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Climate Change Impacts on Flood Vulnerability for Dhaka City

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Abstract—Bangladesh is one of the most vulnerable countries often faced with natural calamity. The country is under serious threat as a result of climate change and the impact will be particularly felt in low land and heavily congested city like Dhaka. Dhaka, the capital of Bangladesh is the economic and administrative center of the country and is surrounded by a network of rivers: Buriganga on the south-west, Turag on the north-west and the Balu on the north-east and Shitalakhya on the south. The city is more vulnerable to intense flooding due to heavy and unpredictable rainfall over the recent years as its drainage capacity is decreasing alarmingly with wetlands occupied by land grabbers. The paper looks into the vulnerability of flooding in Dhaka city by analysing the existing flood protection infrastructures and recommends a number of steps to reduce the risk to flooding.

INTRODUCTION

Bangladesh is one of the most vulnerable countries often faced with natural calamity. The country is under serious threat as a result of climate change and the impact will be particularly felt in low land and heavily congested city like Dhaka. Dhaka is among the rapidly growing mega-cities of South Asia with a population over 12 million [1]. The Dhaka city is vulnerable to flooding particularly during monsoon (June to October). This vulnerability to flooding occurs due to swelling of surrounding rivers and intensive rainfall that generates runoff, which is beyond the capacity of the existing drainage facilities. Dhaka has experienced a number of floods in each decade. Nearly 50 % of the people in the city live in low lying areas where water-logging and drainage congestion due to river floods and excessive rainfall cause serious miseries, especially to urban poor. The annual rainfall in Dhaka city has decreased from 2103 to 1930 mm from the year 1990 to 2009 but monthly rainfall of July-August (567 and 227 mm) has increased to (676 and 482 mm) from the year 1990 to 2009 [2]. With the projected future warming there will be changes in oceanic circulation, and in the hydrologic cycle, leading to altered patterns of precipitation and run-off. The most likely will be an increase in global average precipitation and evaporation as a direct consequence of warmer temperatures. An increase in global average precipitation does not mean that it will get wetter everywhere and in all seasons. In fact, all climate model simulations show complex patterns of precipitation change, with some regions receiving less and others receiving more precipitation than they do now; changes in circulation patterns will be critically important in determining changes in local and regional precipitation patterns.

Flood disasters are the most frequent and devastating natural disaster in the Asia region, and like disasters in general, their impacts have grown in spite of our improved ability to monitor and describe them [3]. For the past thirty

years the number of flood disasters has increased compared to other forms of disaster [4]. Recurrent floods are being widely mentioned as an impact of climate change, alongside frequent and severe cyclones. The country tends to have more devastating floods because of higher sea levels. This is due to reduced gradient of rivers, higher rainfall in the Ganges-Meghna-Brahmaputra river basins and melting of glaciers in the Himalayas [5]. Not all social groups are equally vulnerable to flood-related disasters nor are they exposed to the same combinations of involuntary risks [6]. The poor, lower and lower middle class people are the most vulnerable to flooding.

STUDY AREA

Dhaka is primarily surrounded by the following rivers: Buriganga on the south-west, Turag on the north-west and the Balu on the north-east and Shitalakhya on the south. The inflow of water into these rivers is influenced by the Brahmaputra and the Meghna river system. The average ground elevation of Dhaka city is 0.5-12 meter with 70% of the total area within 0.5 to 5 m. Due to this low topography, a large portion of Dhaka city is inundated during monsoon. The rapid population growth of Dhaka city has led to indiscriminate filling up of low lying lands and wetlands which are used as detention basin¹. The city has three distinct seasons: winter (November-February), dry with temperatures ranging from 10° to 20°C; the pre-monsoon season (March-May), with some rain and hot temperature reaching up to 40°C; and the monsoon (June-October), which is very wet with temperatures around 30°C. Dhaka experiences about 2,000 mm of rain annually, of which about 80% falls during the monsoon. The main natural hazards affecting Dhaka include floods, which are associated with river water overflow and rain water stagnation.

HISTORY OF FLOOD IN DHAKA

Dhaka has a long history of flooding and the city has been affected by floods in 1954, 1955, 1970, 1974, 1980, 1987, 1988, 1998 and 2004, due to overflowing of surrounding rivers. Of these, the 1988, 1998 and 2004 floods were the most damaging in central and south western part of the city [7]. Highest hourly recorded rainfall is 162 mm and recorded daily rainfall 333 mm, the highest single-day rain in 53 years on 28-07-2009 [2]. The floods of 1988 and 1998 were disastrous. In 1988, one of the most severe floods in recent history hit Dhaka and inundated 85 percent of the city. Depths of inundation ranged from 0.3 to more than 4.5 meters, and 60 percent of city dwellers were affected. In 1998, 56 percent of the city was inundated for about 69 days including most of the eastern part. Moreover, during the 1998 flood some protected areas went under water, indicating that current flood management practices must be improved. After the flood of 1998 a study was

conducted [8] to delineate the effect in different wards of the city. It took into account the damage to five major sectors, namely: Housing, Education, Road, Industry, and Shopping and categorized the damage zones into four groups i.e. No-Damage Zone (29%), Low Damage Zone(50%), Moderate Damage Zone (10%), and High Damage Zone(11%). The findings of the study are presented in the Fig. below.

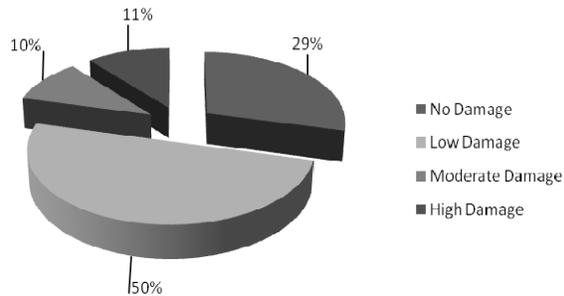


Fig. 1: No. of Wards affected by the flood of 1998.

EXISTING FLOOD PROTECTION INFRASTRUCTURE

After the devastating flood in 1988 the Government has taken a project named DIFPP (Dhaka Integrated Flood Protection Project) for an area of 136 sq. km of western, south-western and north-western parts of the city. Part of the project, which included construction of 30 km of earthen embankment on the western side consisting of 13 sluice gates to control flow of water inside and outside of the embankment, pumping stations to pump out accumulated water (When water level rises above 3.50 m. PWD²). The embankment consists of 80 sheet pile flood wall, 25 km slope of protection work with 260 hectares of ponding area to retain storm water and surface water. The project also consists of 8.44 km main canal excavation, 21.65 km canal re-excavation, construction of 35 km pipe to drain out internal accumulated domestic sewage and storm water as shown in Fig.2.

DISCUSSION AND CONCLUSION

Natural open drainage system is continuously encroached upon or sometimes destroyed for construction of buildings; roads thereby violating the law. About 3,000 sq. m. of natural water bodies have already disappeared during the Riverview Housing Estate development on the Buriganga River bank's southern fringe [9]. An analysis of IRS image of 1996 and IRS image of 2000 clearly shows that water bodies measuring about 2,300 sq. m. were filled in during the development of Bashundhara and Bashumoti housing estates. In 1996, there were 211 acres of water bodies in the Mohammedia housing estate and Adabbar area. During development, about 91 acres of water bodies disappeared between 1996 and 2006 and 68 acres between 2006 and 2009 [10]. Heavy rainfall, waste water from households and industries and septic waste accumulated in wetlands and canals causes urban flooding particularly in low laying areas in the western part of Dhaka city.

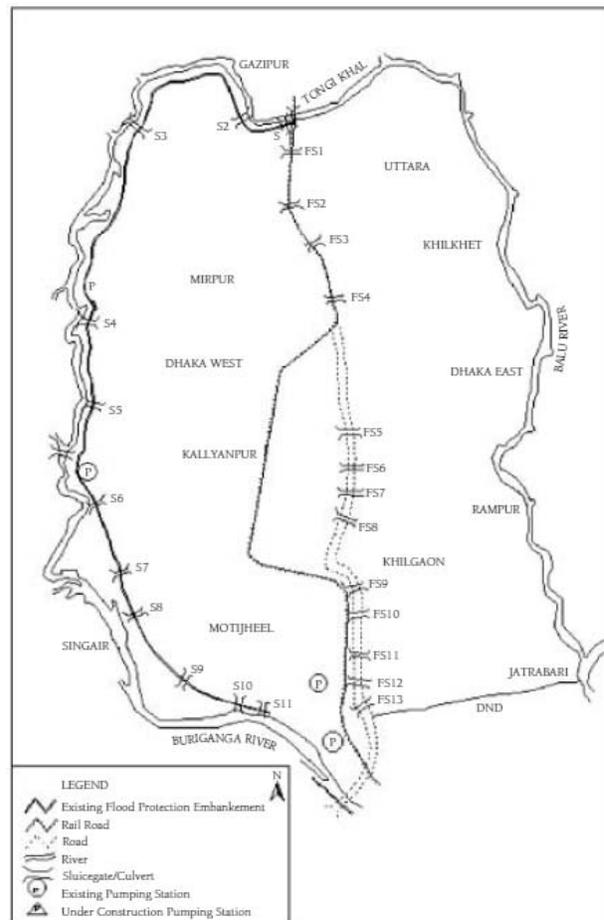


Fig. 2: Existing flood protection infrastructures.

RECOMMENDATION

It has been observed that following recommendations are needed to reduce the vulnerability of flooding in Dhaka city due to climate change.

- A storm water pump station near Rampura bridge is a necessity to pump out the internal storm flow of the Begunbari catchment area as well as other catchments. The inflow of floodwater from outside the embankment through any unidentified access has to be prevented.
- Due to unauthorized and uncontrolled filling of low lying areas and khals and subsequent development of the infrastructure, planned flood control activities are hampered. This needs the immediate attention of the concerned authorities.
- The obstructions on the natural drainage system of Dhaka WASA are very common. Temporary drainage congestion takes place at different places of the city for durations of 2 to 48 hours. An urban management system has to be established with an advanced early warning system on inundation depending on rainfall.
- Control of intrusion of flood water into Gulshan, Baridhara and Banani lakes is a necessity in order to conserve those lakes by improving the drainage system in the area.
- The existing wetland in and around Begunbari and Hatirjheel has to be maintained as detention pond area

for holding the storm water and wastewater of the catchments. Otherwise, water logging inside the city will increase.

- The depth of Begunbari khal needs to be increased by an additional 2.00 m. and also of Gulshan lake by 1.5 m.
- The water supply, sewerage, drainage and flood management system should be developed in an integrated manner.
- Temporary storm water pumping stations are required to be constructed on an emergency basis at the Rampura, Begunbari and Segunbagicha khals with sufficient detention pond area, in order to remove water logging of Gulshan, Banani, Baridhara, Shantinagar, Bijoy Nagar, Motijheel and adjoining areas.
- Dredging work in the Buriganga, Turag, and Balu Rivers should be regularly carried out to maintain navigability and reduce drainage congestion
- Integrated coordination is a must among the concerned agencies like DWASA, DCC, BWDB for better preparation and management of floods.
- A mathematical model has to be developed to assimilate the present and future phenomenon of rainfall-run-off and ground water table fluctuations in order to properly plan in respect of water related issues.

REFERENCES

- [1] BBS, Bangladesh Bureau of Statistics, 2009.
- [2] Bangladesh Meteorological Department, Climate Division, Agargaon, 2009, Dhaka.
- [3] J. Pender, "Climate change and displacement, Community led adaptation in Bangladesh", 2nd International workshop on Community based adaptation to climate change, Dhaka, 2007, Bangladesh.
- [4] P. Blaikie, T. Cannon, I. Davis & B. Wisner, "At risk: Natural hazards, people's vulnerability, and Disaster", Routledge, 1994, London.
- [5] G. F. White, R. W. Kates & I. Burton, "Knowing better and losing more: the use of knowledge in hazards management", *Environmental Hazards*, vol. 3, 2001, pp. 81-92.
- [6] D. Dutta & S. Herath, "Trend of floods in Asia and flood risk management with integrated river basin approach", 2005.
- [7] M. Alam & G. Rabbani, "Vulnerabilities and Responses to Climate Change for Dhaka", *Environment and Urbanization*, vol. 19, 2007, pp. 81-97.
- [8] M. A. Mohit & S. Akhter, "Delineation of Flood Damaged Zones of Dhaka City Based on the 1998 Flood by Using GIS" in M. Ashraf Ali, Salek M, Seraj & Sohrabuddin Ahmed (eds) *Engineering Concerns of Flood*, 2002, Bangladesh University of Engineering and Technology.
- [9] A. Rahman, "Environmental Effects of Housing Estate Development in Dhaka City, Bangladesh", unpublished M.Sc. thesis, Dissertation No. UE-18-08, AIT, Bangkok, 2007, Thailand.
- [10] The Daily Star News "Dhaka in danger", Md. Anisur Rahman, Thursday, 10 June, 2010, Accessed on 12-7-2010, Available at <http://www.thedailystar.net/newDesign/news-details.php?nid=142043>.