in the context of urban development and draw some rules and regulations for the relocations of the slum dwellers for the better housing process.

1.2. Literature review

Shelter is a basic human requirement that enhances human capital to the extent that it can be an asset, not merely for the individual and the house-hold, but also for the nation. Faced with the constraints on suitable and affordable land, most urban dwellers are unable to afford decent living

quarters. The rapid growth of population, the mushrooming of poor settlements and unplanned urbanization have crucial implications for the efficiency and equity of urban services. The critical human rights throw into focus the importance of housing as a social policy issue. Urban management has been disrupted as a result of spatial encroachment and environmental degradation. The dearth of valuable urban land, together with delays in urban planning and its implementation, have made the acquisition of land for housing prohibitively expensive for slum dwellers consequently, the quality of the housing environment is deteriorating. The concern here is not with the level of urbanization but with its impact on human welfare. The major physical problem confronting urban areas in Bangladesh today is the spread of slums. The urban poor tend to settle in slum areas with minimum urban amenities, often unfit for human habitation. In Bangladesh the slums are known as **Busteas** (squatter settlements). There are 4,341 slums in Chittagong in 1994. According to one estimate, squatters constituted about 7% of the immigrants in Chittagong in 1994 (UN-Habitat, 2007). Although slum-dwellers constitute a huge mass globally or forms majority in many urban areas throughout the developing countries, they barely gain any constructive attention from policy makers and city authorities in respect of disaster mitigation. Disasters turn back the development cycle, destroying years of effort and labor and perpetuating poverty for those already poor. Governments of urbanizing countries may have entirely different ministries responsible for emergency management and urban development, one with little knowledge of the other's activities. India's Ministry of Urban Affairs' 1999 Draft National Slum Policy makes no reference at all to the vulnerability of slum dwellers to natural disaster. Yet an estimated 1 % of India's total housing stock is destroyed by natural disaster each year (Ministry of Urban Affairs and Employment, 1999, 21).

Similarly, in many developing countries national disaster management strategies often omit urban settlements (Sanderson, 2000). In Bangladesh, there are no separate policy measures for urban disaster management specially emphasizing on the vulnerability of the urban poor. An underlying problem, however, is that many official disaster management organizations remain seriously under resourced, with little political or legislative support and almost no funds. In his study of national early warning systems, *Andrew Maskrey* concludes that **'even when national disaster management systems have been formally created, good co-ordination between different government and other organizations does not necessarily exist, leading to confusion, contradictions, overlapping functions, and gaps in responsibility'** (Maskrey,1997). Whilst the separation between city and disaster management continues, and the latter remains weak, valuable opportunities for reducing urban risks are often lost. The inevitable consequences of authorities allowing the building on unsafe hillsides or in flood prone areas will remain largely ignored until

disaster strikes. For example, the 2006 flash flood and mud sliding in Chittagong (Chittagong is the second largest city of Bangladesh located by the Bay of Bengal in the eastern part of the country) that left more than 30 people dead was a sort of wakening call for the city administration that barely bothered before to control construction of low income houses and slums on the hills.

1.2.1. Review based on research issues

Vulnerability: Vulnerability is the characteristics for a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. It involves a combination of factors that determine the degree to which someone's life and livelihood is put in at risk by a discrete and identifiable event in nature or in a society (Blaikie et. al. 1994). Vulnerability needs to allow for the identification of differential effects on various categories of the population considering the expansion of risk. Vulnerability also interacts with the social, economical and political issues which are also responsible to determine that who are vulnerable according to their safety and security. Vulnerability in urban areas has generally been equated with poverty (Hamza and Zetter, 1998). On the other hand, and as far as urban areas are concerned, **Anderson (1992)** explains vulnerability of slum areas in terms of **three characteristics**: i) those which result from the concentrations of people and activities in defined and limited space; ii) those which result from the sheer numbers of people and activities; and iii) those which result from proximity to human-made hazards. Concentration of people and activities on safe sites is not a source of vulnerability. But, the unequal distribution of resources, the marginalization of segments of the population and informal activities, and their exclusion from planned and serviced areas, is what forces people on unsafe sites; and then vulnerability is a consequence.

Vulnerability assessment requires contextual analysis of complex and multifaceted factors. **In this research the vulnerability is measured in terms of physical and socio economic aspects which consider the issue of poverty that is accelerated by hazards.**

Slum dwellers: Urban Slum-dwellers are those poor are living in slums. Slums are ill repaired and neglected infrastructures where the communication and physical comforts are poorly supplied with social services and welfare to deal with the needs and problems of families who are the victims of biological, psychological and social consequences of physical and social environment (Rahman, 1985). The socio-economic conditions and deprivation prevailing in the places of their origin often force them to leave their homes.

Particular operational definition for this research of slum dwellers is those who live in the hillside or that houses which are located in the hill shade.

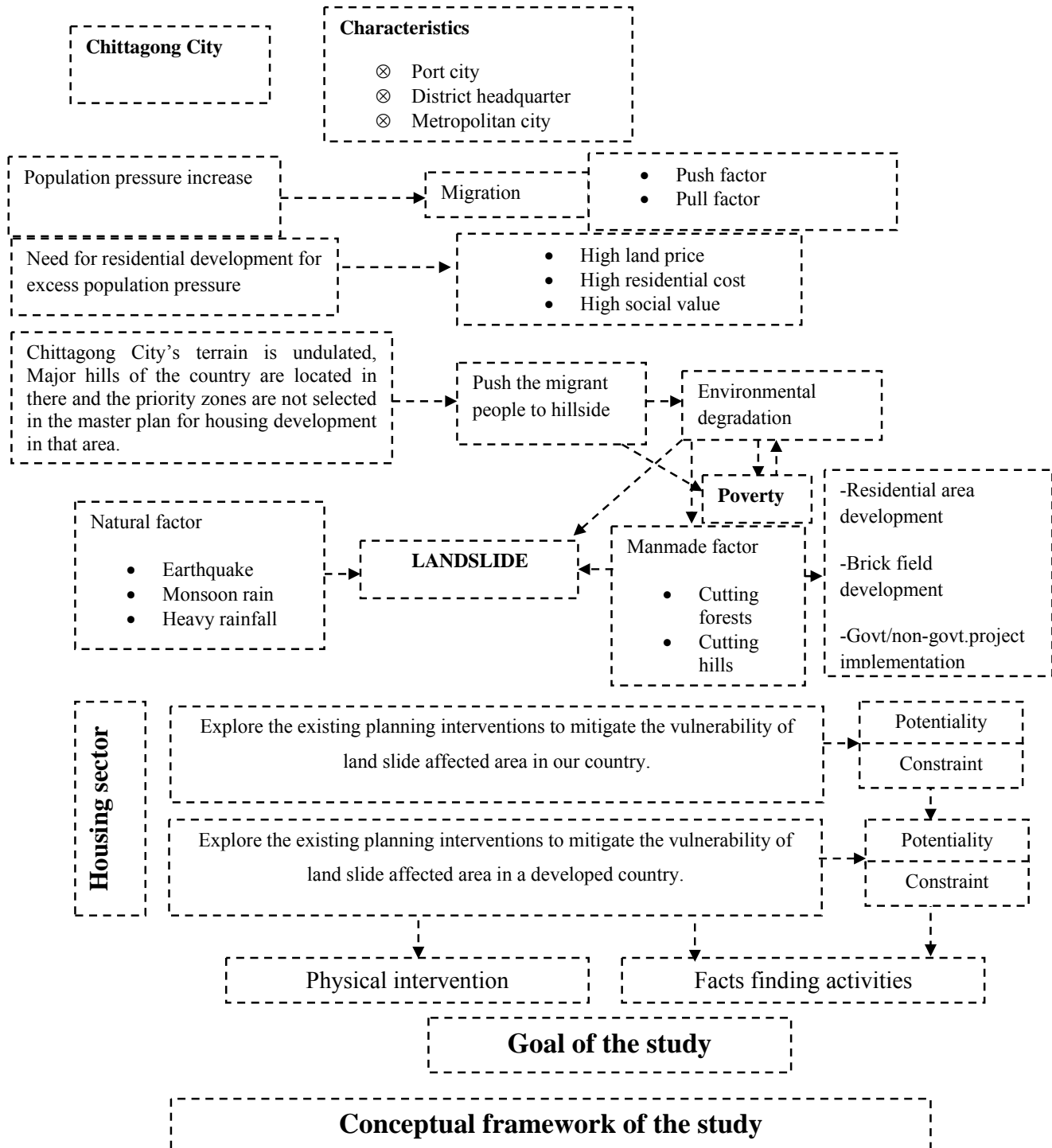
Landslide: A type of mass movement in which the materials displaced retained its coherence as a single body as it moves over a clearly defined plane of sliding (<http://landslides.usgs.gov>). Landslide is often promoted by large accumulation of soil water from rainfall, spring, or melting snow. This adds to the weight of the sliding mass and as pore water pressure increases- reduces friction between constituent particles; the latter is especially important when the sliding mass comprises weathered materials resting on a sub-stratum of clay.

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, June 18, 2007).

From the review it is clear that appropriate policies should be adopted to settle the potential rural-to-urban migrants at their places of origin by generating economic activities and creating employment opportunities, especially during slack agricultural seasons. The strategy should be to render assistance to the poor and the under-privileged to enable them to secure a fair share of the benefits of development and become self-reliant and responsible members of society. Within this strategy, community development will have an important role to play, both in the urban setting, where the problems and possibilities of community development need to be further explored and in the rural areas, where it can have a significant role in programmes designed to halt the unplanned drift to the city.

1.3. Conceptual framework

The conceptual framework of the study is given below:



But to achieve the goal, the research has to face some limitations and these are given below:

- Chittagong is the only city of Bangladesh which has a unique topography guided by hills. So it understandable that there is a few research work on hills or hill cutting.
- In the rainy season when landslide takes place a number of reports are seen to be published in the different news papers. These reports are published basically to criticize concerned authorities regarding their negligence. But fruitful research work on hill cutting is almost merely seen.
- Another important limitation is the unavailability of the maps of hills of different period and in case of response many people strongly opposed to answer the questionnaire despite assurance of hiding their address. Hill owners did not respond to a single question of the researcher. Bureaucratic dilemma often interrupted the process of data collection.

1.4. Research gap

In an article of “**Slope Stability problems of the Chittagong University Campus**” By Khondoker Mosharraf Hossain and Dilip Kumar Dutta reveals a purely technical approach to the solution of the technical problems of the hills stabilization. The literature depicted on the structural solutions of protecting slopes developed by hill cutting for building construction purpose. The University of Chittagong is situated purely in the hilly region. Many buildings or part of the buildings were constructed in the site created by hill cutting. In course of time, these hills created problems of soil erosion. The writers, in their article, tried to give some engineering solutions to the soil erosion. But the subject of hill cutting was not discussed from researcher’s point of view.

Again in an article of “**Degradation of Urban Environment: A case study of Citizen’s perception in Chittagong City (2001)**” By Md. Maksudur Rahman, Ashraf M. Dewan and Md. Shahidul Islam, they discuss the environmental issues related to urbanization process of the city of Chittagong. The article mainly discussed the extent of the environmental degradation. The subject matter of hill cutting has been discussed in very few words to show this as one of the causes of environmental degradation. The use of hills has been described as the problems with some examples. The impact of hill cutting is not discussed elaborately.

In her unpublished Thesis work “**The Nature and the Development of Residential Use of Chittagong City (2002)**”**Mousumi Zahur** tried to describe the process of residential development in the city. She categorized the residential area on the basis of the topographic character of the city.

Accordingly, she pointed out some of the residential areas those were developed in the hilly terrain. She also criticized the trend of residential development as to why should this kind of development not be done in some specific areas. The impact of hill cutting or its social aspects were not discussed in her thesis.

The Chittagong Journalists Forum publishes the article “**Development of Chittagong by conserving its natural environment-Our responsibility.**” of **Mr. Ali Ashraf, Chairman, Institution of Engineers (IEB), Chittagong**, where he discussed about the disasters experienced by the people due to landslides caused by hill cutting with many pictorial illustrations. He tried to show hill cutting is a social problem in his writing; but citing the example of a road near Polo Ground area and local court building constructed on the hilly land in the imperial period, he suggested the people to be honest to the use of hills.

In an article of “**Socioeconomic Vulnerability and Adaptation to Environmental Risk: A Case Study of Climate Change and Flooding in Bangladesh**” by **Roy Brouwer, Sonia Akter, Luke Brander, and Enamul Haque**, they investigate the complex relationship between environmental risk, poverty, and vulnerability in a case study carried out in one of the poorest and most flood-prone countries in the world, focusing on household and community vulnerability and adaptive coping mechanisms. Based upon the steadily growing amount of literature in this field they develop and test their own analytical model which totally neglects the environmental degradation of the slum dwellers and their livelihood pattern.

Again in the article of “**Urbanization and the Problem of Slums in Bangladesh**” by **Habibur Rahman**, He emphasizes the increasing urbanization and the rate of urbanization is accelerated by rural-urban migration due to the operation of 'push' and 'pull' factors, he also ignores the sustainable and adequate access to income and other resources for the slum dwellers to meet basic needs and to build up assets to withstand shocks and stresses.

From the research work it is clear that the following things are absent in our country for landslide vulnerability mitigation and response; these are given below:

Issues	Gaps
Research works	There is no research works based on the landslide mitigation in Bangladesh
Development plan	No development plan or policy support is present in our country to develop housing settlement in landslide affected area.
Governmental program/policy	There is no policy guideline from Government or any other developing authority to mitigate landslide vulnerability.

But from the above literature review, the research addresses the following four key major questions:

- ⊗ How landslide risks and human vulnerability to natural hazards are interrelated with together?
- ⊗ What are the development factors and underlying processes that configure landslide vulnerability and what are the linkages between landslide vulnerability and development?
- ⊗ How can appropriate development policy and practice contribute to the reduction of landslide vulnerability?
- ⊗ How can landslide vulnerability assessment be enhanced in order to inform development policy and practice?

1.4.1. Aim of the research

The ultimate target of the research is to make a

- ⊗ Sustainable and adequate development policy and practice that contribute to the reduction of landslide vulnerability, And
- ⊗ Develop a sustainable and integrated urban livelihoods approach that would integrate measures for reducing poverty by reducing risks from disasters.

1.4.2. Objectives

By considering the limitations and the above research questions the major objectives of the research are given below:

- ⊗ To assess the vulnerability of the study area.
- ⊗ To explore the existing planning interventions to mitigate the vulnerability of land slide affected area.
- ⊗ To suggest some planned ways to mitigate the vulnerability of the slum dwellers of land slide affected areas.

This research tries to assess the vulnerability of the landslide affected area analyzing the planning intervention of the landslide affected area and draw some recommendation that would allows an urban livelihoods approach to integrate measures for reducing poverty with measures for reducing risks from disasters.

1.5. Organization of the Book

This thesis consists of four chapters that describe all the major components of this research.

Chapter one contains background or statement of the problem, literature review on research issues, conceptual framework incorporating the limitations, research gap along with the aim and objectives of the study.

Chapter two consists of methodology which is the base of any research work. The methodology possesses four sub-components, namely –study area, study procedure, survey procedure, analytical procedure. Based on these four paramount components the design of the research will developed which includes numerous micro components like selection of topic and study area, development of

goals and objectives, analysis of objectives and operational requirements, reconnaissance survey, enlisting of expected data and relevant sources, selection of sampling technique and sampling size, preparation of questionnaire, primary data collection, secondary data collection, processing of the data, data interpretation and analysis.

Chapter three consists of the findings and analysis portion; here vulnerability is analyzed from Socio economic aspects considering the population, age and sex structure, educational status, economic characteristics, occupational structure, years of living, indigenous construction practices and materials selection for housing, affordability and attitudes of slum dwellers of the study area. Then vulnerability is assessed from physical aspect analyzing developing city through cutting hills and the reasons behind hill cutting. And then vulnerability is assessed considering some facts. Then for the second objective existing planning interventions of our country is explored and find out the drawbacks from for aspects.

Chapter four is the Discussion and conclusion portion. Here discussion has done from some relevant case studies done by generalized specialized point of view. From there recommendation has drawn by reviewing the existing planning intervention of a country which faces the landslide vulnerability in an effective way and finally conclusion has drawn.

CHAPTER TWO

METHODOLOGY

Methodology helps to organize the experience, observations, analysis of the data and information, their logical interpretation in a systematic manner for the achievement of the study objectives smoothly.

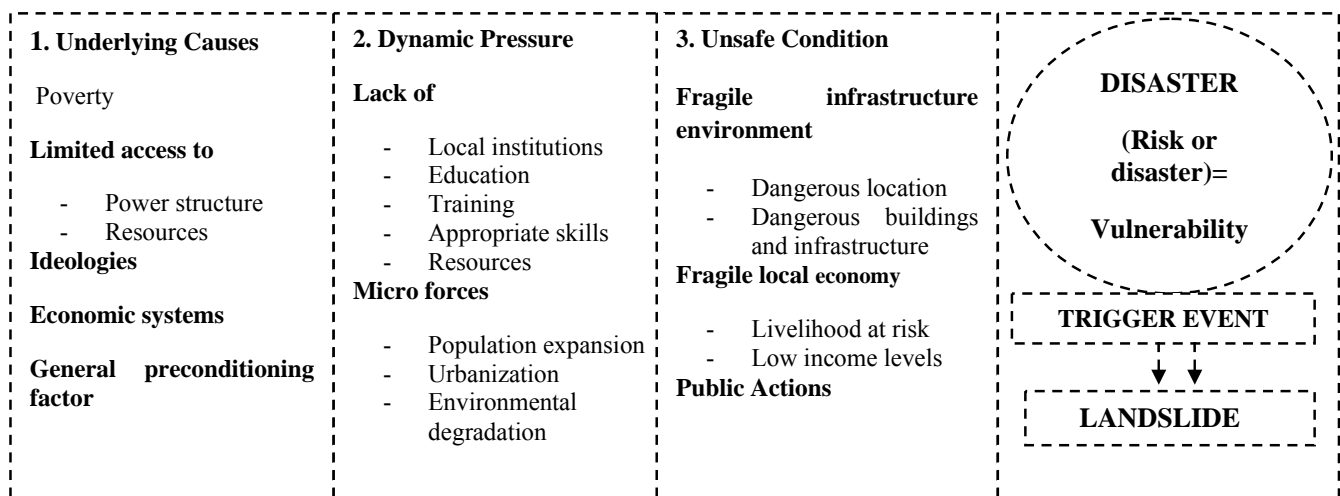
2.1. Introduction

As the objectives were selected, now it was required to develop the procedure or schedule how the study was conducted. It denotes the steps through which the objectives of the study were attained and a conclusion has drawn at the end of the study. The steps are discussed in brief here:

2.2. Conceptualization

Landslide is the perceptible downward sliding or falling of a relatively dry mass of earth, rock or combination of the two under the influence of gravity. The cause is often infiltration of water that makes the swelling SOILS (CLAYS) more fluid. Landslides are a major cause of erosion, causing the strongest degradation known, often exceeding 10,000 tons per sq km in a year. They are common in the hilly areas of southeastern part of Bangladesh. These areas have a long history of instability. Although written records of landslide incidents are very rare, they have been a hazard to people ever since they have been living there. In fact, every year especially in the rainy season landslides take place in both natural and man-induced slopes.

Table 1: The progression of vulnerability (landslide)



Source: Blaikie, 1994.

It was required to enquire- what is the pattern of this landslide? Why the people of the study area are vulnerable? What are consequences of this change? To understand the pattern of landslide, its change and the possible impacts of these change different books, research paper, journal reports have been studied. This also helped to conceptualize the extent and directions of the study.

2.3. Selection of the study area

Selection of the study area is as important as difficult. The success of any study depends upon the selection of the relevant study area. A reconnaissance survey was undertaken in the study area to get better result for the study. The locational aspects of Chittagong city are given below:

2.3.1. Locational aspects of the study area

2.3.1.1. Climate

- ⊕ Warm-humid weather
- ⊕ Average temperature 29°C
- ⊕ Average rainfall 250 cm

2.3.1.2. Rivers

- ⊕ Main River Karnaphuli
- ⊕ Other remarkable rivers are Sangu, Matamuhuri, Halda and Naf.

2.3.1.3. Soil

- ⊕ Maximum soil is the mixer of brown sandy silt and clay silt.
- ⊕ Maximum hills are made of lime stone with thin stratum of acidic earth
- ⊕ The soil particles of the coastal area in the south consist of the silt clay driven by the tidal waves.

2.3.1.4. Topography

According to “Trend of the development of the residential areas of Chittagong City” by Mousumy Zahur (2002) divided Chittagong city into three parts.

➤ Plain land on the east: The area near Bakalia affected by the river Karnaphuli. The vast low land is being infiltrated by the settlement in the recent years.

➤ Plain land on the west: This area consists of Haliashahar and western part of Pahartoli and extended from the mouth of the river Karnaphuli up to the river Feni along the coast of the Bay of Bengal. This vast plain land is now under the pressure of very fast urbanization.

➤ Hilly land in the middle: This area is situated in the middle of the two plain areas. This hilly area is the extension of the hills of Sitakundu range. One part of the hill range is known as the Northern Hill Range extended towards north-eastern part of the city. The hills in the central city are divided in to two parts. One from Panchlaish to Pahartoli and the other part from Enayet Bazar to Nasirabad. The hills with highest pick are situated in this area. The hilly area in Ranged is demarked by the river Karnaphuli.

2.4. Existing landuse in the study area

According to the Chittagong city corporation there are various types of land uses. Maximum uses identified by Chittagong City Corporation are agricultural uses which comprises 39.56 percent. The existing landuse of Chittagong is given below

Table 2: Existing land use of the Chittagong City Corporation area

Landuse Type	Area (Acre)	Percentage (%)
Agricultural	75262.66	39.56
Residential	39643.44	20.84
Water Body	24235.58	12.74
Hills & Hilly Land	18304.11	9.62
Vacant Land	9694.47	5.10
Open/ Community Space	9644.86	5.07
Transport & Communication	4038.32	2.12
Restricted	3800.00	2.00
Commercial Activity	2426.95	1.28
Education & Research	1454.08	0.76
Industrial Activity	837.98	0.44
Service Facilities	446.08	0.23
Mixed Use	339.18	0.18
Office Use	53.64	0.03
Miscellaneous	51.65	0.03
Total	190233.00	100.00

Source: Chittagong City Corporation, 2007.

According to the Chittagong City Corporation there are 88 hills that are vulnerable and their total area is 18304.11 acre which comprises 9.62 percent of the total landuse.

2.4.1. Existing hills in Chittagong

Most of the hilly areas are found in the Thanas of Chandgaon, Double Mooring, Pahartali, Khulshi and Bayezid Bostami. 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. 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. 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. The existing hills in the study area are given below:

Table 3: Total area of hills within Chittagong City Corporation Area

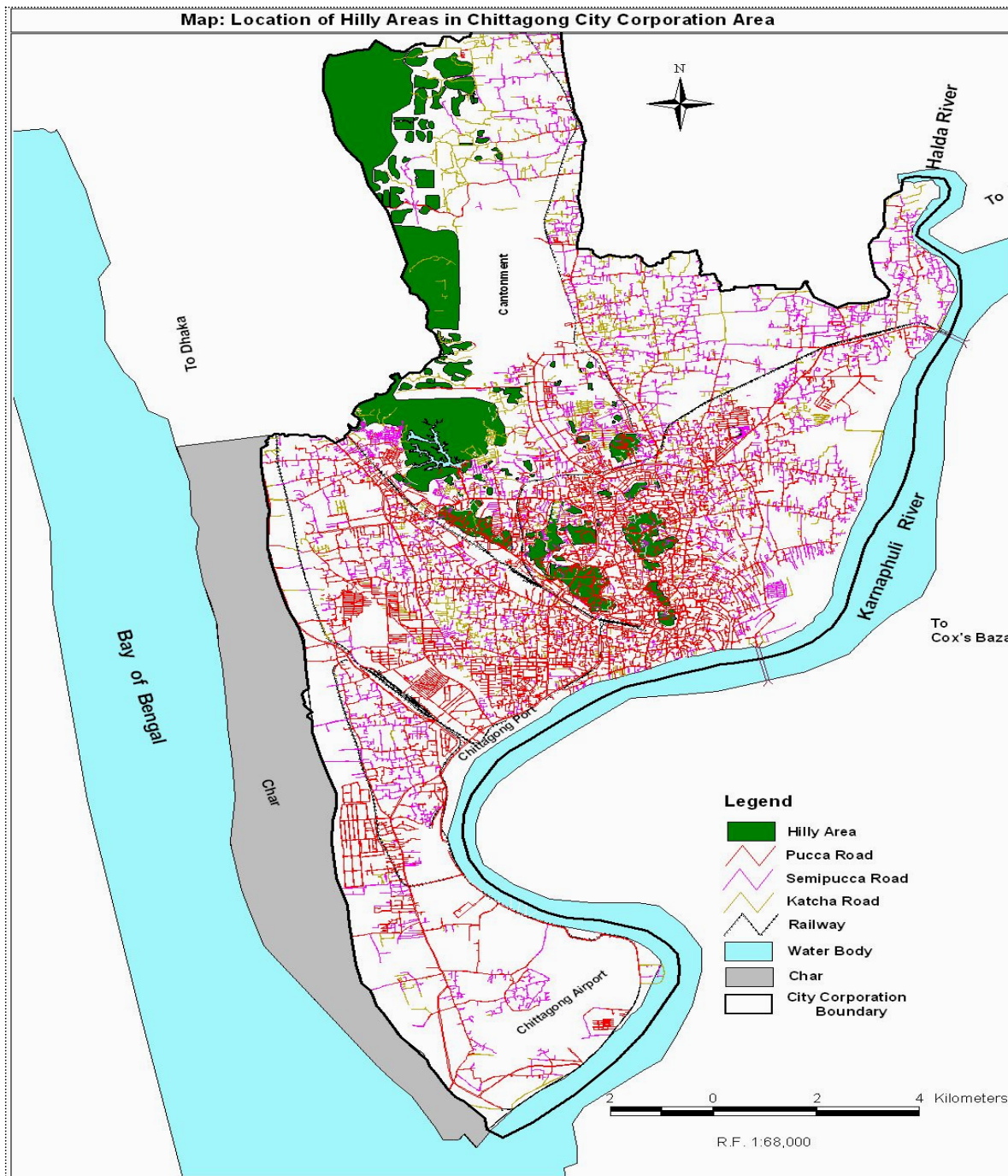
Total Area of CCC (Acre)	Total No. of Hills	Total Area of Hill (in acre)
426907	88	18304.11

Source: Chittagong City Corporation, 2007.

According to City Corporation the total hills comprises 18304.11 acre of land where there are three categories; Category-1: The areas where hills are untouched, that is no sign of hill cutting. Category-2: The areas where hills have been partially demolished; but they are still retainable. Category-3: The areas where hills have been completely demolished and there is no trace of hill ecology.

The existing hills in Chittagong city corporation area are given below:

Figure 1: Location of existing hills in Chittagong City Corporation area (Chittagong Development Authority, 2007)



Source: Chittagong Development Authority, 2007.


2.5. Parameter selection

Based on the objectives different parameter were selected will help to fulfill the objective. These parameters were-

Objectives	Parameter	
	Physical	Socio-economic.
1 To assess the vulnerability of the study area	<ul style="list-style-type: none"> ⊕ Existing infrastructure and houses ⊕ Physical vulnerability ⊕ Location of the vulnerable areas 	<ul style="list-style-type: none"> ⊕ Insecure income ⊕ Occupational structure ⊕ Housing structure ⊕ Livelihood pattern
2. To explore the existing planning interventions to mitigate the vulnerability of landslide affected area	<ul style="list-style-type: none"> ⊕ Policy measure, ⊕ Rules and regulation ⊕ Financial support, ⊕ Landslide management plan 	
3. To suggest some planned ways to mitigate the vulnerability of the slum dwellers of landslide affected areas.	<ul style="list-style-type: none"> ⊕ Designing housing process, ⊕ Policy support for relocation, ⊕ Vulnerable zone declaration 	

2.6 Data collection

After the selection of variables to meet the objectives data was collected. According to the variables two types of data were required to fulfill the study. These are:

 Primary data

 Secondary data

2.6.1. Primary data collection

Through primary data collection, the real information could best be gathered with the help of field survey. In this study primary data was collected in following survey:

- ✓ **Reconnaissance survey**
- ✓ **House hold survey**
- ✓ **Key personals interview**
- ✓ **Case Study of stakeholders**

- ✓ **Reconnaissance survey**

Reconnaissance survey was conducted at first phase of primary data collection. This survey will be conducted get a clear overview of the study area. This helped to know about the existing situation of socioeconomic condition of the study area.

- ✓ **Household survey**

For collecting information about socioeconomic condition of the people living in the study area, causes behind landslide and the consequences of this land slide household survey was conducted. This survey was conducted through a questionnaire.

- **Design of Questionnaire**

Questionnaire will be divided in to 3 parts.

Part-1: People involved in hill cutting.

Part-2: People affected by hill cutting.

Part-3: People from concerned authorities.

- ✓ **Key personals interview**

For collecting information about landslide and its impact on local livelihood key personals interview will be done by snowball sampling where the seed of this tree will be an expert of landslide management. According to his guideline further interview will be taken from other specialists of relevant fields.

- ✓ **Case studies of stakeholders**

Through interviews with some of the stakeholders major infrastructural changes were identified. Case studies of some salient cases of landslide affected were taken and discussed for indicating the detailed extent of change occurring due to landslide in the study area. It also indicates the factors responsible for the change. The detailed study on a particular case revealed the consequences of the land slide. Both positive and negative impacts were identified through these case studies.

2.6.2. Secondary data collection

Secondary data collection includes necessary map collection, demographic information collection from the secondary source, and detailed information about the land slide from the relevant authorities. Secondary data was collected from Bangladesh Bureau of Statistics, Chittagong Master Plan, Chittagong Development Authority, Chittagong City Corporation other available sources.

Objective no. 1 To assess the vulnerability of the study area

Data requirement	Data Type	Respondent/organization Name
Location, Historical data	Secondary	BBS, Journals.
Occupation & Income pattern, Demographic scenario, Educational status.	Primary	Questionnaire survey, BBS, Government and related agency documents,
Topological data, Existing location of hills, Structures in hills & vulnerable area in hills.	Primary & Secondary	Field survey, CDA, CCC, Internet

Objective no. 2 To explore the relevance of existing planning interventions to mitigate the vulnerability of land slide affected area

Data requirement	Data Type	Respondent/organization Name
Policy measure	Secondary	Journals, published and unpublished books, articles, newspaper by GOs (CDA,CCC,LGED)and some NGOs like CARE, CDP in Chittagong etc.
Organizational assistance	Primary	Physical observation, Questionnaire survey
Landslide management plan	Secondary	Chittagong master plan, National housing policy, National disaster management plan

Objective no. 3 To suggest some planned ways to mitigate the vulnerability of the slum dwellers of land slide affected areas

Data requirement	Data Type	Respondent/organization name
Existing planning interventions in our country	Secondary	Journals, published and unpublished books, articles, newspaper by GOs (CDA, CCC, and LGED) and some NGOs like CARE, CDP in our country.
Existing planning interventions in a developed country	Secondary	Journals, published and unpublished books

2.7. Sampling technique and sample size

This study is mainly based on the assessment of vulnerability of landslide affected area. For these two types of measurement is required. One is measuring vulnerability from Physical aspects and the other is from Socio-economic aspects. It is necessary to see that if there is unequal distribution of resources or if the people are excluded from planned and serviced areas which are responsible for their insecure income and throw them in the landslide vulnerability. For questionnaire survey household is classified into three groups-

- Hills under this type are those which have not been noticeably altered and need to be conserved as hill and forested area.
- Hills under this type are those which have been altered and may be allowed for controlled low density development.
- Hills under this type are those where massive destruction of virgin hill topography has been made in to the interior of hill areas particularly for brick manufacturing.

As the time is very short and the population of the Chittagong City is large, it will not possible to study on all the population of the selected sites. So that, stratified random sample will be selected to conduct the questionnaire survey of different household for primary data collection. Here samples were selected after a certain interval. Sample was taken after every 4 house. But these samples had to fulfill the following prerequisite:

The respondent should stay in the study area permanently.

The respondent should be head of the family.

The formula:

$$n_0 = (Z\sigma / e)^2$$

Where,

n_0 = Crude sample size

Z = Confidence level (in 95% confidence level Z=1.96)

σ = Standard deviation (which will not be found from the sample to be drawn but from previous experience)

e = Error tolerance (its value will be ± 0.4)

2.8. Data analysis and interpretation

After collecting data from field survey and secondary sources those were processed and complied with the application of different software. Maps were digitized with the help of Arc GIS software. Then attribute data related to the land use and its change was added to the digital coverage. Information collected through household survey was automated using SPSS and a compiled database was prepared. While working with household data some data was coded and processed so that they can be easily understood and could be efficiently used for different statistical analysis.

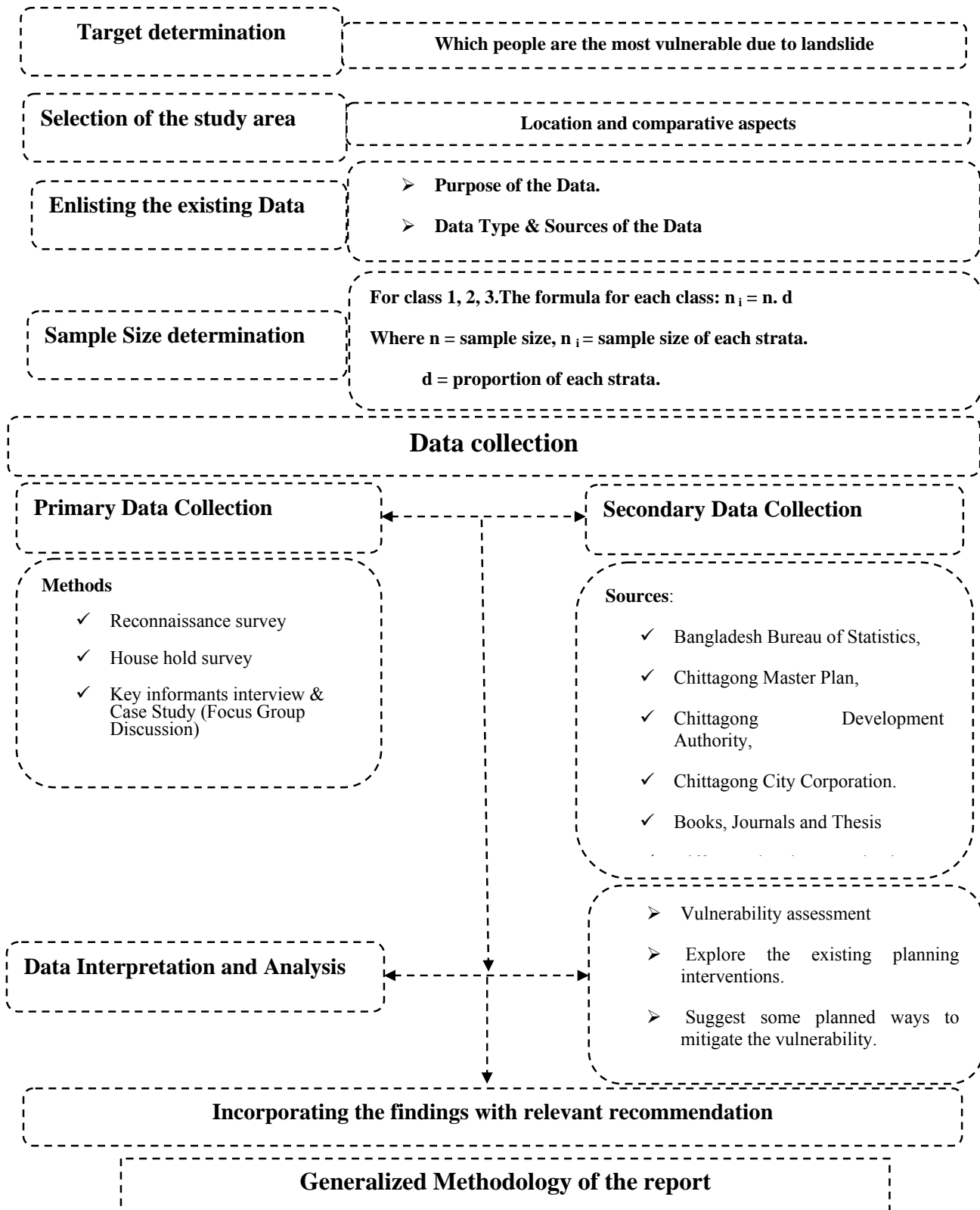
2.9. Data processing and interpretation

The collected data have been categorized, grouped and interpreted aiming at objectives of the study. Maps, documents and other information are presented to support of the study.

2.10. Final report

At first, a draft final report prepares and after its checkout a final report prepare.

2.11. Methodology of the study



2.12. (Objective-analysis-expected output matrix)

Objective	Analysis	Expected output	
<p>1. To assess the vulnerability of the study area</p>	<ul style="list-style-type: none"> • Location, Historical data • Occupation & Income pattern, Demographic scenario, • Educational status • Important indigenous landslide preparedness features. 	Analysis the vulnerability of the landslide affected area	
		Physical	Socio-Economic
		<ul style="list-style-type: none"> ⊕ Existing infrastructure and houses ⊕ Physical vulnerability ⊕ Location of the vulnerable areas 	<ul style="list-style-type: none"> ⊕ Insecure income ⊕ Occupational structure ⊕ Housing structure ⊕ Livelihood pattern
<p>2. To explore the relevance of existing planning interventions to mitigate the vulnerability of land slide affected area.</p>	<ul style="list-style-type: none"> • Organizational assistance • Policy measure • Regular monitoring system • Landslide management plan 	Existing development interventions in the Landslide affected area and their drawbacks in implementation procedure.	
<p>3. To suggest some planned ways to mitigate the vulnerability of the slum dwellers of land slide affected areas.</p>	<ul style="list-style-type: none"> • Existing planning interventions in our country • Existing planning interventions in a developed country 	Develop a sustainable and integrated urban livelihoods approach to integrate measures for reducing poverty with measures for reducing risks from disasters	

CHAPTER THREE

FINDINGS AND ANALYSIS

3.1. Vulnerability analysis

As far as urban areas are concerned, **Anderson (1992)** explains vulnerability of slum areas in terms of **three characteristics**: i) those which result from the concentrations of people and activities in defined and limited space; ii) those which result from the sheer numbers of people and activities; and iii) those which result from proximity to human-made hazards.

Concentration of people and activities on safe sites is not a source of vulnerability. But, the **unequal distribution of resources, the marginalization of segments of the population and informal activities, and their exclusion from planned and serviced areas**, is what forces people on unsafe sites; and then vulnerability is a consequence.

The vulnerability of the study area has been analyzed from two perspectives. They are:

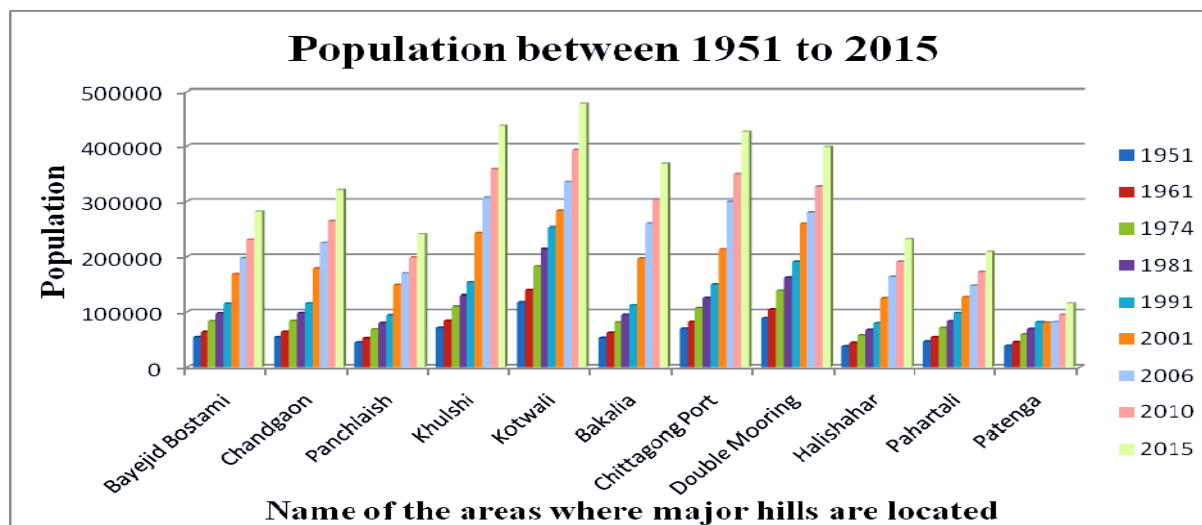
3.1.1. Socio-economic aspects and

3.1.2. Physical aspects.

3.1.1. Socio economic aspects

3.1.1. i. Population: Population is an important parameter to know the overall socio-economic condition of an area. First population census was done in 1861 in this region. After the independence of Bangladesh, first population census was recorded in 1974. The preceding census years are 1981, 1991 and 2001. The graph shows the population of Chittagong from 1951 to recent date.

Figure 2: Population between 1951 to 2015 (Chittagong City Corporation, 2008.)



Source: Author, 2008.

From the graph it is clear that in Khulsi, Kotwali, Bakalia and Double Mooring where the major hills are located, population is increasing at alarming rate. The low-income settlements that are built under these hills making the environment more vulnerable

3.1.1. ii. Age and sex structure

Table 4: Age and sex structure of the respondents in the study area

Age Group	Sex of the respondent		Total
	Male	Female	
<15	12	0	12
15-25	7	5	12
25-35	15	0	15
35-45	15	6	21
45-55	12	5	17
55-65	1	12	13
>65	9	1	10
Total	71	29	100

Source: Author, 2008.

In the study area majority male respondent are within the age limit of 25-45 i.e., 30% belongs to this age group. 12% female belongs to the age group of 55-65. Aged male person (>65) responds about indigenous practices about housing materials, income pattern and coping mechanism and so on. 21% respondents respond highest which age group 35-45.

3.1.1. iii. Educational status

Table 5: Educational status of the respondents with respect to sex of the study area

Level of Education		Male	Female	Total
		Frequency	Frequency	
Illiterate		26	8	34
Literate	Can sign	3	8	11
	Class i-v	15	3	18
	Class vi-viii	14	0	14
	Class ix-x	4	6	10
	S.S.C pass	1	3	4
	H. S.C	4	0	4
	Degree and above	1	1	2
	Madrasa	3	0	3
	Total	71	29	100

Source: Author, 2008.

In the study area educational condition is very pitiful. Educational status of the survey area has been categorized into literate and illiterate in this study. Here illiterate has been considered to those who cannot sign. 34% of the total population are illiterate, 29% people are educated up to class five. Very little percentage of people especially, male are educated above HSC and higher level. On the other hand male population is more literate than female population.

3.1.1. iv. Economic Characteristics

After the late 70's the economic condition of the city is developing. The economy of the city can be best be revealed through the income pattern of the city dwellers.

Table 6: Income level of the people living in the study area

Monthly income level	Percentage distribution
Less than 3000	45.0
3000-5000	35.0
5000-7000	11.0
7000 or above	9.0
Total	100.0

Source: Author, 2008; Chittagong City Corporation, 2007; City development strategy (CDS) of Chittagong city in context of national and city perspectives, Bangladesh.

In the study area maximum people are day labors, maid servant or hawkers and their income is between in the range of less than 3000 and the percentage is higher (45%).After that maximum people are engaged in grocery shop and business. Very few of them are engaged in service and students.

3.1.1. v. Occupational Structure

Occupational structure of the study area is also different from other areas because of the variation in the employment pattern. Maximum people of the study area are day labors and their percentages are 24. Female headed families are headed by the maid servants. There are few businessmen but they are minimum in number.

Table7: Occupational Structure of the study area

Employment pattern	Percentage distribution
Service holder	4.0
Business	7.0
Hawkers	15.0
Day labors	24.0
Maid servant	15.0

Students	8.0
Driver	9.0
Carpenter	4.0
Grocery shop	8.0
Others	6.0
Total	100.0

Source: Author, 2008; United States agency for International development, 2001.

Monthly income of the study area is very low compare than other areas of Chittagong City. Expenditure mainly used to cope with their consumption pattern. Maximum people are poor and hardcore poor. Thus, about 45% of the family earns within the range less than 3000.

The average household income per month is TK 5,543. It is equivalent to per capita yearly income of US\$283. According to **United States agency for International development, 2001** the amount is equivalent “**just enough to meet experience on food and non-food items.**” However some of the major economic characteristics of the city are –

1. Livability has been deteriorating due to a widening gap between inequalities public services and growing population especially the urban poor.
2. Competiveness has also been decreasing due to the failure to attract new investments
3. City governance and capacity building issue remains the most serious constraint for more effective management of the city.

3.1.1.vi. Years of living

Table 8: Years of living of the respondents in the study area

Year range	Starting year	Percentage
Below 5	Among 2001-2005	14
5-15	1990-2005	12
15-25	1980-2005	26
25-35	1970-2005	23
>35	Before 1970	25
Total		100

Source: Author, 2008.

From the table it is seen that a major portion about 26 % of people are living from 15 to 25 years. 14% people are living form below 5 years. It is also seen that about 23% and 25% of people are living within the range from 25-35 and >35 years respectively. So it is measure that most of the people are living in this place from a long time.

3.1.1. vii. Indigenous construction practices of housing

Survey findings reveal that housing characteristics based on indigenous construction techniques and locally available material. Their construction practices are different in many facets than the other housing characteristics of Chittagong City. As the study area is landslide affected area, so, respondents protect roof, wall and even also tie the frame indigenously. Materials used for construction of roof and wall gives an indication of structural survival practices of a severe landslide affected area.

3.1.1. vii. a. Materials selection

Materials selection and utilization these materials are the prime consideration for housing to protect against disaster. Maximum houses are built without trained professionals. The inhabitants (carpenters, roof builders) built tin roof and wood made wall. Pucca houses construct *razmistries* (masons) and *kamlas* (helpers). But together with household or community members build houses largely. Sometimes *kamlas* were used for knotting frame elements. Some *kamlas* helps to construct houses in lieu of food/meal. But together with household or community members construct houses largely. Construction skills were learnt through past experience. Local construction workers make roof and wall materials for construction of house by available local materials. They also select those materials that found easily. Roof and wall materials select the villagers are given in the table no 9.

Table 9: Materials used for construction of roof and wall

Wall Materials	Roof materials					Total
	CI sheet/ Tin	Tile	Thatch(rice straw)	Concrete	Others	
Mud	8	6	25	7	7	53
Tin		3	1	1	1	6
Thatch			1		1	2
Brick	5	1	1	3		10
Wooden	2	1	1		4	9
Bamboo	1	2	13	2	1	19
Total	16	13	42	13	15	100

Source: Author, 2008.

Most of the dwellers use mud wall. They are about 53% of the total households. About 19% dwellers use bamboo as their wall of the dwelling. A small percentage of the dwellers (10 per cent) use brick as for wall materials.

As maximum inhabitants are hardcore poor thatch (rice straw) is available and used generally as the cheapest roof material. Though it is seen that most of the dwellers use thatch but it is not permanent. It needs repair of every two or three consecutive year. About 42% households of the study area use thatch as for roofing material. 16% households use CI sheet/tin as roofing purpose. The house-building season comes just after a heavy rainfall or heavy mudslide and people use the straw to re-thatch annually. Some of the dwellers uses CI sheet/tin whose economical condition is relatively better. They are about 16 percent of the total households.

3.1.1. viii. A case study of City Corporation about room occupancy and floor space of the slum dwellers

Chittagong City Corporation, 2007.

Room occupancy by households shows the pattern of congestion in the living environment. In Chittagong congestion is that acute as usually found in large cities. Only about 27 percent of the households live in one room house, most of whom are poor living in slums or squatters settlements.

In terms of floor space nearly 67 percent of the households use less than 60 sq ft. The poor in slums and squatter settlements use up to 400 sq.ft on average. In general Chittagong City most of the residential units are one storied and there is very little vertical expansion. Both physical and economic constraints are responsible for such low height development.

3.1.1. ix. Affordability analysis of slum dwellers

Affordability is the means to analyze the willingness to pay for a definite service in consumer perspective. In the aspects of housing affordability can be defined as the willingness or to pay for housing expenditure from the income considering the total expenditure pattern. The housing expenditure is affordable when a person can ensure the basic expenditure for the rest of the non-housing expenditure from his real income. The reality is that affordability is a dynamic magnitude, which cannot and should not be restricted by arbitrary norms of bureaucrats. However in the case slum dwellers the rate of repayment in terms of rent is fixed in a definite scale. But the affordability deserves to estimate income and inflation of goods and services that are associated with livelihood. But monthly income of the study area is very low compare than other areas of Chittagong City. Expenditure mainly used to cope with their consumption pattern. Maximum people are poor and hardcore poor. Thus, about 45% of the family earns within the range less than 3000.

The average household income per month is TK 5,543. It is equivalent to per capita yearly income of US\$283. According to **United States agency for International development, 2001** the amount is equivalent **“just enough to meet experience on food and non-food items.”**

Another example of individual vulnerability a recent climate change cell (2007, p.3) of Bangladesh has pointed out- the poorest are the hit earliest a hardest by the impacts of the climate change:

“Poorer people are more susceptible to the destruction caused by the landslide for a variety of reasons .The poor typically live in substandard housing that is more susceptible to damage from landslide. Substandard or non-existing sewerage facilities and lack of potable water in poor neighborhood can result in greater exposure to water borne diseases after landslide. Areas that are historically prone to landslide or mudslide are often inhabited by the poor.”

Hence being poor is by itself a useful vulnerability indicator. Taking into account that poverty is a multidimensional concept that has many dimensions and the poor are a heterogeneous group with large proportion of the poor moving into and out of poverty. We look at a few poverty measures

including hardcore food poverty (measured by the percentage of population with the calorie intake lower than 1850kcal/capita/day), as being at the margin of starvation leaves little capabilities to adapt to any negative stock.

3.1.1. x. Vulnerability analysis in context of study area

Vulnerability is a condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard. Human vulnerability includes within it the vulnerability of social and economic systems, health status, physical infrastructure and environmental assets. It is possible to look at these subsets of vulnerable systems in isolation, but here we are concerned with the broad picture of human vulnerability.

A Case study of human vulnerability on Motijharna area in Chittagong university campus

- ❑ Lack of proper accessibility (width of access road is only two feet).
- ❑ Problem of light and air circulation.
- ❑ Improper waste collection and disposal system (no dustbin within the study area).
- ❑ Minimum Per capita floor space [about 20sq.ft. /person (Chittagong city corporation, 2007)] is absent there.
- ❑ Low household income (less than 1500-3000tk. /month).

- ❑ Family size is very high (more than 5persons/family).
- ❑ Mostly female-headed households (divorced or deserted).
- ❑ Lack of education, health awareness and training.

From the case study it is clear that Motijhorna area indicates the absence of social and economic systems, health status, physical infrastructure and environmental assets which ensures the vulnerability of the study area.

3.1.1. xi. Attitudes of slum dwellers

The majority of the slum inhabitants (26%) have been living in the slums 15 to 25 years. 14% people are living form below 5 years. It is also seen that about 23% and 25% of people are living within the range from 25-35 and >35 years respectively and every year, newcomers are settling in the slums. Though the inhabitants of slum areas were facing a lot of problems, most of them (93%)

expressed their willingness to stay in the slums as they did not have alternative accommodation anywhere else. The community facilities most desired by the slum dwellers were drinking water, medical facilities, sanitary latrines, approach roads and electricity and gas lines. They also expressed their willingness to contribute in the form of labor towards having these facilities in the slum areas.

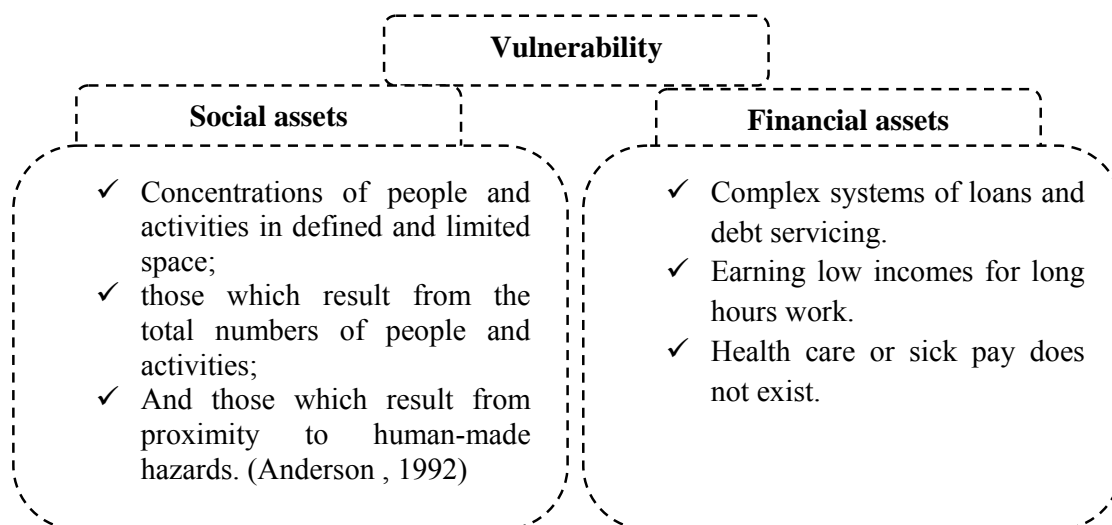
There is clearly a need to respond to this vast scale of urban poverty and deprivation. However, before making any attempt to undertake programmers' for socio-economic development, it is pertinent to have a clear picture of the social and economic conditions of this rootless, floating population. The collection of some basic information is a pre-requisite for making plans for socio-economic development.

From the analysis it is clear that there are two types of vulnerability which are interrelated among them. These are

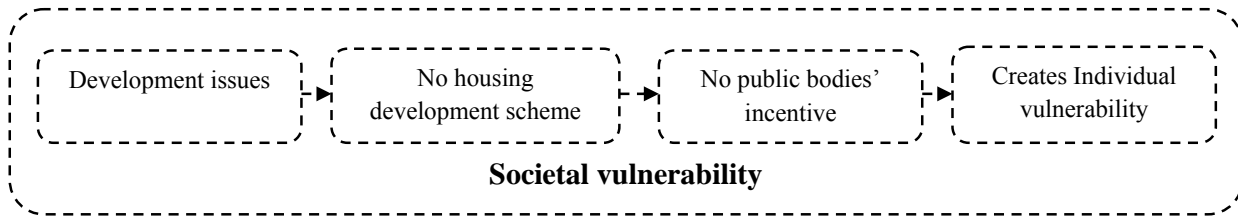
Individual vulnerability: the vulnerability of fatality or injury to any identifiable (named) individual who live within the zone impacted by the landslide; or follows a particular pattern of life that might subject him or her to the consequences of the landslide.

Societal vulnerability: the vulnerability of multiple fatalities or injuries in society as a whole: one where society would have to carry the burden of a landslide causing a number of deaths, injury, financial, environmental, and other losses.

But unplanned development is making the slum-dwellers **Vulnerable**.



But there are other major reasons behind vulnerability



From the discussion and field survey it is clear that unequal distribution of resources, the marginal segments of the population and informal activities, and their exclusion from planned and serviced areas, is what forces people on unsafe sites; and then vulnerability is a consequence.

3.1.2. Physical aspects

3.1.2.i. Developing city through cutting hills

The city of Chittagong developed with the hills. It has several hilly areas within its vicinity. So it can be assumed that the history of hill cutting began with the history of its inception. The 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 Dutch. 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 by cleaning jungles on the hills to prepare livable land (Hassan Taufique 2004). In the Master plan of Chittagong Development Authority prepared in 1961, some areas of the city were suggested to be developed by hill cutting. This decision also prompted the hill owners to demolish hills. After the independence of Bangladesh in 1971, Chittagong became the biggest port city of the country and generated huge bulk of population within the city. 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. Development trend of city through cutting hills from 1948 to 1991 is given below:

Figure 3: Development trend through cutting hill in the Year of 1948 (Chittagong Development Authority)

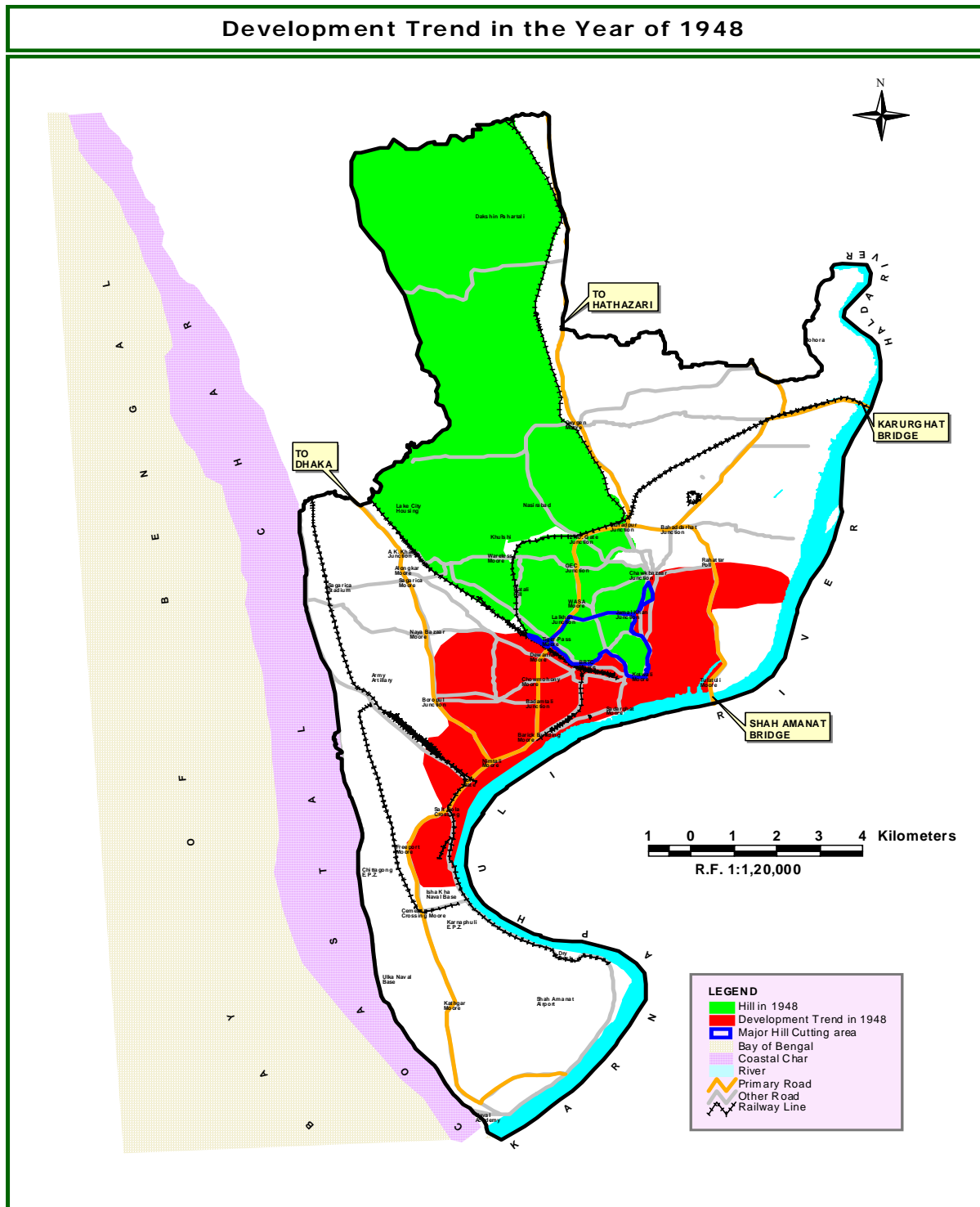


Figure 4: Development trend through cutting hill in the Year of 1988 (Chittagong Development Authority)

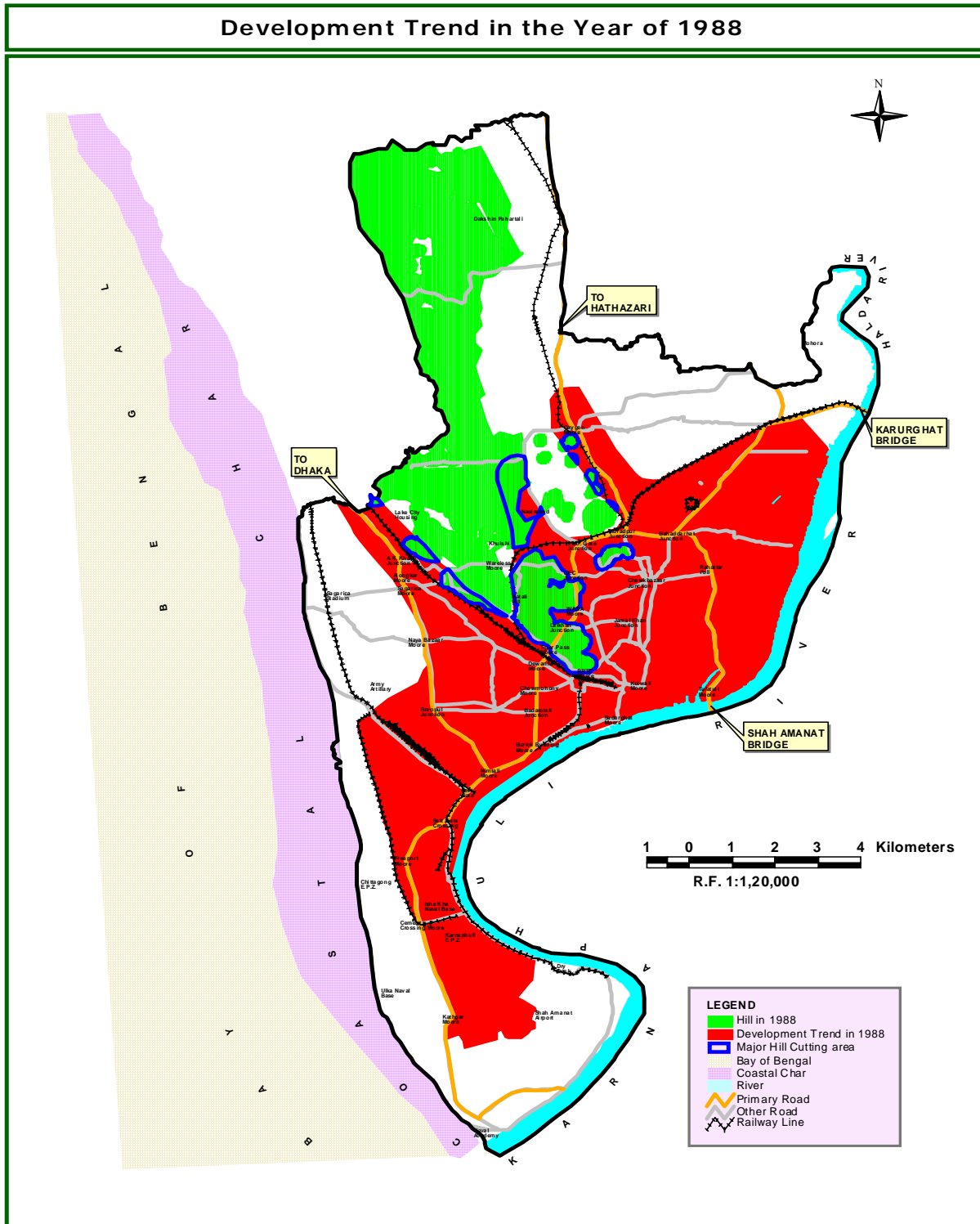


Figure 5: Development trend through cutting hill in the Year of 1997 (Chittagong Development Authority)

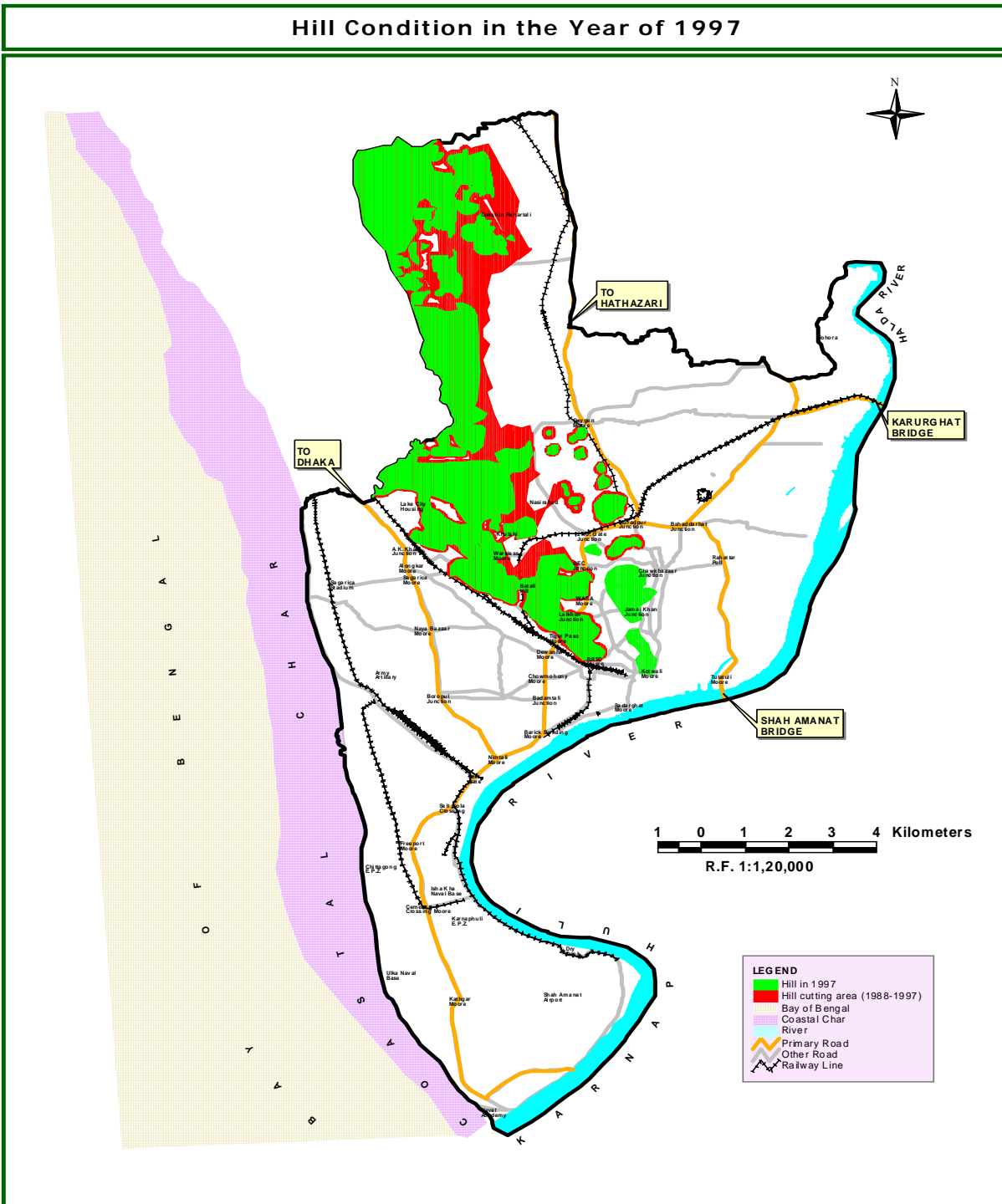
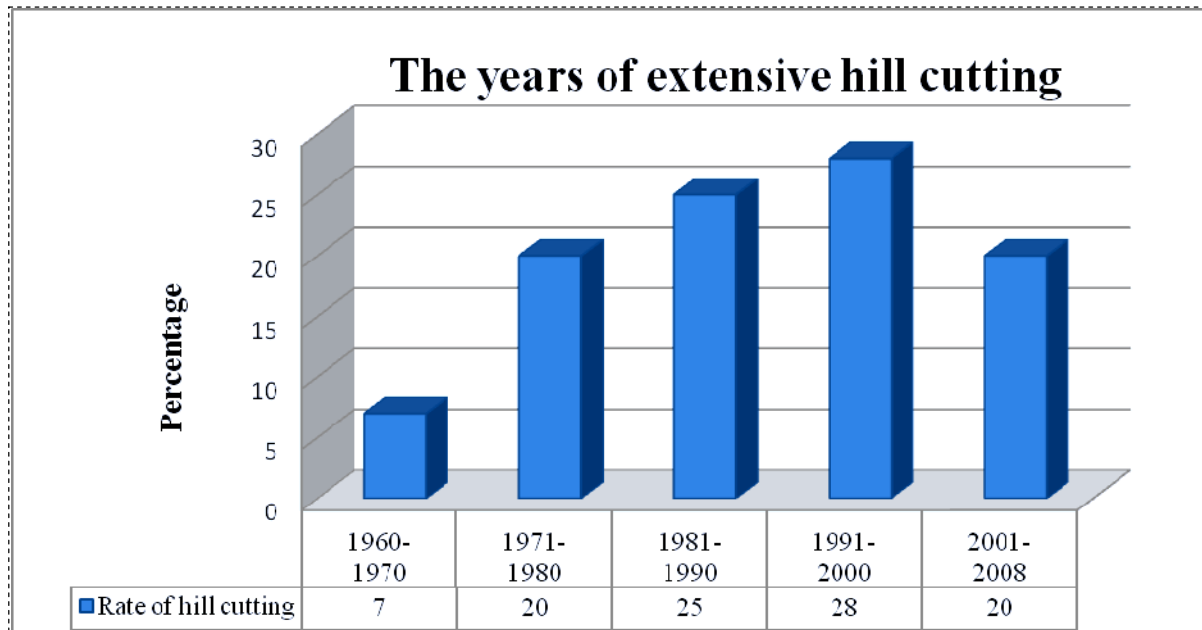


Figure 6: The rate of hill cutting from 1960 to 2008 (Author, 2008 & Chittagong Development Authority)



From the Analysis it is clear that the hill cutting was extensive in the period 1981 to 2001 and its range was between 25 to 28. But in the 2001-2008 periods it reduced into 20 percent. But still the rate is very aggressive and it could cause any further damage if the necessary precautions are not taken immediately.

3.1.2.ii. Reasons

From environmental point of view hill cutting is dangerous to the city but there is a great economic return also. People related with hill cutting are somehow profited financially. Development of residential plots, making of brick fields or establishing industrial estates all are profit making business at the cost of the hills ecology.

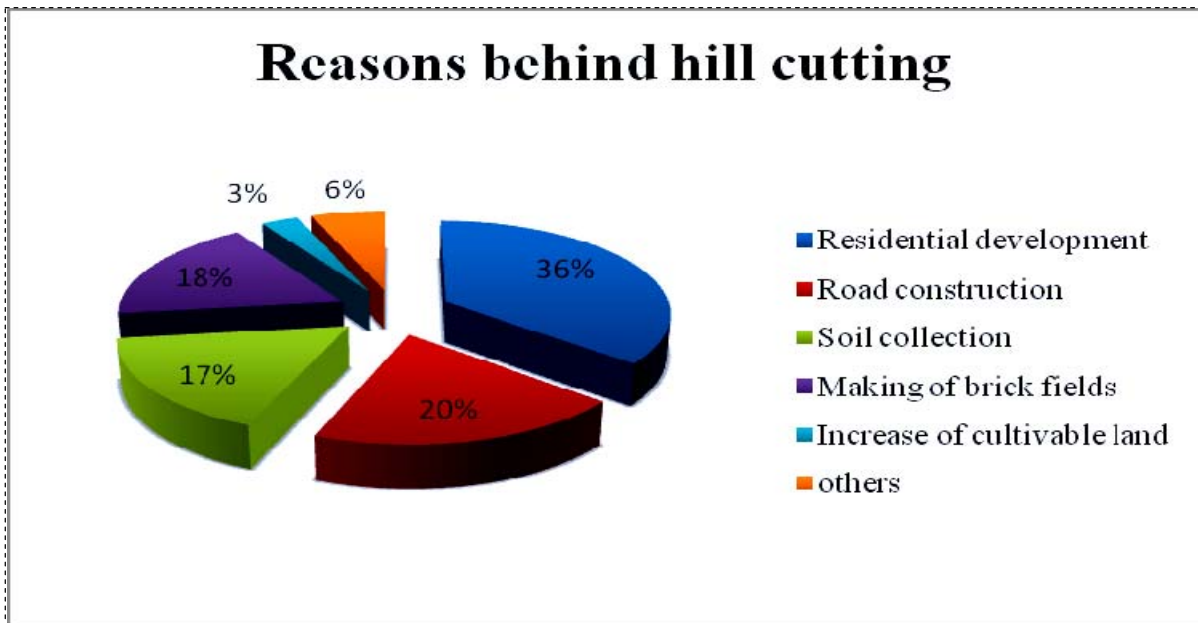
Hills within the vicinity of City Corporation area belong mostly to the Railway department. More over City Corporation, several real estate company as well as some individuals pose a remarkable number of hills. The high powered committee formed after the incidence of landslide on June 11, 2007 to find out the causes of the hill cutting has identified three major causes. These are:-

- a) Establishment of housing society.
- b) Establishment of brick fields
- c) Performing development work. Viz. construction of roads of institution.

But from the field survey it also reveals there are certain other major causes of hill cutting that are given below:

- ✓ Development of residential area
- ✓ Establishment of Industrial Estate
 - ⊗ Establishment of brick fields
- ✓ Soil collection
- ✓ Construction of roads and highways
- ✓ Creation of cultivable lands (Cultural Cause)
- ✓ Use of the earth collected from hill cutting

Figure 7: Reasons behind hill cutting (Author, 2008 & United States agency for International development, 2001)



Among all the causes the most important is to leveling 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 leveling land for construction of building is the main cause of hill cutting.

It is interesting to know that in the Master Plan of Chittagong city prepared in 1961, some of the hilly areas were proposed to be developed by hill cutting. Areas in South Kulshi and Nasirabad areas are the examples of residential development by hill cutting. Although the proposal was to cut the hills in a limited extent, but in reality a great amount of hills were demolished in the name of residential development.

In the early 90's real estate business flourished in Chittagong. Nearly 30 real estate companies are working here to build high building within the City Corporation area. They are engaged in leveling high lands of filling low lands to develop salable residential plots. A sign board placed on a hill written "Plots for sale" is now frequently seen in Chittagong.

✓ **Establishment of Industrial Estate**

The establishment of Industrial Area is another cause of hill cutting. The Nasirabad Industrial Area on both sides of Baizid Bostami road is established by totally hill cutting. In the Master Plan of Chittagong of 1961, these areas were proposed to be developed as the light, medium or heavy Industrial Estate. This Industrial Estate has generated many industrial workers to live near their working place that had no choice but encroaching in to the hilly areas for their dwellings.

⊗ **Establishment of brick fields**

The soil of hill is very suitable for brick making. Most of the brick fields are situated at the base of the hills. It implies that owners of the brick fields extensively use the earth collected from hill cutting. The process of brick making itself is the cause of environmental degradation. When hill cutting is added to this process, its contribution to the environmental degradation increases many fold.

✓ **Soil collection**

Soil is collected basically to raise the plinth of the new construction. During the period of 1990, the city started expanding outwards. The fringe areas of the city are mainly low lying lands. The lands need a considerable amount of earth to make them suitable for construction. As the hill cutting or transporting the hills' earth is prohibited, one can observe that the earth being shifted from the hill site to the construction areas with truck in the broad day light.

✓ **Construction of roads and highways**

A number of roads have been constructed by hill cutting. Connecting road from Hat hazari

road to Bhatiari (widely known as BMA road), Road from GEC junction to Alanker junction, all these roads have been constructed by hill cutting. Besides, some internal roads connecting different wards are also constructed by hill cutting. Roads from Surson road to Medical hostel, from Chatteswari road to O.R. Nizam roads, roads leading to the top of the Battali hills are the example of city's internal roads made by hill cutting. It is remarkable here that all these examples of road construction by hill cutting are the **good example of hill cutting** except one high way recently constructed by Chittagong Development Authority. This major road of 120 feet wide was proposed to be constructed through the hilly land to connect Baizid Bostami road with Dhaka Trunk road. The alignment was done without honoring the hill's topography. According to the officials of the Asian University for Woman (AUW), it is not the intension, but the ignorance of the authority of managing such a comprehensive project in the ecologically sensitive areas. As a consequence of unplanned hill cutting, massive demolition of hills took place while constructing the road. The obvious result of the construction of this road was a massive landslide which caused almost total destruction of road in the incidence of landslide in June 11, 2007.

✓ **Creation of cultivable lands (Cultural Cause)**

One interesting cause of hill cutting is discovered by Mr. Abul Momen, Editor, The Daily Prothom Alo, a famous daily news paper of Bangladesh, Chittagong Bureau. He opined that people of this country is traditionally habituated with living in the flat land. People living the slum areas near hills are migrated from different part of the country. They are basically farmers by profession and accustomed to live on the flat land. Although they have engaged themselves in Metropolitan activities, yet, because of their cultural back ground of cultivation, they have created small flat lands for cultivation in the surroundings of their areas by encroaching hills.

✓ **Use of the earth collected from hill cutting**

Although leveling of hills to make land suitable for construction work is a major cause of hill cutting, there is a versatile use of earth from hills. It is known from the statistics that around 23% of earth is used to level the low land. To fill up the plinth of the building 12.50%, to use as the raw materials for brick fields 25.30% and 22.75% is used in the construction or maintenance of roads. Filling up the ponds is very popular in this region. In the statistics pond has been considered as the low land.

3.1.2.iii. Existing hills in Chittagong city

Most of the hilly areas are found in the Thanas of Chandgaon, Double Mooring, Pahartali, Khulshi and Bayezid Bostami. 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. The history of last hundred years reflects the reality that in most areas as mentioned above hills have been affected by the owners or by the people living in those areas. Most of the hills of Chittagong are extended from north to south as the fault line between Indian and Burmese plate is aligned north to south. So the topographic character of Chittagong was developed as hilly at one end and flat valley at the other end. 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. 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. The different category of hills and the structures existed on them in Chittagong city is given below:

Table 10: Different Categories of Hill

Hilly Area in Acre	No of Hill		Area (Acre)	
	No	%	Area	%
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%

Source: Chittagong Development Authority (CDA)

Figure 8: Location of Existing Hills in the CCC Area

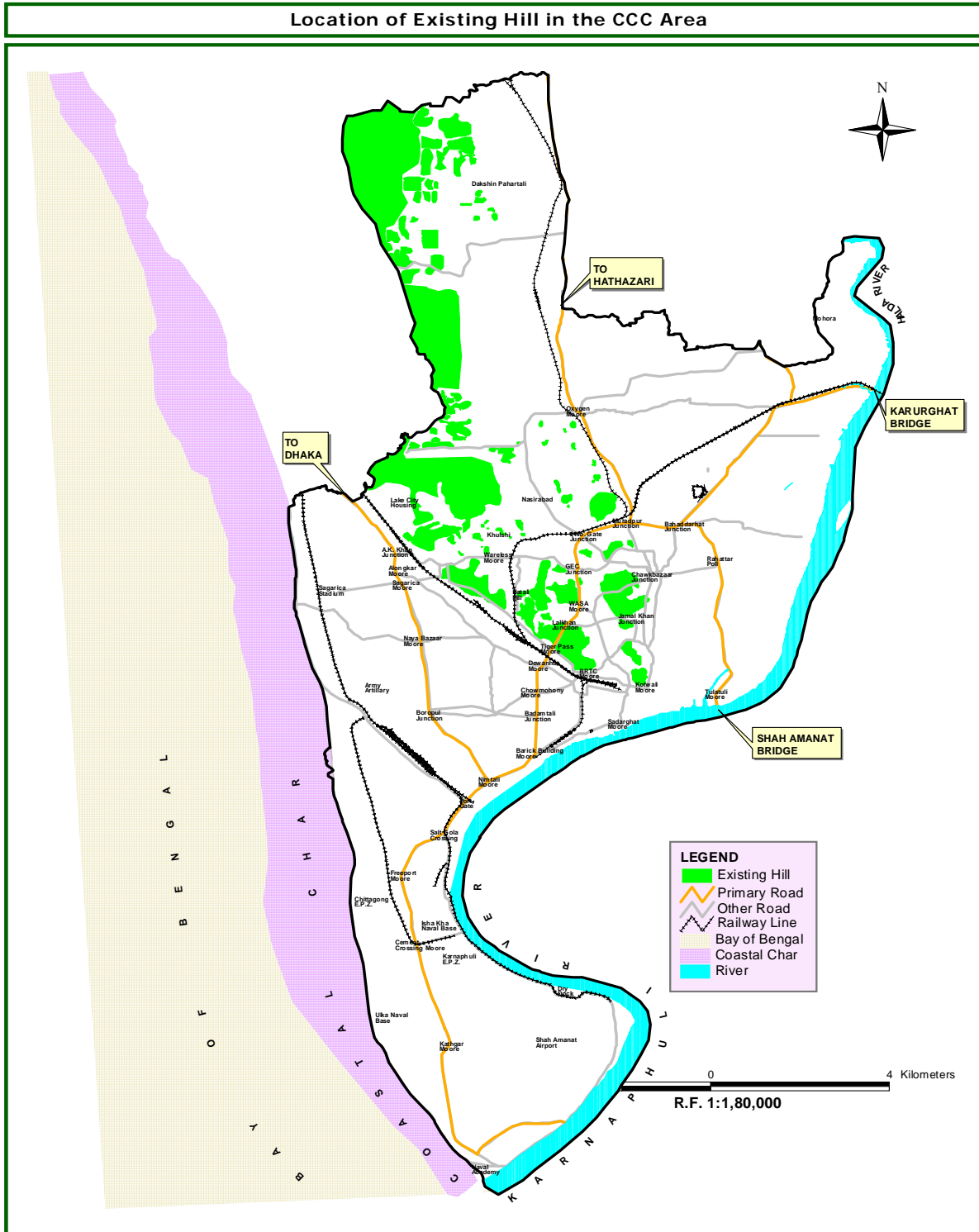


Figure 9: Different Categories of Hill in the CCC Area

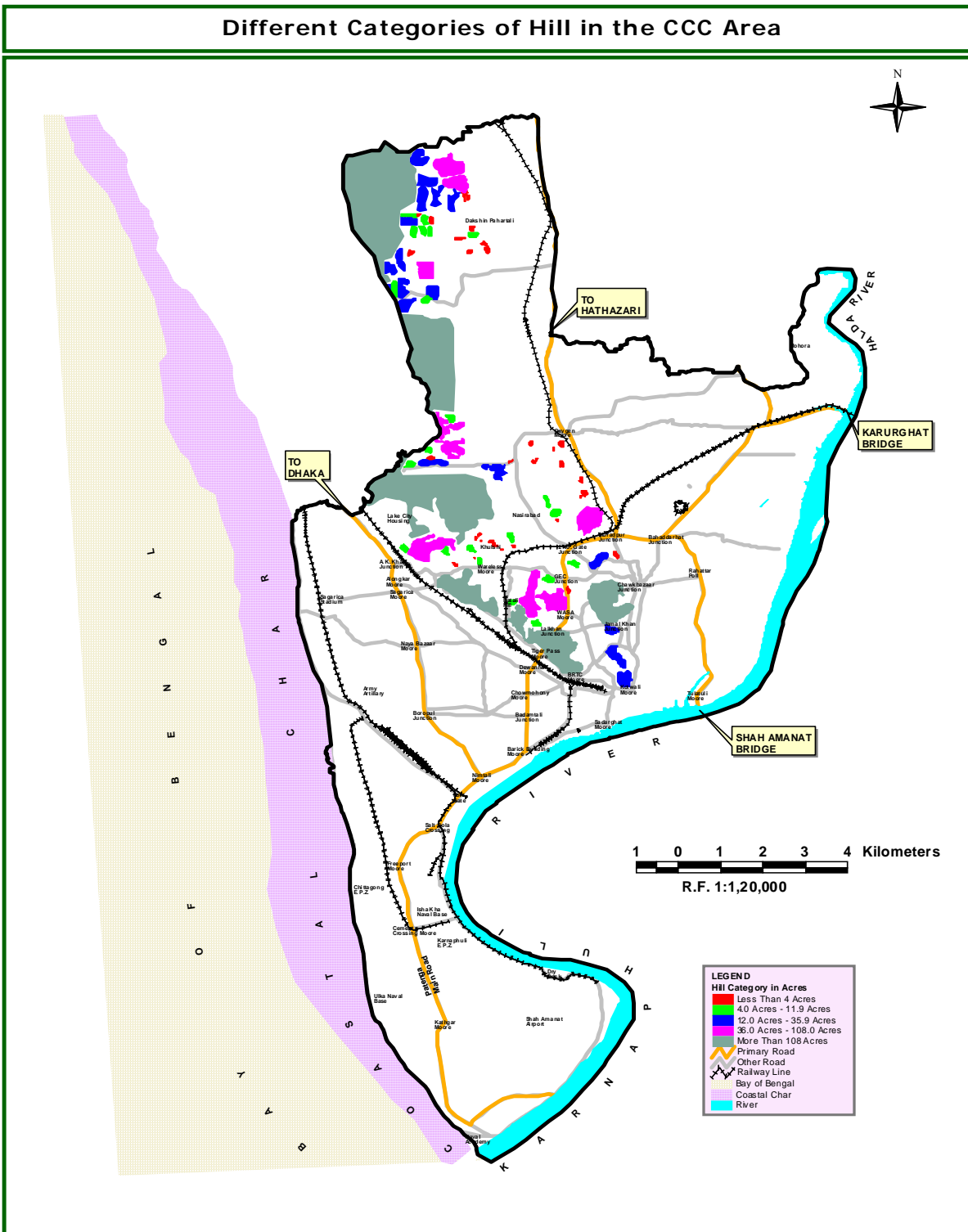
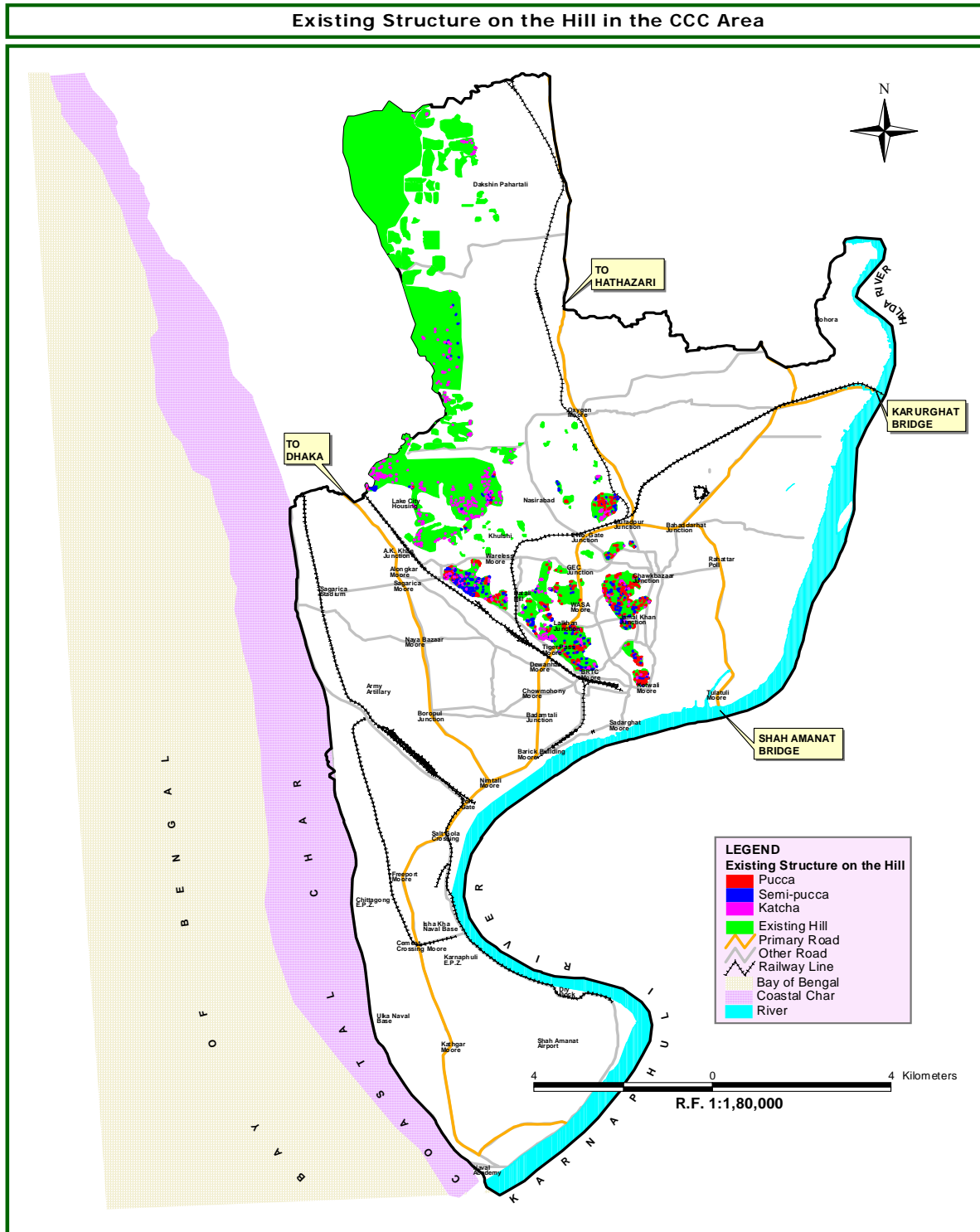


Figure 10: Existing Structure on the Hill in the CCC Area



3.1.2. iv. Vulnerability Assessment

Vulnerability is a condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard. Vulnerability includes within it the vulnerability of social and economic systems, health status, physical infrastructure and environmental assets. Each of the variables used here are measured at a scale of 1 to 4, where upper value indicates the highest limit of any variable whether it is 'vulnerability' or not (JJS,2004). To assess the vulnerability, scores are derived from the factors that are locally applicable and manageable in terms of data collection and time. The value of vulnerability factors are categorized under high (4), medium (3), moderate (2) and low (1) and assign their respective score. Again, uniform values of vulnerability factors are summed up for better understanding and mapping. To evaluate and assessing vulnerability for certain area the criteria should be:

1. Location of the existing structures
2. Location of existing hills
3. Distance from primary road.

Furthermore each of these criteria can be assessed separately to make it more logical special for any participatory assessment which will make peoples opinion more analytical and judgmental. Similarly criteria for assessing the vulnerability of people of a landslide affected area can be:

- Location of the house from hill.
- Insecure income source.
- House structure.
- Awareness.
- Repair tool for housing development after a certain landslide.
- Infrastructure.
- Education.
- Earning Member.

Table11: Vulnerability assessment of selected areas of Chittagong City Corporation area

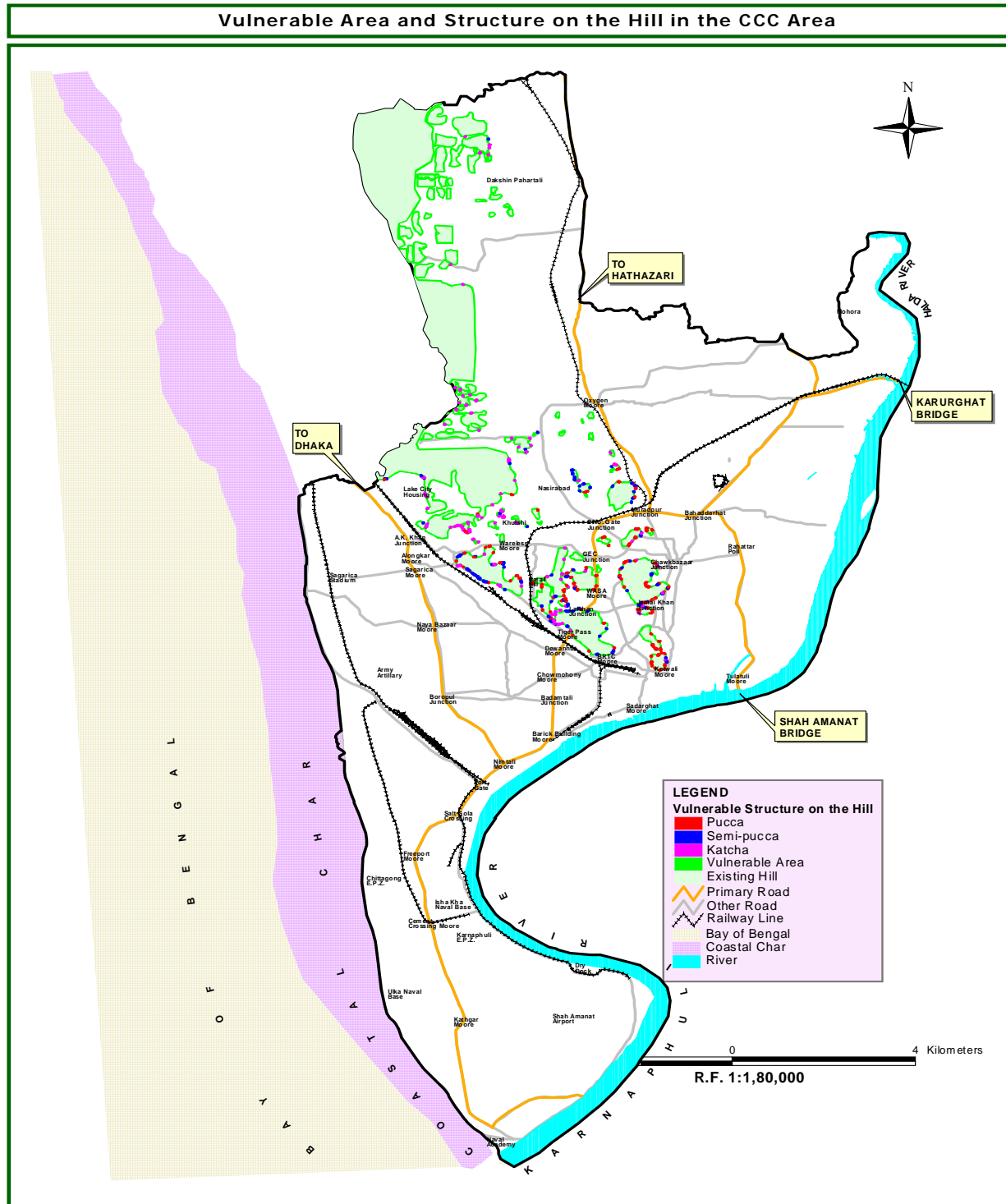
Criteria	Scale of scoring (scale range = 1 to 4)	Score for areas				
		Lalkhna Bazar	Motijhorna	Foy's Lake	Pahartli	Khulsi
Location of the house from hill	Location more than 2 km. =1	4	4	4	4	4
	Location within 2 km =2					
	Within 1 km. =3					
	Location within walking distance =4					
Insecure income source	Percentage of people lives on daily wage =4	4	4	4	4	4
	Percentage of people lives on monthly wage =3					
	Percentage of people lives on income after certain period =2					
	Percentage of people lives on Govt. service men =1					
House structure	House with pucca structure =1	4	4	4	4	4
	House with pucca floor and wall =2					
	House with pucca mud-made floor and wood wall =3					
	Katcha house structure =4					
Awareness	Most of the people are aware of landslide =1	1	1	1	1	1
	More than 50% people are aware =2					
	Less than 50% people are aware =3					
	Less than 25% people are aware =4					
Repair tool for housing development after a certain landslide.	Immediate availability of repair tool in low expense =1	4	4	4	4	4
	Availability in affordable expense =2					
	Availability in moderate expense after long time =3					

	No tool =4					
Infrastructure	Good =1	2	2	2	2	2
	Moderate =2					
	Satisfactory =3					
	Low =4					
Education	Honors' or above=1	4	4	4	4	4
	Higher Secondary=2					
	Primary / Secondary=3					
	Illiterate = 4					
Earning Member	3 or above persons=1	4	4	4	4	4
	3 persons=2					
	2 persons=3					
	1 person= 4					

Source: Author, 2008 & Chittagong City Corporation, 2007.

For assessing the vulnerability certain areas have been taken under consideration where the maximum hills are located in Chittagong City Corporation area. These areas are Lalkhan Bazar, Motijhorna, Pahartali, Oxygen, Politechnic, Bayezid Bostami, Foy's lake, Panchlaish, Khulsi (For details see appendix-2). But according to Questionnaire Survey and the data gathered from Chittagong City Corporation there are five areas which are more vulnerable than other areas and these are Lalkhan Bazar, Motijhorna, Foy's Lake, Pahartali and Khulsi. These areas are vulnerable because there are lack of education, repair tool for housing development, lack of awareness, less earning members and lack of education. So from the analysis the vulnerable areas are shown in the map.

Figure 11: Vulnerable Area and Structure on the Hill in the CCC Area



3.2. Existing planning interventions

Planning intervention is that section of planning which helps to restrict the haphazard development and smoothen the way of development. It is interesting to know that there are rules of permitting hill cutting and the punishment of violating the conditions of hill cutting but not the rules of conserving hills in our country. After the independence of Pakistan from the British rulers, the necessity of hill cutting became inevitable because of the industrial development in the then East Pakistan. Industrial areas in East Naziabad, Sholoshahar, Pahartoti and Fauzderhat are developed in the early 50's are more or less contributed to the hill cutting. Some hilly areas were proposed to be developed as the industrial area in the Master Plan prepared by Chittagong Development Authority in 1961. There are many policy and regulations which are directly or indirectly related to landslide mitigation. These policy and regulations and their drawbacks are given below given below:

3.2.1. Chittagong metropolitan master plan 1995-2015(direct)

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. The guidelines related to hills are-

guide. 01: Take environmental issues into account in all decision related to the future development of Chittagong.

guide. 04: Ensure that hill cutting is carried out with a view to creating developable sites needed within the next five to ten years and that it is carried out in a way that minimizes the adverse environmental impacts.

The process of approval of the projects as practiced by Chittagong Development Authority (CDA) is not subjected to the submission of Environmental Impact Assessment (EIA). CDA, on the other hand, could not adopt any alternative efficient tools to take environmental issues in to account.

Drawbacks

The need for this sanction provided the opportunity for the Government to impose conditions on hill cutting which address the environmental impacts identified above. But the reality is no specific development guideline for creating developable sites by hill cutting (more precisely, trimming of the hills) could be made by the authority. So the hill owners took the full advantage of the absence of any guideline.

3.2.2. Detailed Area Plan for Chittagong City 2007(Direct)

Chittagong Development Authority has prepared a set of detailed development guidelines for Chittagong city called **Detailed Area Plan for Chittagong City 2007**. In this planning report, the whole city has been divided in to 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. The detailed Area Plan has classified the hills in to several categories depending on the level of their destructions and forest covering. During the period of plan preparation, a massive land slide took place in the city due to excessive rainfall on June 11, 2007. At least 116 people died in the incidence. Consequently the guidelines or the suggestions given in the report regarding hills are predominantly about protection of lives and property of the city people.

In the Master plan of Chittagong City prepared in 1995, particular attention has been given for the protection and improvement of urban environmental quality. It has been guided to take into consideration the environmental impact assessment related to all development activities of Chittagong. It is the recommended policy to accept a sustainable level of development and try to avoid all possible environmental conflicts.

3.2.3. Comparative discussion between Master Plan 1961 and Master Plan 1995 in terms of hills' land use. (Direct)

3.2.3.i. Master Plan 1961: The plan was based upon four strategic assumptions:

- a) The port would continue to be important
- b) The central business area should be retained
- The development of the low-lying area west of the Dhaka trunk road and southwards towards Muga would continue and
- d) The urban population, growth rate would be 2.25%.

Hill cutting was considered, with the comments that steep slopes would lead to excessive erosion, which in turn would endanger the stability of residences and cause silting of water courses at the foot of the hills.

The report concluded that

Prohibition of hill cutting would be impracticable, and recommended an orderly allocation of hilly areas to be cut, with stringent control of development in hill areas in order to prevent any possible development areas becoming sterilized.

Drawbacks of the report

The Master Plan of 1961 permitted controlled cutting of hills. But in reality, the scale of hill cutting was massive, because, hill cutting was proved to be very profitable to the land speculators.

3.2.3.ii. Master Plan 1995

Structure Plan, one of the four components of the Master Plan 1995, consists of seventy six policies in twelve different sectors of development. Environment is one of the sectors which describe the policies relating hills and the hill ecology. The policies are-

guide. 01: Take environmental issues into account in all decision related to the future development of Chittagong.

guide. 04: Ensure that hill cutting is carried out with a view to creating developable sites needed within the next five to ten years and that it is carried out in a way that minimizes the adverse environmental impacts.

Drawbacks

The need for this sanction provided the opportunity for the Government to impose conditions on hill cutting which address the environmental impacts identified above. But the reality is no specific development guideline for creating developable sites by hill cutting (more precisely, trimming of the hills) could be made by the authority. So the hill owners took the full advantage of the absence of any guideline.

3.2.4. East Bengal Building Construction (EBBC) Act 1952(Direct)

In Section 3 of the East Bengal Building Construction Act 1952, it is described,

“.....no person shall, without the previous sanction of an Authorized Officer, construct or reconstruct or make additional or alteration to any building or excavate or re-excavate any tank within the area to which this act applies.”

Drawbacks

It is remarkable here that the act has specific guideline for any construction or the excavation of ponds. But being the common law of the country there is no direction for hill. So the hilly areas like Chittagong or Sylhet the act needed to be amended. In the next four decades, through much experimentation, the act was amended in the year 1990.

3.2.5. Bangladesh Environmental Conservation Act 1995(Indirect)

The section 5 of this act is.....

If the Government is satisfied that an area is in an environmentally critical situation or is threatened to be in such situation, the Government may, by notification in the official Gazette, declare such area as an ecologically critical area.

Referring to this act, the director of environment department, Chittagong Mr. Nazmul Haque stated that when a hilly area is declared to be environmentally critical by the Government, only then DoE could intervene to that matter. It is not clearly stated in any section of this law that hills should not be demolished.

3.2.6. Major Drawbacks of the Laws and their Solutions

Operational Issues

- ✓ Integrating landslide concerns in development of Multi-hazard Disaster Management Plans at national, regional and local levels is absent.
- ✓ Creating Network of knowledge based institutions dealing with landslide studies for effective implementation of national landslide agenda.
- ✓ Management of change from outmoded technologies of landslide remediation to state-of-the-art technology based landslide control.
- ✓ Private sector and Insurance sector participation in environmental protection of slopes.
- ✓ Establishment of Disaster Knowledge Network (a network of networks) and national clearinghouse of information embedding landslide mitigation measures in development plans.
- ✓ Landslide education, public awareness and local capacity building.
- ✓ International linkages, cooperation and joint initiatives (for examples-under SAARC).

Administrative Issues

- ✓ Introduction of progressive landslide project implementation and monitoring guidelines and writing of handbooks and Manuals for adoption.
- ✓ Streamlining the procedures for speedy funding of priority/fast track projects.
- ✓ Seeding the concept of landslide prevention, and opportunity costs in administrative management of landslides.

Financial Issues

- ✓ Criteria for disbursement of funds for servicing different areas of landslide mitigation and minimizing the gaps.
- ✓ Building costs on preventive action and long-term maintenance of major problematic slope development budget.
- ✓ Creating techno-financial regime for landslide project implementation.

- ✓ Disbursement of landslide mitigation funds to non-governmental agencies and organizations and create a bridge between GO's and NGO's.

Regulatory Issues

- ✓ Introduction of policies for sound slope protection, planned urbanization, regulated landuse and environment friendly land management practices.
- ✓ Strong law against environmental violence and unhealthy construction practices
- ✓ Law governing new constructions on problematic slopes and in the landslide prone areas.

In a case study of Mr. Tazmilur Rahman, Asst. Director, DoE, Chittagong, addresses from the Bangladesh Environmental Conservation Act 1995 , section 15 (1) that the maximum range of penalty for offence is given as 10 lakh taka or 10 years imprisonment or by both. But the lower range is not described. So a person can avoid punishment of the maximum range of time or money for the absence of the lower range. This lacking should be minimized considering the real facts.

But the major drawbacks of the interventions are there is a wide variety between actual necessity of society and regulation prescribed to control landslide. There must be a connecting bridge between the society's actual need and the prescribed regulations.

CHAPTER FOUR

DISCUSSION AND CONCLUSION

4.1 Open discussions

It was found that very few voluntary social welfare agencies or urban community development projects of the Department of Social Welfare run direct and specific programmes for the welfare of slum dwellers. The municipalities which are in many ways concerned with providing community services and facilities to the city dwellers do not generally provide any services specifically to the slum population. In the past, efforts were made to transport the floating population of the slums of Chittagong city to places earmarked on the outskirts of the city but the result was not encouraging. But, unless appropriate action is taken to improve the living conditions of these shanty areas and counter the trend of migration of people from rural to urban areas, urban conditions will deteriorate even further. Some case study will portray the existing picture of the study area.

4.1.1. From generalized point of view

Abdul Malik, Age: 54 years, Motijharna Bosti, Chittagong University Campus

“There is lack of proper accessibility because the width of access road is only two feet. There is also problem of light and air circulation. Improper waste collection and disposal system make the area unhealthy. Maximum household income is less than 1500-3000tk. /month and family size is very high (more than 5persons/family) to afford them within this income. So the young’s are not interested in education, health awareness and training which through them to informal activities.”

Hence being poor is by itself a useful vulnerability indicator. Taking into account that poverty is a multidimensional concept that has many dimensions and the poor are a heterogeneous group with large proportion of the poor moving into and out of poverty. We look at a few poverty measures including hardcore food poverty (measured by the percentage of population with the calorie intake lower than 1850kcal/capita/day), as being at the margin of starvation leaves little capabilities to adapt to any negative stock.

4.1.2. From specialized point of view

Meeting the Millennium Development Goals (MDGs) is extremely challenged in many communities and countries by losses from landslides triggered by natural hazards. The destruction

of infrastructure, the erosion of livelihoods, damage to the integrity of ecosystems and architectural heritage, injury, illness and death are direct outcomes of landslide. But landslide losses interact with and can also aggravate other stresses and shocks such as a financial crisis, a political or social conflict, disease and environmental degradation. And such landslide losses may set back social investments aiming or to protect the environment as well as economic investments that provide employment and income. Some professionals see this problem from their point of view and give some suggestions.

Dr. Shahidul Islam, Professor, Dept. of Geology, Chittagong University

“Causes of landslide in the hilly regions in Chittagong and to minimize its vulnerability are a lengthy process. 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. But for reducing landslide vulnerability there are some measures that need to be considered.

- ✓ To stop forest cleaning of the hills with stiff slope (more than 30°)
- ✓ To develop green coverage with tree plantation in the previously demolished hills.
- ✓ To take proper engineering measures to protect these demolished part of the hills
- ✓ To stop residential development, making brick fields, construction of roads and collection of sands

Hill cutting as the social problem and it should be conserved to protect the earth’s natural topography. It is hard to imagine what could be the extent of revenge of the nature if it is not handled carefully.”

Mr. Ali Ashraf, Chairman, Institution of Engineers (IEB), Chittagong

“It is our 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”

Town planner, Chittagong development authority

“Room occupancy by households shows the pattern of congestion in the living environment. In Chittagong according to Chittagong city corporation congestion is that acute as usually found in

large cities. Only about 27 percent of the households live in one room house, most of whom are poor living in slums or squatters settlements. In terms of floor space nearly 67 percent of the households use less than 60sq ft. The poor in slums and squatter settlements use up to 400 sq .ft on average. In general Chittagong City most of the residential units are one storied and there is very little vertical expansion. Both physical and economic constraints are responsible for such low height development.”

From the above discussions it is clear that there is a complex relationship between environmental risk, poverty, and vulnerability in a concrete case studies carried out from different perspective of the society focusing on household and community vulnerability and adaptive coping mechanisms. Building upon the growing theory and empirical evidence regarding these relationships, it is clear that there is strong relationship between relation between Disaster and Development and these are given below:

DISASTER-DEVELOPMENT		
Issues	Economic Development	Social Development
Disaster limits development	Destruction of fixed assets, loss of production capacity, market access or material inputs, damage to transport, communications or energy infrastructure, Erosion of livelihoods, savings and physical capital.	Destruction of health or education infrastructure and personnel, death, disablement or migration of key social actors leading to an erosion of social capital.
Development cause disaster risk	Unsustainable development practices that create wealth for some at the expense of unsafe working or living conditions for others or degrade the environment.	Development paths generating cultural norms that promote social isolation or political exclusion.
Development reduces disaster risk	Access to adequate drinking water, food, waste management and a secure dwelling increases people’s resiliency. Trade and technology can reduce poverty. Investing in financial mechanisms and social security can cushion against vulnerability.	Building community cohesion, recognizing excluded individuals or social groups (such as women), and providing opportunities for greater involvement in decision-making, enhanced educational and health capacity increases resiliency.

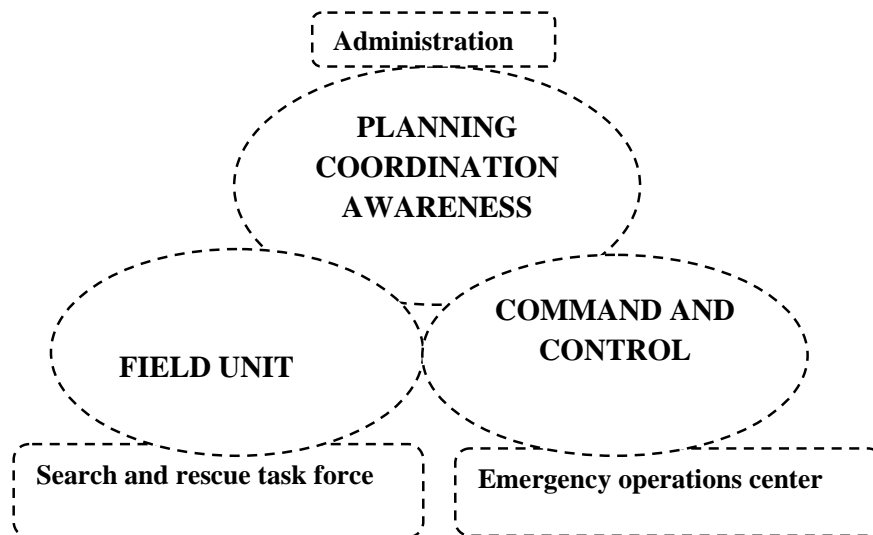
4.1.3. Existing planning interventions in a developed country (INDIA)

4.1.3. i. India's national disaster management plans strategy

Consistent with the national approach, Mumbai's Disaster Management Plan refers to its goals of mitigation strategy as:

- To substantially increase public awareness of disaster risk so that the public demands safer communities in which to live and work.
- To significantly reduce the risks of loss of life, injuries, economic costs, and destruction of natural and cultural resources that result from disasters.

They also contain a multi-hazard response structure, capability analysis, including an inventory of resources, and mitigation strategies, apart from a directory of personnel and institutions in the districts with their contact addresses, telephone and fax numbers.



The administration deals with planning, coordination and awareness issues. Planning has been working on a multi-hazard disaster plan, a micro-level resource chart, a response strategy for subversive activities and the composition of an experts group on DM (Disaster management). Effective coordination among all involved agencies for effective response has been one of the major concerns and awareness creation has included various campaigns to sensitize and inculcate concepts about disasters, safety measures etc, among school and college students, teachers, governmental organizations and NGOs.

4.1.3.ii. Features of the draft national policy on disaster management

The status report of Disaster Management in India (2004) summarizes the broad features of the draft national policy on disaster management as follows:

- ⊗ A holistic and pro-active approach towards prevention, mitigation and preparedness will be adopted for disaster management.
- ⊗ Each Ministry/Department of the Central/State Government will set apart an appropriate quantum of funds under the Plan for specific schemes/projects addressing vulnerability reduction and preparedness.
- ⊗ Where there is a shelf of projects, projects addressing mitigation will be given priority. Mitigation measures shall be built into the on-going schemes/programmes.
- ⊗ Each project in a hazard prone area will have mitigation as an essential term of reference. The project report will include a statement as to how the project addresses vulnerability reduction.
- ⊗ Community involvement and awareness generation, particularly that of the vulnerable segments of population and women has been emphasized as necessary for sustainable disaster risk reduction. This is a critical component of the policy since communities are the first responders to disasters and, therefore, unless they are empowered and made capable of managing disasters, any amount of external support cannot lead to optimal results.
- ⊗ There will be close interaction with the corporate sector, nongovernmental organizations and the media in the national efforts for disaster prevention/vulnerability reduction.
- ⊗ Institutional structures/appropriate chain of command will be built up and appropriate training imparted to disaster managers at various levels to ensure coordinated and quick response at all levels; and development of inter-State arrangements for sharing of resources during emergencies.
- ⊗ A culture of planning and preparedness is to be inculcated at all levels for capacity building measures.

- ⊗ Standard operating procedures and disaster management plans at state and district levels as well as by relevant central government departments for handling specific disasters will be lay down.
- ⊗ Construction designs must correspond to the requirements as laid down in relevant Indian Standards.
- ⊗ The existing relief codes in the States will be revised to develop them into disaster management codes/manuals for institutionalizing the planning process with particular attention to mitigation and preparedness.
- ⊗ To promote international cooperation in the area of disaster response, preparedness, and mitigation in tune with national strategic goals and objectives.

From the above discussion there arise the following questions that need to be solved for landslide hazard mitigation and vulnerability reduction. These are

- **Research** — Is there any predictive understanding of landslide processes and available triggering mechanism to cope natural disaster for the study area?
- **Vulnerability assessments**— Is there any guideline present to delineate susceptible areas and different types of landslide hazards at a scale useful for planning and decision making?
- **Real-time monitoring**—Is there is any active landslides monitoring system available to mitigate substantial risk?
- **Loss assessment**— Any method for compiling and evaluating information on the economic impacts of landslide hazards present there?
- **Public awareness and education** —Is there a developed information and education system available for the user community?
- **Implementation of loss reduction measures**—Is there any effective mitigation action prevailing for the area?
- **Emergency preparedness, response, and recovery**— what measures should be taken to built a resilient community?

For minimizing the landslide vulnerability the strategies should be as follows:

Element 1: Research

For this strategic approach the following measures has to be taken into consideration

- Develop a national research agenda and a multiyear implementation plan based on the current state of scientific knowledge concerning landslide hazard processes, thresholds, and triggers and on the ability to predict landslide hazard behavior.
- Develop improved, more realistic scientific models of ground deformation and slope failure processes and implement their use in predicting landslide hazards nationwide.
- Develop dynamic landslide prediction systems capable of interactively displaying changing landslide hazards in both space and time in areas prone to different types of landslide hazards (for example, shallow debris flows during intense rain, deep-seated slides during months of wet weather, and rock avalanches during an earthquake).

Element 2: Hazard Mapping and Assessments

Landslide inventory and landslide susceptibility maps are critically needed in landslide-prone regions of the Nation. These maps must be sufficiently detailed to support mitigation action at the local level. The following actions will provide the necessary maps and assessments and other information to officials and planners to reduce risk and losses:

- Develop and implement a plan for mapping and assessing landslide and other ground-failure hazards nationwide
- Develop an inventory of known landslide and other ground-failure hazards nationwide.
- Develop and encourage the use of standards and guidelines for landslide hazard maps and assessments.

Element 3: Real-Time Monitoring

Development and application of real-time monitoring of active landslides using state-of-the-art research and telecommunications technologies are critically needed nationwide in cases of imminent risk. The following actions will provide the necessary warning and other information to officials and communities to avoid or reduce losses:

- Develop and implement a national landslide hazard monitoring and prediction capability
- Develop real-time monitoring and prediction capabilities on both site specific and regional scales, to assist national, regional, and local emergency managers determine the nature of landslide hazards and the extent of on going risks.

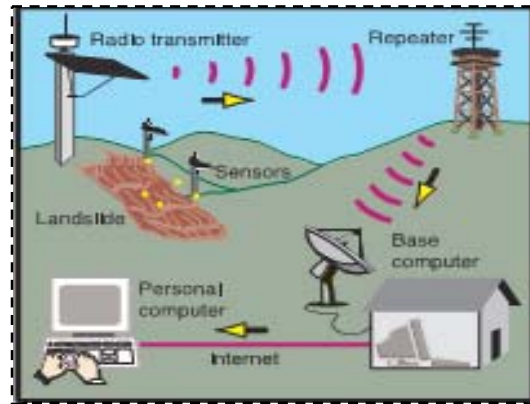


Figure: Network for transmission of real-time landslide data.

- Apply remote-sensing technologies such as Synthetic Aperture radar and laser altimetry for monitoring landslide movement nationwide
- Incorporate state-of-the-art techniques such as micro seismicity and rainfall and pore-pressure monitoring with hydrological based models of slope stability and global positioning systems (GPS).

Element 4: Loss Assessment

The following actions will provide a framework for compiling and assessing a comprehensive data base of losses from landslides and other ground failure hazards, which will help guide research, mapping, and mitigation activities nationwide:

- Assess the current status of data on losses from landslides and other ground failures nationwide, including the types and extent of losses to public and private property, infrastructure, and natural and cultural resources
- Establish and implement a national strategy for compilation, maintenance, and evaluation of data on the economic and environmental impacts of landslide and other ground-failure hazards nationwide to help guide mitigation activities and track progress.

Element 5: Information Collection, Interpretation Dissemination, and Archiving

The following objectives will make landslide hazard information accessible to scientists, officials, decision makers, and the public to assist research, planning, policy, and mitigation activities:

- Evaluate and use state-of-the-art technologies and methodologies for the dissemination of technical information, research results, maps, and real-time warnings of potential landslide activity
- Develop and implement a national strategy for the systematic collection, interpretation, archiving, and distribution of this information.

Element 6: Guidelines and Training

The following are high priority objectives related to guidelines and training:

- Develop and implement guidelines and training for scientists and geo- technical engineers in the use of landslide hazard and other technical information for mapping and assessing landslide hazards
- Develop and implement guidelines and training for scientists and geo- technical engineers for responding to landslide disasters and providing needed scientific and technical information for response and recovery efforts
- Develop and implement guidelines and training for planners and decision makers in the use of landslide hazard maps, assessments, and other technical information for planning, preparedness, and mitigation.

Element 7: Public Awareness and Education

Achieving widespread public awareness of landslide hazards will enable communities and individuals to make informed decisions on where to live, purchase property, or locate a business. Local decision makers will know where to permit construction of residences, business, and critical facilities to reduce potential damage from landslide hazards. The following actions will raise public awareness of landslide hazards and encourage landslide hazard preparedness and mitigation activities nationwide, tailored to local needs:

- Develop public awareness, training, and education programs involving land-use planning, design, landslide hazard curriculums, landslide hazard safety programs, and community risk reduction
- Evaluate the effectiveness of different methods, messages, and curriculums in the context of local needs.
- Disseminate landslide-hazard-related curriculums and training modules to community organizations, universities, and professional societies and associations.

Element 8: Implementation of Loss Reduction Measures

A successful strategy for reducing landslide losses must also include a mitigation component. Mitigation actions generally fall to National and local governments, businesses, and individuals. Mitigation measures at the local level include a range of tools and techniques, such as land-use planning, regulation of development, engineering controls, building codes, assessment districts, emergency planning and warning, and private financial and insurance incentives and disincentives. The following actions will facilitate and encourage implementation of appropriate and effective mitigation measures that are tailored to local needs:

- Develop an education program for national and local elected and appointed officials that sensitize them to the risk and costs of landslide hazards and encourage them to develop legislation and policies that support effective landslide hazard mitigation.
- Develop and disseminate prototype incentives and disincentives for encouraging landslide mitigation to government agencies, the private sector, and academia.
- Evaluate engineering and construction approaches to mitigate landslide hazards and develop a national plan for research to improve these techniques.
- Encourage implementation of successful landslide mitigation technologies

Element 9: Emergency Preparedness, Response, and Recovery

Despite improved landslide hazard mitigation, disasters will occur. For this reason, governments at all levels, the private sector, and the public will need to be able to adequately prepare for, respond to, and recover from disasters involving landslides. Governments will need to better plan for landslide emergencies. Scientists, engineers, and emergency response professionals will need to be trained in the best practices to employ during a response, and public officials responsible for recovery from disasters will need to be informed of options that will reduce future landslide losses. Incorporating the following actions in a national landslide mitigation strategy will improve the Nation's ability to respond to and recover from landslide disasters:

- Provide training for National, Regional, and local emergency managers on landslide hazards preparedness, response, and recovery.
- Develop a coordinated landslide rapid response capability to assist National, Regional, and local emergency managers in determining the nature of landslide hazards and the extent of ongoing risks.
- Provide dedicated landslide expertise and equipment required for rapid emergency deployment of real-time data to emergency managers, as well as the ability to successfully transfer monitoring technology to other agencies.

4.2. Recommendation

4.2.1. Following Proposals were made in the Detailed Area Plan Project to protect the hills

- ⊕ Hill cutting will not be permitted.
- ⊕ Any kind of residential, industrial or commercial use shall not be permitted in the hilly area.
- ⊕ Hills retained intact shall be protected by intensive forestation
- ⊕ Partially damaged hills must be protected by retaining walls or vegetation.
- ⊕ Any project in the hilly topography particularly major road projects must be subject to Environmental Impact Assessment.
- ⊕ Residential, commercial or industrial use may be permitted at a distance of 100m away from foothill.
- ⊕ Location of brickfields should be relocated outside the city.
- ⊕ Institutional or residential building may be permitted in the previously damaged hills with low ground coverage (10% to 30%) subject to the forestation scheme.
- ⊕ One off type of buildings for single family use may be permitted on the hill top with only 10% ground coverage.
- ⊕ Experts' opinion must be taken from R & H and Bangladesh Army to construct road in the hilly region.
- ⊕ Sufficient silt trap and water reservoir must be provided to undertake any project in this region.
- ⊕ Bridges or culverts shall be provided so that natural water flow is not hindered in case of road construction.

But the following major items should be the prime concerns for any plan adoption.

- ⊗ **Hill Cutting:** Stop all types of hill cuttings, either in a new area or in locations currently being cut by an individual, group, society or institutional level. Hills which have already been cut and made level for housing purposes can no longer be allowed to develop as high or middle density residential areas. However, very low density houses for individual uses, structural development of no more than 10% of total area and buildings up to 3 floors can be permitted.
- ⊗ **Vegetation Coverage:** Keeping pace with the forest policy and environmental policy of the Government, it is necessary to keep at least 15% of the city landscape under vegetation/ forest coverage. It can be achieved through the development of green belt along the sea shore, along the river front line, on the existing and altered hill areas, along the khal bank lines, remaining vacant areas for further development and also in the planning process for individual plot development.
- ⊗ **Water Pollution:** No industrial activities would be allowed to continue on the sea / river bank side unless toxic and hazardous effluences are treated at an acceptable level at their own cost before discharging in to the sea/ river water.
- ⊗ **Water logging:** Widening of all drainage by immediate removal of all illegal occupancies, excavation of the major khals and turn those to natural tidal creeks, fix bank lines up to the reach of the tidal limit, create a green buffer zone up to 50-100 ft wide along the bank line.
- ⊗ **Open Space and Water Bodies:** Ensure the protection of Foy's lake water and the surrounding ecology from all types of legal and illegal developments, sound pollution, air pollution and water pollution. Protection of all existing ponds / tanks and water bodies of more than 0.5 acre.
- ⊗ **Air Pollution:** All brick field need to be relocated to far north from the city boundary, following the guidelines of brick field ordinance 2001.

4.2.2. Development needed hill cutting, but with some rules

Cutting or razing of hill is permissible on fulfillment of five conditions:

- 1) Cutting or razing of hill shall not cause any serious damage to any hill, building structure or land adjacent to or in the vicinity of the hill; or
- 2) Cutting or razing of hill shall not cause any silting of or obstruction to any drain, stream or river; or
- 3) Cutting or razing of hill is necessary to prevent the loss of life or property; or
- 4) Cutting of hill which is normally necessary for construction of dwelling house without causing any damage to hill; or
- 5) Cutting or razing hill is necessary in the public interest.

4.2.3. Environmental protection and enhancement

For the better environmental protection and enhancement the following ten Point Agenda should be followed for any plan adoption is given below:

- Environmental Impact Assessment (EIA) should be given priority for any project approval and implementation. Alignments can only be confirmed after such evaluation. Thus all major road projects will be indicative of a need for connection. The current projects should be reviewed to take environmental considerations in mind and to control damage and to ensure water management.
- Efforts will be made to repair the eroding hills and stabilize the edges, so as to stop all further damage. Through dialogue with housing societies, developers and land owners, the Authority will ensure minimum provision of open spaces, play ground, and other community facilities by the as per Govt. rules 2004. The Authority may impose further conditions as is relevant.
- All H1 type hilly lands have to be retained and further hill culling strictly controlled. Such hills are mostly located north of the Foy's lake area, railway land at Pahartali,, Battali hill, Prabartak hill, FRI hill, and Ispahani hill. However, amongst permitted projects building coverage should be limited to 10% of site area. Subject to environmental protection and sustainable hill slope development. Low density residential and institutional and community use may be permitted taking full account of water management and slope protection.

- To delineate the boundary between the hills and dissected plains and also between dissected plains and industrial zone, 100m wide forest buffer zones is recommended. Such zone will limit the expansion and encroachment of each land use type and enhance the physical environmental quality of the area.
- The aesthetic environment of MotiJharna hill should be enhanced with trees, plants and vegetation cover.
- Five hilly sites of various sizes under various uses are owned by the government and private landowners. The existing hilly character should be protected and very low density residential and urban amenity development will be permitted. Expansion of industries will not be permitted. The Authority should ensure enhancement of the natural hilly environment.
- To reduce the deadly effect of cyclone and storm surges and act as a shield a seaside mangrove green belt, extending from the embankment to low tide limit is recommended. There will be gaps (100m on both sides) of the natural, khals and natural creeks.
- To reduce further vulnerability due to surges, development of a green corridor along the landward side of the coastal embankment by non-mangrove native species is recommended. A tree plantation zone of varying width is recommended on the landward side of the coastal embankment.
- To reduce the deadly effect of cyclone and storm surges and act as a shield a sea side mangrove green belt, extending from the embankment to low tide limit is recommended. There will be gaps (100m on both sides) of the natural khals and natural creeks. Measures should be taken to facilitate visitors (elevated walkways, boat berthing decks etc).
- An interceptor khal may be thought of at the base of the hills, at the least one hundred yards from the base of the hills. Basing on the physical feature survey map, the bases of the hills are identified in the detail area plan. These interceptor khals, in addition to slowing down the surface run off, will also work as silt trap, eventually reducing the silt load coming to the drainage system.

4.2.4. Responsibility before, during and after a Landslide

Some precautions can minimize the severity of landslide and these are:

PREPARE FOR A LANDSLIDE

- Learn to recognize the landslide warning signs.
- Look for drainage patterns on slopes near your home noting where flow increases over soil-covered slopes. Check these slopes for signs of land movement, such as small slides or flows or even increasingly tilting trees — changes could alert you to a greater landslide threat.
- Minimize home hazards — plant ground cover on slopes and build retaining walls.
- Make evacuation plans — plan at least two evacuations routes since roads may become blocked or closed.
- Safe areas include slopes that have no movement history, flat-lying areas away from sudden changes in slope, and areas along ridges away from tops of slopes.
- **BE ESPECIALLY ALERT WHEN DRIVING.** Embankments along roads are particularly susceptible to landslides.

DURING A LANDSLIDE

- Quickly get out of the path of the landslide or mud flow, **RUN UPHILL** to the nearest high ground in a direction away from the path. If rocks and other debris are approaching, run for the nearest shelter such as a group of trees or a building.
- If escape is not possible, curl into a tight ball and protect your head.

AFTER A LANDSLIDE

- Stay away from the slide area, there may be danger of additional slides. Remember that flooding may occur after a landslide.
- Check for injured and trapped persons near the slide, without entering the direct slide area. Direct rescuers to their locations
- Listen to a battery-operated radio or television for the latest emergency information.
- Check building foundations, chimney, and surrounding land for damage. Check for damaged utility lines and report any damage to the utility company.
- Replant damaged ground as soon as possible since erosion caused by loss of ground cover can lead to flash flooding.

4.3. Conclusion

The area of the Chittagong metropolitan city is 60 square miles. Among them, 30sq miles are hilly area, five per cent of the hill peaks are filled with multistoried government, private offices and residences; five per cent of hills are bare without forest and unutilized and rest 20 per cent hills are under ownership private organizations. Although this city is no stranger to natural disasters, landslide of a major kind has never been recorded and would perhaps never have occurred unless the topography were rudely disturbed by human greed. About one lakh poor people live in different slums built up on the foot of the hill in the port city Chittagong.

The accelerated pace of urbanization has been accompanied by a concurrent pressure on urban services. The need for urban services multiplies with the rapid influx of migrating people, but often the authorities cannot provide the necessary services. In such a context, planning, as an instrument of redistribution for better housing, has resulted in a chaotic situation in Chittagong. The reorganization and reorientation of institutional arrangements to facilitate short planning periods rather than a grand master plan seems to be a more appropriate response. Long-term master plans underestimate the vibrancy and volatility of urban development. Appropriate policies should be adopted to settle the potential rural-to-urban immigrants at their places of origin by generating economic activities and creating employment opportunities, especially during slack agricultural seasons. It is absolutely necessary to prepare a national physical plan in order to determine the future of urban growth and development. At the same time, efforts should be made to improve the existing situations prevailing in the slums and provide basic services, following the principle of aided self-help and mobilizing the resources of both the communities and outside agencies. The strategy should be to render assistance to the poor and the under-privileged to enable them to secure a fair share of the benefits of development and become self-reliant and responsible members of society. Within this strategy, community development will have an important role to play, both in the urban setting, where the problems and possibilities of community development need to be further explored and in the slum areas, where it can have a significant role in programmes designed to halt the unplanned drift to the city and minimize the manmade disaster like Landslide.

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