Conference Paper

Hazard, Risk and Resilience: Overview of Two Major Urban Areas of Bangladesh

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Abstract

Bangladesh is known as one of the disaster-prone countries of the world. Geographical locations of the country and climate change phenomena make the country more vulnerable to a natural disaster. Most of the urban areas of the country are also susceptible to both geological and climatic hazards. These risks and vulnerabilities have been aggravated by poverty, rapid and unplanned urbanization of the country. The two major urban areas of the country including capital city Dhaka; the largest and main port city Chittagong are experiencing natural hazards, and the inhabitants of those areas are on risk. Due to the location of these two urban areas, different types of natural hazards are faced almost every year by the dwellers. The research reviewed local and global disaster framework, and recent literature works to assess the existing resilience scenario of these two cities. Informal interview of dwellers and local government officials was also conducted on both cities. This study tries to discuss the probable significant natural hazards of the two major cities of the country. The research also presents the existing resilience scenario of these two major urban areas in consideration of the global and local disaster management framework. The study will also try to suggest some recommendations to increase and improve the resilience of these significant metropolitan areas.

Keywords: Urban hazard, risk, resilience, Bangladesh

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1. Introduction

More than 50 percent population of the world is now living in urban areas. Due to the present high increase rate of the urban population, 65 percent of the world's population will be live in cities by the year 2030 and mostly in the developing world [1; 2]. The majority of the top 20 cities in the world are situated in Asia. Large cities are mainly vulnerable to a wide variety of hazards, with the majority of these populations living in high to moderate risk zones[2]. The large megacities of Asia including Dhaka, the capital of Bangladesh had experienced severe incidents of flooding, cyclone surges and earthquakes in the past decade [3]. Other Asian cities had faced urban flooding, intense rainfall, and landslide. This type of incident is increasing more by climate change phenomena [4]. Many least urbanized countries of the world are located in

Asia including Bangladesh where less than 30 percent population lives in urban areas. The urban population of Asia is increasing fast compare to other continents of the world. Out of 20 megacities in the world, 13 are located in Asia with more than 10 million populations[5].In these cities, more than 37% of urban people are living in slums and squatter settlements. Disasters have occurred both in developed and developing countries, but the developing countries' people are experiencing such incidents more intensely. Many cities have been affected by natural and human-induced disasters in the past. Urban disasters also made extraordinary impacts on city budgets, and due to these pressures, urban authorities require to shift budget from urban development to emergency response, evacuation, rehabilitation, and early recovery sectors[6]. As the intensity and occurrences of urban disasters have increased now-a-day, the urban authorities are on the pressure to cope with the situation and need to build and increase urban resilience to these disaster events.

Bangladesh(Figure 1) is located between 20^o to 26^o North and 88^o to 92^oEast[60]. It is bordered on the west, north, and east by India, on the south-east by Myanmar and the south by the Bay of Bengal.Most of the area of the country is low-lying land comprising mainly the delta of the Ganges and Brahmaputra rivers. Floodplains occupy 80 percent of the country. Mean elevations range from less than one meter on tidal floodplains, one to three meters on the main river and estuarine floodplains and up to six meters in the Sylhet basin in the north-east[7]. Only in the extreme northwest elevations are greater than 30 meters above the mean sea level. The northeast and southeast portions of the country are hilly, with some tertiary hills over 1000 meters above mean sea level[8]. Located between the Himalayas and the Bay of Bengal, the country is very prone to various natural disasters [9].Due to the geographical location of Bangladesh, all cities including the capital city Dhaka and largest port city Chittagong are vulnerable to both geological and climatic disasters. These risks and vulnerabilities have been aggravated by poverty, rapid and unplanned urbanization of the country. The present study tries to focus on two main urban areas existing disaster resilience scenario with consideration to global and national Disaster Risk Reduction (DRR). Different previous studies explained probable hazards for both cities and also explained about hazards that created a negative impact in the past. As DRR get more attention to the present time, it is necessary to consider the DRR scenario of urban areas. This study will give an impression of the present condition and how we can incorporate DRR on plans, strategies, and policies for the improvement of the present condition.

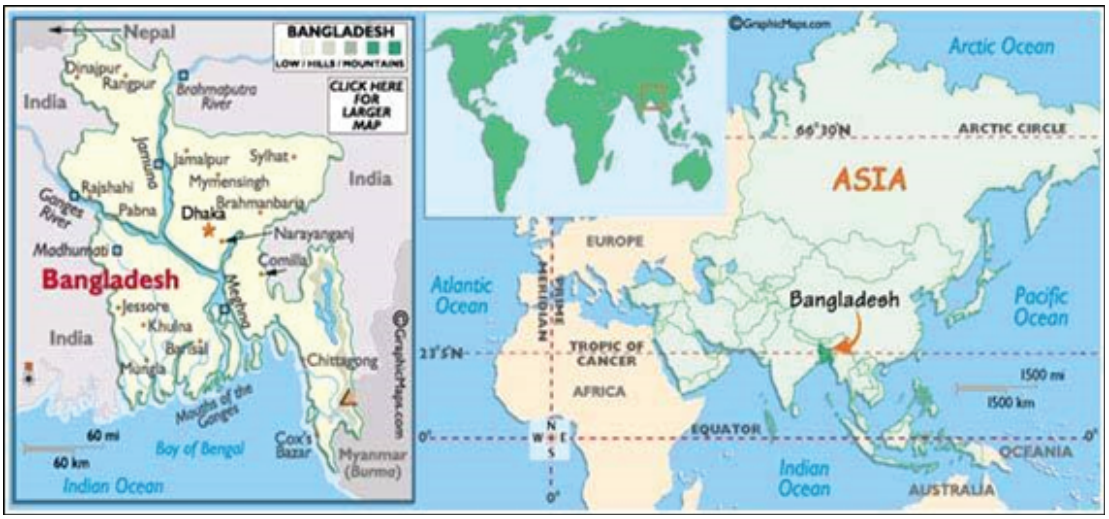

Figure 1: Location of Bangladesh [61].

2. Materials and Methods

This study considered secondary information as predominant sources of information. Several relevant papers, journals, books, international and governments reports and policies were reviewed. Qualitative information was considered for the study. The first step of the study was to assess the existing global and local frameworks and policies of disaster. Selection of urban areas was based on hazard, risk, exposure, and importance of the urban areas within the country. Informal discussion was also conducted to know the local government organizations current status.

3. Results and discussion

3.1. Global framework for disaster risk reduction and resilience

Disaster Risk Reduction (DRR) has attained more concern compared to disaster response and recovery of development initiators, designers, and scholars [2].According to ISDR (2004), DRR makes all efforts to minimize human vulnerability and disaster risk to prevent or reduce the adverse impacts of hazards within the broad context of sustainable development[10]. United Nations World Conference on Disaster Reduction (UNWCDR) 2005 in Kobe, Japan was the turning point in the history of global disaster risk management systems[2]. The Hyogo Framework for Action building the resilience of different nations and communities to disaster, which was the outcome of UNWCDR. UNWCDR insisted every nation work on five priority areas HFA[11]. HFA 2005–2015 is the agreed structure with five priority of action for making the world safer from extreme

events and enhancing community resilience against disasters. HFA has guided to reduce disaster risk and to achieve the UN's Sustainable Development Goals. But disasters continue to undermine efforts to achieve sustainable development in the developing world after the adoption of HFA. Sendai Framework for Action (2015-2030), with its four priority of action, comes out for the substantial reduction of disaster risk. Sendai Framework (SFDR) is the first major agreement of the Post-2015 development agenda. The UN Member States adopted the Sendai Framework for Disaster Risk Reduction 2015-2030. The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015[2]. The global framework of disaster resilience is also connected and considered by global development framework MDGs (2000-2015), SDGs (2016-2030), Asian Regional Plan for Disaster Risk Reduction (ARPDRR) and SAARC Framework for Action (SFA).

3.2. National framework for disaster risk reduction and resilience

Bangladesh's regulative framework for disaster management provides relevant legislative, policy and best practice framework under which the activity of disaster risk reduction and emergency management in Bangladesh is managed and implemented.National Disaster Management Act-2012, National Disaster Management Policy 2015, Standing Order on Disaster (SOD) 1997 which was revised in April 2010, National Plan for Disaster Management (NPDM) 2010–2015 are the key documents guiding the disaster management works in Bangladesh. The disaster management plan was prepared in consideration of Hyogo Framework for Action 2005–2015 and the SAARC framework on Disaster Management [12].Draft National Plan for Disaster Management (NPDM 2016-2020) is the successor of previous NPDM 2010-2015. Draft NPDM 2016-2030 aligned with recently established SFFDRR 2015-2030 which was also followed in ARPDRR.NPDM 2016-2020 differs in its framework from the previous NPDM 2010-2015 by aligning with recently established global and regional frameworks[13].Bangladesh is considered one of the most vulnerable countries in the world due to climate change and sea level rise concern [14].In 2005, Bangladesh became one of the first least-developed countries to prepare its National Adaptation of Action (NAPA) by the Ministry of Environment and Forest which was updated in 2009[15].In 2008, the country went a step further and prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), which was also later revised in 2009 [16].The country aligns its DM strategies and plans with SFDRR, Sustainable Developments Goals (SDGs) and Global Climate Agreement such

as the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol.

Bangladesh is also shifting from reactive responses to a proactive disaster risk reduction culture. This approach emphasizes to hazard identification, mitigation, community preparedness, capacity building, enhancing community resilience, planning, management and addressing the issues of vulnerabilities. After the declaration of HFA (2005-2015) which was followed by SFA (2015-2030), the country is trying to mainstream DRR in their development efforts [24]. Ministry of Disaster Management and Relief (MoDMR) of the Government of Bangladesh has the responsibility for coordinating national disaster management efforts across all agencies. The National Disaster Management Council (NDMC), headed by the Prime Minister, is the supreme body for providing overall direction for disaster management which includes disaster risk reduction, mitigation, preparedness, response, and recovery. The goals and activities of DM for the 7^{th} Five Year Plan integrated the four priority areas of SFFDRR[13]. Apart from NDMC, various coordination and advisory committee and programs have been formed to reduce urban disaster risks. Government agencies also introduced and enforce different acts and policies to control urban growth, regulate land use, population density and building construction[24].

3.3. Urban hazard, risk, and resilience

Hazard can be defined as an event or an occurrence which possesses the potentiality to damage. This event caused by natural elements or human activities. The term damage largely focuses on human damage, i.e. loss of life, injury, property damage. Smith (2013) defined a hazard as a potential threat to humans and their welfare arising from a dangerous phenomenon or substance that may cause loss of life, injury, property damage, and other community losses or damage The most significant word in the definition of Hazard is “potentiality”. If an event with terrible capacity to damage happens in an abandoned area, it cannot be termed as a hazard because it has no scope to harm human life and activities. So the space of the event is a key issue to define an event as a hazard. The term “Exposed” needs some attention. If someone is not exposed to an event then it does not hazard. When large numbers of people exposed to the hazard are killed, injured or damaged in some way, the event is termed as a disaster. So a disaster may be seen as the realization of hazard, although there is no universally agreed definition of the scale on which loss has to occur to qualify as a disaster. In general, risk means the possibility of occurrence of a hazard on a certain scale [17].

Alexander (2000) concerned about the particular loss created by the hazard to define the risk. Probability of damage or loss created by a particular hazard occurrence in an area where human beings and their assets are available can be considered as a risk. The term risk is related to both vulnerability and resilience. Resilience has become an important concept in natural hazards research in recent years and the development of disaster reduction at the local, national, regional and global levels[18]. According to Tierney and Bruneau, (2007) “Resilience may be considered as the capacity of physical and human systems to respond and recover from extreme events” [19].

More than 95 percent growth of the population in developing countries will take place in urban areas by the next 20 years [20]. So the increase of urban vulnerabilities has also become a reality [21]. Urban local governments have the primary responsibility for implementing all the necessary measures to save the inhabitants life and their assets from different hazards, reduce the risk from hazards and to increase the resilience to recover from the hazards. Since city governments have the power and responsibility to protect residents and their assets, DRR and enhancing the city’s disaster resilience must be an integral part of urban planning and investment [10]. The concept of urban resilience means the capacity of a city to bounce back effectively and quickly from the impacts of a disastrous event [22]. So urban authorities need to prepare a disaster management plan, and HFA insisted almost all nations incorporate DRR into their urban risk reduction plans. Mainstreaming DRR in city/urban planning policy may help to minimize the impact of disasters on urban people lives. In urban risk reduction planning, prevention is less costly than post-disaster reactions and early recovery and resilience may reduce the extent of any damage from a calamity[6]. City resilience is considered as the ability of an established system to cope with and withstand the impact of a major disaster and recover quickly to normal city functioning.

However, resilience largely varies from city to city, depending on the use and application of resilience methods.

Similarly, vulnerability and exposure to such events also vary from city to city [2]. Asia is known as the epicenter of urban surge due to the rapid urbanization trend in seven developing countries of Asia including Bangladesh [23; 24]. Some cities are extremely vulnerable to coastal hazards, like Chittagong from Bangladesh. The urban agglomerations in the Ganges-Brahmaputra Deltaic region (Bangladesh) are exposed to various coastal hazards. Some Asian cities are exposed to river flooding including Dhaka. Earthquakes are another type of devastating event, to which many cities in Asia including some urban areas of Bangladesh are comparatively more vulnerable [2].

Several city governments in Asia are taking significant steps toward enhancing their cities' resilience and reducing disaster risks. As the rate of urbanization is highest in Asia [4], disaster risks are also high in Asian cities. The large Asian cities with more than 10 million inhabitants have high exposure to at least two different kinds of natural hazard [25].In Asia, almost all nations, developed and developing including Bangladesh have taken initiatives to formulate their policy in consideration of DRR [6]. As climate-related urban disasters occurrence are increasing currently, urban authorities need to endorse DRR in their city planning and development processes properly. Globally there is an increasing trend of urban flooding due to climate change [2]. According to the World Bank, cities are the first respondents to climate change impact[26]. Very few cities in Asia have developed urban flood proofing and flood management plans, and much still has to be done by city authorities. Heavy rainfall, the existing drainage system fails to accommodate access to water. The overflow water inundates urban services and structures [2]. Almost all of the megacities and large cities in Asia are vulnerable to the risk of earthquakes also. Over the last two decades, the region has experienced several earthquakes of high intensity including thousands of human casualties[27]. Urban disasters disrupt a city's lifeline and economic activities and put unprecedented pressure on its economy [28]. After the strike of disaster, roads and drains are blocked, and other essential urban services need rehabilitation and quick recovery. After a devastating event, huge amounts of money are spent on the response and recovery purpose also[26]. Urban authorities need to shift budget allocation from urban development to emergency response, evacuation, rehabilitation and early recovery purpose[6].

3.4. Urban hazard, risk and resilience in Bangladesh: A focus on Dhaka and Chittagong city

3.4.1. Geological and climatological Urban hazard risk in Dhaka city

The urbanization rate in Bangladesh is one of the highest in the world, and it will continue in the future [29]. By the year 2030, approximately 40 percent of Bangladesh's people will be living in urban areas. Natural disasters along with poverty, low income, rural migration to cities has been rapid and continuous in the country. This high rate of migration is also responsible for a 40 percent increase in urban populations and Dhaka and some other coastal cities, this figure is as high as 70 percent [30]. It is estimated that Dhaka alone contains nearly 40 percent of the country's urban population. In recent decades it has been identified as one of the fastest growing cities with an urbanization rate of over 2.5 percent[25;31; 32]. But the urbanization of the country

mainly concentrated in the four large cities and more than 60 percent of the urban population lives in those cities[24].

Dhaka (Figure 3), the capital is the hub of administrative, political, economic, industrial, cultural, educational and research activities in the country. The megacity is considered as the most vulnerable to climate change also[33; 34].The city is growing into the flood-prone, low-lying areas with an elevation of 2-13 meter above mean sea level, but most of the urbanized areas are at the elevations of 6-8 meter[35; 36]. The city is bounded and crossed by several interconnected rivers and canals [33].Uncontrolled and unplanned rapid urbanization is responsible for increasing environmental degradation and disaster risks in Dhaka [37].Dhaka faces a number of both human-made and natural disasters which are increasing at an alarming rate [25].Floods, earthquakes, and tornados are the most common climatological and geological natural disasters faced by the capital city [25; 38]. The city is considered as one of the most susceptible cities for flood [33]. Floods of Dhaka are associated with river water overflow, and rain-water stagnation and severity of the floods are increasing gradually [33; 36; 39; 40; 41; 42]. Heavy flooding occurred at least ten times from 1954 to 2007, and the floods in 1988, 1998, 2004, and 2007 were disastrous[25; 38].The entire city and particularly slum areas were affected by those floods[25; 43].In recent years, Dhaka has seen extensive water logging during the monsoon season (May–October). The main cause of these floods was the rise in water levels of the rivers bordering the city[43]. In addition to the rise of river water, internal drainage congestion and uncoordinated operation of flow regulation structures contributed to the flooding. Rapid and unplanned urban growth and an uncontrolled real estate boom in the city cause serious encroachment of natural drainage and retention areas, hindering the natural flow of water and causing substantial water logging and flooding in almost every year of the past decade [24].Identification of several faults in and around the city [25] is responsible for considering the area as one of the most vulnerable to earthquakes. The Earthquake Risk Index (EDRI) for Dhaka put it at the top of its list of the 20 highest-risk cities in the world [25; 44]. More than 75 earthquakes of high magnitude occurred within a 200-km radius of Dhaka between 1885 and 2015which indicate the possibility of occurrence of future major earthquakes in the region.According to the prediction, in the year around 2017 Dhaka would experience an earthquake with a magnitude of 7.3 [25; 45]. Disorganized and unplanned development, poor emergency response and low rescue capacity make the city highly vulnerable after such a high-magnitude earthquake [46; 47]. Earthquakes can also cause liquefaction of soil and built-up areas even more in danger of structural collapse[25].

3.4.2. Geological and climatological urban hazard risk in Chittagong City

Chittagong (Figure 3), the second largest metropolitan city is situated on the bank of Karnaphuli River that lies on the fringe of Bay of Bengal [48; 49]. The Karnaphuli River lies to the south of the city, the coastal plain to the west and the flood plain of the Halda River to the east [50].The core of the city is 15 kilometers upstream of the river mouth where the Karnali meets the Bay of Bengal. The city is formed of hilly land extending from the north, with lower elevations near the river [51]. The city is considered as the largest port city and the main commercial center of Bangladesh [48; 49], sharing 19.7 percent of total urban population and contributing 30 percent of national GDP [52]. The city has accommodated 4.5 million population [52] comprising 186 square kilometers of existing Chittagong City Corporation [53]. Physiography of the city is unique within the country [53].The city is located in the south-eastern coastal region of Bangladesh which is considered one of the cyclone-prone regions in South Asia associated with storm surge and coastal flooding [54].The city is also experiencing flash floods, landslides and earthquakes regularly [59]. Chittagong-Noakhali region is getting more violence by cyclone and storm surges [55]. Approximately 41 percent of cyclones travel through this funnel-shaped region each year [54]. The coastal areas of Bangladesh experienced 12 major cyclones between 1970 and 2016 which were also followed by storm surge [56]. The city has already been identified as one of the most vulnerable city for landslide as the city dwellers have experienced several devastating landslides for the last couple of years. Rapid unplanned urbanization at hill slopes has increased the disaster for the city [57; 60]. Heavy rainfall and illegal hill cutting were responsible for landslides in June 2007, and this incidence killed 126 people living on steep slope sites [49]. Unplanned rapid urbanization is also responsible for waterlogging on the monsoon season. Unplanned urbanization is also creating water logging problem on the time of high tide of Karnaphuli River and Bay of Bengal.

3.5. Role of city government in risk reduction and resilience

3.5.1. Existing scenario of Dhaka city

The Ministry of Food and Disaster Management (MoFDM) in Bangladesh has designed a local government framework to define specific organizations and their responsibilities as functional tools in response to any natural or human-made disaster[24].The National Plan for Disaster 2010–2015 proposed that there will be a plan for each Pourashava/City

Figure 2: Map of Dhaka City [62].

Corporation, to be prepared by the Pourashava/City Corporation Disaster Management Committee, with links to the National Plan. These plans should highlight overall risk mapping, preparedness and risk reduction approaches, disaster response and recovery at all stages for the area. But DCC, which was divided to DSCC and DNCC in 2011 had no typical disaster management plan. The SOD includes a provision for establishing a Disaster Management Committee at the City Corporation level and outlined detailed roles and actions for it to take to prepare and respond to disasters. By the SOD, the DCC formed a Disaster Management Committee headed by the mayor and composed of engineers, zonal officers, ward commissioners, conservancy officers, staff and volunteers[25]. Some other important organizations of the city are also part of this committee. This committee is responsible for pre-disaster, disaster and post-disaster initiatives and management [33]. But disaster management and risk reduction related tasks conducted or initiated by any of these specific city corporations (DSCC or DNCC) have not been well documented[25].

Figure 3: Map of Chittagong City [63].

Dhaka city faces heavy rainfall, tornadoes, waterlogging, and flooding during the rainy season from July to October [33]. River and rainwater flooding has become a severe threat to the city [39]. In preparation, during July and August DCC arranges campaigns, meetings, and seminars at the ward level to increase awareness. Various departments of DCC also make preparations and stock appropriate emergency items to help citizens respond to flooding and waterlogging. Speedy dissemination of flood and cyclone forecasts to relevant officials and organizations is ensured by the Disaster Management Committee of the DCC.The DCC also identifies safe centers and emergency shelters for evacuation, assigns responsibilities and arranges disaster drills. Relief and rehabilitation works are monitored, and emergency instructions are provided to other organizations and service departments such as the Dhaka Electric Supply Authority (DESA), Water Supply and Sewerage Authority (WASA), FireService and Red Crescent.It also organizes a meeting to exchange views, experiences, problems, and difficulties

during the disaster. After a flood occurs, DCC (now DNCC and DSCC) conducts surveys and estimates the number of canals and drains (both on the surface and underground) that require clearing. It also prepares eviction/demolition lists of shops, houses and all types of unauthorized structures as well as lists of roads that are to be raised above the floodwater level [33].Ministry of Food and Disaster Management has developed an Earthquake Contingency Plan for the DCC in 2009. This contingency plan includes nine clusters of different tasks and service groups for earthquake preparedness, response, and recovery.Among these, the DCC is responsible for taking the lead role in seven clusters which are responsible for command and coordination, search, rescue and evacuation, relief service, shelter service, water supply, sanitation and hygiene, restoration of urban service and transportation. As a part of DRR, DCC (DNCC and DSCC) has organized workshops, exercises, drills, awareness campaigns and rallies for the last few years.National Plan for Disaster Management 2010–2015 has proposed the preparation of a Disaster ManagementPlan by the Disaster Management Committee[25].

3.5.2. Existing scenario of Chittagong city

Like DCC (DNCC and DSCC), CCC has a disaster management committee headed by the mayor.The committee coordinates with local government departments such as the Chittagong Development Authority, the Bangladesh Water Development Board, the Meteorological Department, the defense authorities, the emergency authorities, ward representatives and NGOs. The committee usually sits during the pre-monsoon period to define roles and responsibilities regarding pre and post-disaster activities and can also call emergency meetings. However, in practice, these agencies are hardly coordinating their tasks regarding risk assessment or disaster preparedness [58].The local Meteorological Department usually provides forecasts for heavy rainfall and issues a pre-hazard warning to the departments or agencies with responsibility for disaster preparedness [59]. However, no specific responses, either before or during the rainfall were undertaken by any of the agencies in the local disaster management committee because of their undefined roles. Landslide-affected communities were also not aware of the measures they should take before and during heavy rainfall and were not supported by rescue teams to move to a safe location.Landslide risks during heavy rainfall time were also not addressed by the city disaster management committee.CCC's responsibilities were limited to infrastructure development to avoid waterlogging. Vigilance teams were formed at CCC to monitor informal settlements that were at risk and to create awareness on residents who need to move to temporary safe

shelters during rainfall after 2007 landslides incidence [58]. A moderate earthquake can also create landslides in the area[24].Although Dhaka and Chittagong both are on the moderate zone (zone 2), but CCC had no contingency plan for earthquake-like DCC (DNCC and DSCC).

4. Conclusion

Location of the country has made it vulnerable to geological and climate-related hazards.Urban areas of Bangladesh are more vulnerable to disaster risks due to rapid, unplanned and unregulated urban growth, but risk reduction measures are not considered in local level planning practices.In most cases, land use planning and building code are treated as the most fundamental tool for risk reduction into the urban development process. But a city needs a detailed assessment of its current levels of vulnerability and resilience to possible hazards. A city's vulnerability to disaster is determined by its level of economic development and disaster preparedness. Local governments are considered as the key stakeholders in DRR and disaster preparedness. But these two cities' local government organizations were not able to prepare a Disaster Management Plan by considering possible hazards of the city. Disaster management related activities of DCC (DNCC and DSCC) are mostly focused on flood-related disasters.To reduce the disaster risk faced by the DCC (DNCC and DSCC) and CCC, local government organizations and government of the country needs to learn the lessons from various disaster-prone cities of the developed world.City government should work on urban risk reduction and increase their communities' strength to possible hazards.It is necessary for both cities local government to give priority for making their cities own disaster management plan in consideration of possible major hazards which is also stated as one of the key goals of SFDRR 2015–2030.

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