

Environmental and Social Impact Due to Urban Drainage Problems in Dhaka City, Bangladesh

Md. Masud Alom, Md. Zahid Husain Khan

Abstract- Dhaka, the capital city of Bangladesh is one of the populous Mega City in the world. As the growth of urban population tacking place at an exceptionally rapid rate, the city is unable to cope with changing situations due to their internal resource constraints and management limitations. In recent years Dhaka City is facing extensive drainage problems during the monsoon (May to October) as a common and regular problem like water pollution, traffic congestion, air and noise pollution, solid waste disposal etc. This paper focuses on the overall situation of the drainage system, environmental impact and health hazard of urban people by unplanned drainage system of Dhaka city. This work includes some lab test (Water test), questionnaire survey and collection of drainage maps. Inadequate drainage sections, conventional drainage system with low capacity and gravity, natural siltation, absence of inlets and outlets, lack of proper maintenance are the prime causes of blockage in drainage system. Management of drainage system of Dhaka City is presently a challenge for the urban authorities. Therefore, a close coordination among urban authorities and agencies and collaboration between public and private sectors is needed for effective management and sustainable operation of urban drainage system.

Keywords: Drainage System, Environmental Impact, Management, Maintenance and Operation.

I. INTRODUCTION

Dhaka, the capital of Bangladesh is one of the most densely populated cities of the South-Asian countries. Dhaka is located in central Bangladesh at 23°42'0"N 90°22'30"E, on the eastern banks of the Buriganga River. The city stretching around an area of 1,463.6 sq. Kilometres is now a city of about 13 million people growing in an annual rate of 6 percent (Bangladesh Bureau of Statistics - Community Report 2011). Dhaka experiences a hot, wet and humid tropical climate. The city has a distinct monsoonal season, with an annual average temperature of 25 °C (77 °F) and monthly means varying between 18 °C (64 °F) in January and 32 °C (90 °F) in May & approximately 87% of the annual average rainfall of 2,123 millimetres (83.5 in) occurs between May and October.[weatherbase.com.]. Dhaka municipality was founded on 1 August 1864, and upgraded to "corporation" status in 1978. City Corporation has been divided into two administrative parts in 2011 for ensuring better civic facilities. Those parts are (1) Dhaka City Corporation-North and (2) Dhaka City Corporation-South.

Manuscript published on 30 August 2014.

* Correspondence Author (s)

Md. Masud Alom, Lecturer, Department of Civil Engineering, World University of Bangladesh, Dhaka, Bangladesh.

Dr. Engr. Md. Zahid Husain Khan, Associate Professor, Department of Civil Engineering, World University of Bangladesh, Dhaka, Bangladesh.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](http://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

Dhaka is experiencing environmental degradation due to rapid urbanization, increase in population, and industrialization. The process of urbanization is linked with the economic development, which makes an increasingly higher contribution to the national economy. Drainage system in Dhaka City is not a new problem but the frequency of this problem is increasing day by day. Even a little rain causes a serious problem for certain areas, so that parts of Dhaka are inundated for several days. The water depth in some of the areas may be as much as 50-70 cm, which creates large infrastructure problems for the city and a huge economical loss in production (Mark and Chusit, 2002). Drainage gases create unpleasant odour which pollute environment and create health hazard for inhabitants of Dhaka. So it is required to take appropriate steps for better management of the problems.

II. OBJECTIVES OF THE STUDY

The core objectives of the study can be stated as:

- To assess the effects of environmental and social change due to improper drainage system.
- To investigate health hazard of urban people produced by drainage problems.
- To find out the possible ways for mitigating the problems.

III. BACKGROUND

Drainage system is a very common problem like the others regular environmental problem of Dhaka City. But very few studies have been conducted on drainage system and water logging of the city and there is no study been conducted to find out the causes of such problem and its impacts on the human life as well as the economy. A project taken by Dhaka Water and Sewerage Authority (DWASA), 2000 "Rehabilitation of DholaiKhal" described in its report that before 1947, storm water of Dhaka city drained out through different natural canals. But thereafter, the city developed spontaneously without any drainage plan causing depletion of natural drains. Henceforth unfit drainage system became a problem for the city. In 1964, Dholikhhal was filled in for carrying out development works without taking any necessary steps to drain out the water of surrounding area and thus drainage system turned out as a great problem. Bari and Hasan,(2001) investigated the impact of land use changes due to urbanization on storm runoff characteristics in the eastern part of Dhaka City. They found that the volume of peak rate runoff increases with growth in urbanization. Most of the low lying lands, which once acted as retarding basin, have been filled up.



Computed results show that runoff volume is increasing with increase in built-up area in Dhaka city. "Dhaka City Storm Water Quality Assessment", Khan S.A. and Chowdhury, J.U. (1998), described that the deterioration of storm water quality in Dhaka has become a matter of concern in the recent years.

IV. METHODOLOGY

The study would focus on effects on environmental and social changes due to drainage system at Dhaka city. The methodological approaches for this study are as follows.

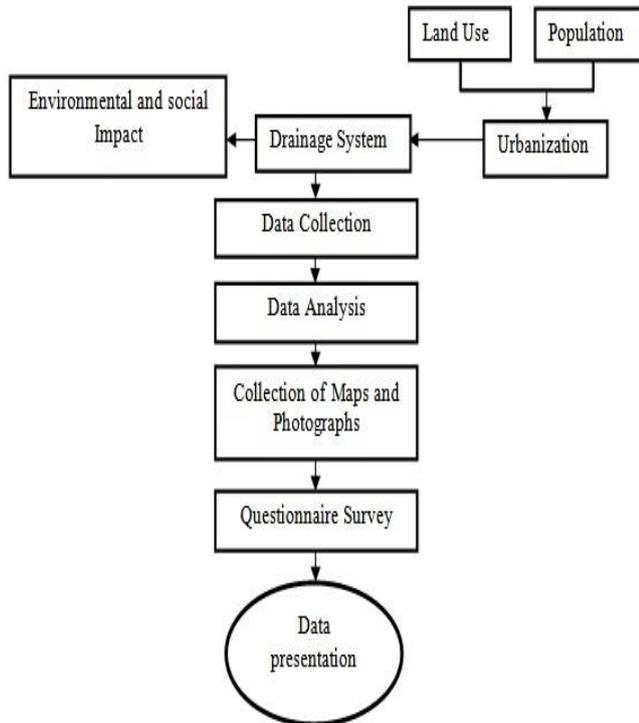


Fig. 1 Methodological Flowchart of the Study

A. Land Use

Land use involves the management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements. Dhaka started to develop in a more planned way after 1947 when it gained regional and political importance (Chowdhury, J.U., 1998). Previously, commercial and residential areas were situated side by side, mostly concentrated beside the narrow roads, old Dhaka still presents this situation with a mixture commercial, residential and small industries. After preparation of the Master Plan of the city in 1958 by the DIT (Dacca Improvement Trust), the commercial centres of the city was moved to Motijheel and a high residential area was developed at Dhanmondi. Housing colonies for government employees, universities, parks, commercial and industrial zones, lakes and other public facilities were developed gradually to meet the demands of the expanding city. With the development of the city, wide roads and other paved areas replaced the unpaved areas, natural depressions, and agricultural land. In many cases, natural drainage canals and open water bodies were filled up for development works. However the present status of Dhaka city demonstrates that the development of the city did not succeed to fully meet the requirements of a mega city.

B. Population

Dhaka city became the capital of the independent state of Bangladesh in 1971. This additional factor as well as the initiatives of private sectors led to Dhaka’s phenomenal growth since 1971. Since Dhaka became the capital of an independent country the pressure on it has been enormous.

The permanent inhabitants of the city have registered a steady growth. Along with it there was a very large floating population, the pressure of which has resulted in the growth of slums on any available vacant land. The recent phenomenon of high rise buildings, both in the commercial and residential sectors occupy the city’s highlands and demonstrate ever-increasing pressure on Dhaka as it builds upwards, an inevitable and common phenomenon in all modern cities facing population growth. The scenarios of Dhaka city Population from 1991 to 2011 is shown in table below.

Table -1 Population of Dhaka City, (1991 – 2011)

Year	Population	Source
1991	69,50,920	Census of Bangladesh, 1991
2001	99,12,908	Census of Bangladesh, 2001
2011	1,43,99,000	Census of Bangladesh, 2011

C. Drainage System

When rainfalls on to undeveloped land, most of the water will soak into the topsoil and slowly percolate through the soil to the nearest watercourses or groundwater. A small proportion of the rainfall – usually 15 to 20 percent – becomes direct surface runoff that usually drains into watercourses slowly because the ground surface is rough. So for removing water quickly from soil surface adequate drainage system is required. Drainage can be either natural or artificial. Many areas have some natural drainage which means the excess water flow to the lakes and rivers. Natural drainage, however, is often inadequate and artificial or man-made drainage is required. There are two types of artificial drainage: surface drainage and subsurface drainage.

D. Data Collection

To fulfil the objective of the study both primary and secondary data were needed. All the necessary data has been collected from various sources. For the purpose of the present study, three different types of maps have been collected. Dhaka topographic survey maps (1995-2005). The existing land use map has been collected from Dhaka Metropolitan Development Plan (DMDP) and the land use of different periods has been collected from some relevant literatures and organizations. The existing drainage layout map was also needed and this has been collected form Dhaka Water Supply and Sewerage Company (DWASA). Rainfall data and the storm water drainage system data were needed for the study.

The rainfall data has been collected from Meteorological Department of Bangladesh and the drainage data has been collected from Drainage Department of Dhaka City Corporation. Lots of photographs were also needed to illustrate the effect of drainage system, related obstacles into the smooth drainage of urban runoff and its effects on urban life. Some of these photographs have been collected directly from the field survey and some other from daily newspapers as well as from internet websites.

E. Questionnaire Survey and Interview

To find out inherent causes of the environmental and social change due to improper drainage system in Dhaka City and its associate impact on city life, a field survey as questionnaire survey, informal interview and open discussion has been conducted with the authorities of different concerned organizations, experts and people living in the study area. The questionnaire was designed in such a way that it would track down the problem from the inception and the effect of the environmental and social change due to the unfit drainage system in the locality. The

respondents were selected in different water logging prone area of the city with different professions.

F. Data Analysis and Presentation

All the data from lab test and different sources were analysed separately. Collected data has been analysed using some statistical computer software like, Microsoft Excel, Microsoft Office etc. Finally the analysed data have been integrated and presented as figures and tables.

V. EFFECTS ON ENVIRONMENT AND HUMAN LIFE DUE TO UNFIT DRAINAGE

Drainage gas is a complex mixture of toxic and nontoxic gases produced and collected in sewage systems by the decomposition of organic household or industrial wastes, typical components of sewage. Sewer gases may include hydrogen sulphide, ammonia, methane, carbon dioxide, sulphur dioxide, and nitrogen oxides. Improper disposal of petroleum products such as gasoline and mineral spirits contribute to sewer gas hazards.

Table - 2 Lab Test value and standard value for different drainage gases

Sl. No.	Parameters Name	Sample obtained value	Avg. Sample obtained value	Standard Value
01	Carbon-di Oxide, CO ₂	75 mg/l	106.67 mg/l	< 35 mg/l
		120 mg/l		
		125 mg/l		
02	Ammonia, NH ₃ – N	20 mg/l	22.33 mg/l	0.2 mg/l
		28 mg/l		
		19 mg/l		
03	Total Chlorine	1.9 mg/l	1.64 mg/l	0.017 mg/l
		2.3 mg/l		
		0.5 mg/l		
04	H ₂ S	0.30 mg/l	0.25 mg/l	< 0.10 mg/l
		0.40 mg/l		
		0.05 mg/l		

VI. ENVIRONMENTAL IMPACT

A. Water Pollution

Dhaka WASA maintains two separate sewer systems: one for domestic wastewater and another for storm water. However, in reality storm sewers also receive domestic wastewater, which causes unwanted deterioration of the storm water discharges. According to survey, 95 percent inhabitants said that storm water of Dhaka City becomes polluted as it is mix with solid waste, clinical waste, silt, contaminants, domestic waste water and other human activities, which contaminated ground water as well as the receiving water bodies.

B. Water Born Diseases

In urban areas, the most adverse impact of water logging created by drainage blockage is incidents and prevalence of

various diseases. 84 percent of the respondent replied that stagnant storm water increases the diseases as it becomes

polluted in different ways. In poorly drained areas, urban runoff mixes with sewage from overflowing latrines and sewers, causing pollution and a wide range of problems associated with waterborne diseases. Sometimes, the poor people had to rely on surface or shallow groundwater sources that are polluted, as they don't have access to portable water during the period of monsoon. Malaria, Dengue fever, respiratory problems, eye and skin disease are the worst impacts of drainage problem in Dhaka City.

C. Breeding Site of Mosquito

Poor drainage of rainwater leads to the creation of breeding sites for disease vectors. Solid waste blocks the drainage system and creates flooding in the streets resulting in increase mosquitoes, bad odour, and inconvenience. “Dhaka City is suffering a lot from tremendous increase of mosquitoes and its associated diseases vectors, which is the ultimate result of water logging” opined by 88 percent of the interviewers. Among the diseases associated with mosquito, dengue is the main and it spreads by special mosquitoes named “Aides” which breeds stagnant water.

VII. SOCIAL PROBLEM

A. Disruption of Traffic Movement

Disruption of traffic movement is an important identified impact according to 88 per cent of interviewers, which arises due to the traditional water logging problem created from improper drainage system. Again drainage department of Dhaka City Corporation (DCC) start repairing unfit drain, normal traffic movement is hampered and produce traffic jam in the city area and people lose their valuable time.

B. Disruption of Normal Life

93 percent inhabitants mentioned that drainage problem hamper daily life of the city dwellers. Due to inadequate drainage facilities, storm water cannot convey properly, as a result water logging is created in low-laying and flood prone areas. The logged water of rainfall seriously disrupts normal life and it has direct impacts on the poor inhabitants. It is also seen that, for unsuitable drainage system traffic accident occurs frequently in city areas when road are submerged.

VIII. RECOMMENDATIONS

Rapid population growth and its growing demand for housing in Dhaka City are encouraging the real estate business and private developers to grab and encroach of wetlands, low lands, water bodies and natural drainage system for housing, roads and commercial activities. These unplanned development activities are grossly violating the Dhaka Metropolitan Development Plan (DMDP) and the Wetland Conservation Act. Due to such activities, the natural drainage pattern and flood retention areas are destructed and creating the unprecedented water logging. Therefore, the concerned authorities need to take appropriate measures immediately to overcome the situation. Following steps can help the authorities for comprehensive management of storm water and minimize the suffering of the city dwellers from physical, social, economic and environmental point of view.

- The concerned authority like Dhaka South city corporation (DSCC), Rajdhani Unnayan Kartripakkha (RAJUK) and Bangladesh Water Development Board (BWDB) will have to establish “right-of-way” right over the natural drainage system and ensure that the drainage system is free from any obstruction, blocking, or encroachment.
- On the basis of the Drainage Improvement Plan, all areas where existing main drains are located or will be required in future will have to be identified and

enforced existing legislation to prevent unauthorized development or encroachment on the drain alignments.

- Immediate action and steps will have to be taken by the concerned authority to remove all blocking and unauthorized constructions, encroachments etc. from the existing natural drainage system by enforcing necessary regulations.
- Adequate funds in all annual budgets for carrying out routine maintenance program should be provided.
- Institutional set up for effective operation and maintenance of drains should be strengthened.
- The concerned authority should ensure regular and careful maintenance of all the interconnected secondary and tertiary drains through proper monitoring program to secure its efficient operation.
- There should be a high degree of close communication and co-ordination between the different urban authorities responsible for operating and maintaining the various components of the drainage network.
- The inhabitants should be motivated for cooperation for maintenance of drainage system.

IX. CONCLUSION

The paper discusses about the overall situation of drainage system of Dhaka city and how adverse effect is created on social, physical, economic and environment by unplanned drainage system. Planning, design, operation and maintenance of urban drainage systems is a challenge for urban authorities because of unplanned development activities, and the effectiveness of storm water management systems can be directly linked to the efficacy of urban management. A methodology is proposed here to find the problems and some recommendation is made for overcoming the adverse situation. An effective questioner survey is conducted for finding the problems and possible solution, also some laboratory test is done on drainage water for finding environmental effect. As Dhaka is a populous mega city in the world, so it is important to create a planned city. For this reason proper drainage system should be established and proper management should be provided. This paper will be helpful for showing possible ways for finding the best solution.

REFERENCES

- [1] Bari, F.M., and Hasan, M. 2001. Effect of Urbanization on Storm Runoff Characteristics of Dhaka City. Tsinghua University Press. XXIX IAHR Congress. Beijing.
- [2] BBS. 2003. National Population Census 2001, Preliminary Report, Bangladesh Bureau of Statistics. Government of Bangladesh. University Press Limited, Dhaka.
- [3] Chowdhury, J. U. et al. 1998. Measurement and Analysis of Rainfall Runoff in Selected Catchments of Dhaka City. Institute of Hydrology. Wallingford, UK.
- [4] Huq, S. and Alam, M. 2003. Flood Management and Vulnerability of Dhaka City. Bangladesh Center of Advance Studies (BCAS). Dhaka.
- [5] M. Ali Ashraf & Md. Shariful Alam Chowdhury. 2009. Drainage Planning in the Cities of Bangladesh: Case Study of Drainage and Water Logging in Chaktai Commercial area, Chittagong.
- [6] Mark, O. and Chusit, A. 2002. Modeling of Urban Runoff in Dhaka City. Asian Institute of Technology (AIT). Thailand.
- [7] www.weatherbase.com. Retrieved 2008-12-15.





Md. Masud Alom, Graduated in Civil Engineering from Rajshahi University of Engineering & Technology (RUET), Rajshahi in 2009. Obtained Masters degree in civil engineering from University of East London (UEL), UK. in 2011. Involved in multidisciplinary research work and have got two publications in different technical journals. Member of Institute of Engineers Bangladesh (IEB). Involved in teaching of

civil engineering and environmental science in different universities of Bangladesh.



Dr. Engr. Md. Zahid Husain Khan, Graduated in Civil Engineering from Bangladesh University of Engineering & Technology (BUET), Dhaka in 1977. Obtained Masters degree in Urban and Regional Planning (MURP) from BUET in 1992. Done PhD in Environmental Science from American World University, USA in 2006. Involved in multidisciplinary

research work and have got nine publications in different technical Journals home and abroad. Member of professional institutes namely fellow member , Bangladesh Institute of Planners and life fellow of Institute of Engineers Bangladesh. Have got more than 35 years of professional experience in civil engineering projects. Involved in teaching of civil engineering and environmental science in different universities of Bangladesh.