ISSN 2072-3334
Development Compilation
Vol. 08. No. 01. February 2013

EVALUATION OF WATER QUALITY AND SANITATION SYSTEM OF EIGHT SELECTED SLUM AREAS IN DHAKA CITY

S. M. Helal Uddin[*]
Dr. Md. Zahid Husain Khan[**]
Md. Masud Alom[***]

Abstract: The World Health Organization has estimated that up to 80% of all sickness and disease in the world is caused by inadequate sanitation, polluted water or unavailability of potable water. It has been evidenced that nearly 1.5 billion people lack in safe drinking water and that at least 5 million deaths per year can be attributed to water-borne diseases. Slum population has been increasing in Bangladesh over the last three decades along with the growth and expansion of cities and towns. As a result, majority of population in Bangladesh suffer from different kinds of water and excreta-borne diseases that aggravate in their poverty situations. That's why, essential goal of the study is to investigate of quality of water and sanitation system in slum areas in Dhaka city. During the study period, data and information were collected by interviewed of the slum dwellers selected 8 slum areas. However, the level of hygiene knowledge and practice has been found to be significantly low among the slum dwellers. The study in slum areas of Dhaka city has found that the sanitary and water supply condition are improving very slowly. The drainage system is the most neglected sector in the slums. The open disposal of human excreta pollutes the nearby water bodies, canals and drains causing severe water pollution. Besides, solid waste management and drainage system are totally unsatisfactory in the slum area. The study recommends for the slum dwellers that water must be boiled before drink. Many motivational work and idea marketing from government, international NGO and NGO side help to improve their awareness level.

[*] Senior Lecturer, Department of Civil Engineering, World University of Bangladesh, Dhaka–1205, Bangladesh.
[**] Senior Faculty, Department of Civil Engineering, World University of Bangladesh, Dhaka-1205, Bangladesh.
[***] Lecturer, Department of Civil Engineering, World University of Bangladesh, Dhaka–1205, Bangladesh.

Keywords: Dhaka City, slum areas, water quality parameters, sanitation

Introduction

According to the Centre for Urban Studies Slum as a residential area where more than three hundred people live in one acre (0.405 hectors) of land. An average of more than three adults live in a single room. Worldwide at least 1 billion people are estimated to live in slum communities and experts projected that the number will rise to 1.6 billion by the year 2020 (Choudhury, 1980) and to 2 billion by 2030, whereas the global population is expected to increase from 6 to 8 billion by 2030 (Ali, 2011). In Bangladesh, the slum population is also increasing at an alarming rate especially in the urban areas due to migration by the rural poor. For instance, the proportion of the population living in the slums of Dhaka city has increased from 20% in 1996 to 37% in 2005 (Moe and Rheingans, 2006). Slum population has largely increased in Bangladesh over the last three decades along with the growth and expansion of cities and towns. Urban poverty is largely due to the transfer of the rural poor to urban areas (Rayhan, 2005). But the urban facilities are quit unsatisfactory for urban dwellers in Dhaka city. However, Bangladesh produces 17 million metric tons of human faeces and 57 million metric tons of urine each year (Ali, 2011). The major portion of these excreta is deposited into water bodies and open places, so polluting water sources, groundwater and the general environment. As a result, majority of population in Bangladesh suffer from different kinds of water and excreta-borne diseases that aggravate in their poverty situations. The global health burden associated with these conditions is staggering, with an estimated 4000–6000 children dying each day from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene (Moe and Rheingans, 2006). The World Health Organization estimated that up to 80% of all sicknesses and diseases in the world is caused by inadequate sanitation, polluted water or unavailability of water (WHO. 1997). Approximately three out of five persons in developing countries do not have access to safe drinking water and only about one in four has any kind of sanitary facilities. Generally in Bangladesh mentionable percentage of the communicable diseases are due to poor environmental health conditions arising from unsafe and inadequate water supply and poor hygienic and sanitation. About 80% of the rural and 20% of urban population have no access to safe water. Therefore, considering the present context and sanitation situation of selected slum areas, hygienic, sustainable and eco-friendly sanitation system has been increasingly needed.

Slums are the informal settlements of Dhaka city that accommodate the low-income group of people. According to a study conducted by Center for Urban Studies (CUS), the total number of slums and squatters in DCC area in 1988 was 1,125 with a population of about 1 million. Another study done by the

same organization in 1996 found that the number of slums and squatters has increased to 3007 with 1.5 million population. Now the number slum of Dhaka City is 4500. Based on an estimation of experts it may be said that the existing slums and squatters of Dhaka city accommodate no less than 3 million people. This population helps to keep the city alive by working and supporting various sectors, particularly transport, industry, factory, domestic, utility service, business establishments, small shops, super markets, petty trading, etc. These are the people who take the low level jobs and live in informal settlements under terrible conditions and the common scenario slums are poverty, poor-quality households, over-crowded, centre of low–income people, skilled and unskilled manpower, limited health care service and unhealthy environment, awkward social structure, corruption etc.

Methods and Material

Study Area

Almost 50% inhabitants live in slums and squatters with a very vulnerable condition of Dhaka city. The total number of slums in the Dhaka City Corporation area is approximately 4,500. For the study 8 slums were surveyed. Sites selected for habitation problem and environmental hazardous of low cost areas slums in Dhaka city. The selected slums area Agargao Sweeper Coloni, Rayar Bazar Bosti, Dhuary Para Bosti, Mirpur – 1 Sweeper Coloni, Banani Bosti, Shyalbari Bosti, Agargao Bosti, and TNT Coloni Banani.

Data Collection Method

A total of 48 households in 8 slums were interviewed and survey in a recall period of 30 days. This study is based on survey methodology and laboratory analysis. Water quality determination and sanitation system investigation were laboratory survey based, respectively. The households were selected on the basis of drinking water source and sanitation type. Gathered data were edited manually and entered into computer. Average and percentage were used for the presentation of information. A total of 48 households were interviewed and six households from each slum and water samples were collected from every slum. The questionnaires were serially numbered according to the sequence in which the households were interviewed.

Water Samples Collection and Analysis

A total of 8 water samples were collected from tap and deep tube well water samples from the point-of-source. The samples were collected in 1 L plastic bottles, which were pre-washed with dilute HCl and rinsed three to four times with distilled water. The water samples were collected after 10 minutes drain tap water to remove supply water stored in the pipe. For physical parameters and anions was not acidified. Samples for trace metal analyses were acidified with HNO_3 to adjust the pH (<2). Samples were labeled, sealed and

transported to the laboratory and stored in refrigerator at a temperature of about 4˚C until the analysis was done. The non-acidified water samples were analyzed for pH, CO_2, alkalinity, total hardness (TH), total dissolved solids (TDS). The collected water samples were analyzed the parameters including pH, total hardness (TH), turbidity, total dissolved solids (TDS), total suspended solids (TSS), total solids (TS) and the concentrations of major cations and anions. pH were determined immediately after collection of the samples to avoid further contamination. TDS, TH and chloride were determined by using TDS meter, standard EDTA and $AgNO_3$ method, respectively. Samples for Ca, Mg, Fe, As and Cl have analyzed using standard methods (APHA, 1995). For microbial analysis samples were collected in 250 ml capacity glass bottles. Microbial parameters such as total coliform (TC) and faecal coliform (FC) were determined by membrane filtration method. BOD and COD were also determined by standard methods. All experiments were conducted in triplicate to ensure accuracy and precision. All reagents used in this study were analytical grade chemicals.

Statistical Analysis

In present Study, SPSS, MS-Excel were using in order to statistical and various graphical illustrations.

Results and Discussion

Water Quality and its Comparison

Descriptive analysis of the water samples from the analytical results of the physical, chemical and biological parameters in the selected slum areas in DCC is shown in Table 1 which contains minimum, maximum, mean and standard deviation of various parameters of supply water. Maximum value of pH in water samples were found 6.6 at Shyalbari Bosti and minimum value was 6.1 at Mirpur–1 Sweeper Coloni with a mean value of 6.36±0.16 which is not exceeds WHO and Bangladesh drinking standards. Maximum value of color in water samples were found 25 PCU at Shyalbari Bosti and minimum value was 5 PCU at Dhuary Para Bosti with a mean value of 14.38±7.29 PCU.

Table 1 Descriptive Statistic and Quality Comparison of Different Parameters of The Water Samples

Parameters	Minimum	Maximum	Mean	Std. Deviation	Bangladesh DWS	WHO (1996) DWS
pH	6.1	6.6	6.36	0.16	6.5-8.5	6.5-8.5
Color, PCU	5	25	14.38	7.29	15	15
Turbidity, NTU	1.3	4	2.79	0.97	10	5
TDS, mg/l	95	269	142.13	55.60	1000	1000
TSS, mg/l	15	15	15.00	0.00	10	10
TS, mg/l	110	284	157.13	55.60	-	-
CO_2, mg/l	9	27	16.38	7.15	-	-
Alkalinity, mg/l mgmmmg/Lmg/lmg/lmg/l	17	60	35.00	14.32	100	100
Hardness, mg/l	110	119	115.38	3.38	250-500	-

Parameters	Minimum	Maximum	Mean	Std. Deviation	Bangladesh DWS	WHO (1996) DWS
Cl, mg/l	20.02	108.1	37.90	29.17	150-600	250
Fe, mg/l	0.01	0.2	0.08	0.06	0.3-1.0	0.3
BOD, mg/l	1.9	4.4	2.66	0.91	0.2	-
COD, mg/l	5.5	11.7	8.66	2.29	4	-
TC, cfu/100ml	0	4	1.88	1.36	0	0
FC, cfu/100ml	0	1	0.38	0.52	0	0

Maximum value of turbidity in water samples were found 4 NTU at Agargao Sweeper Coloni and minimum value was 1.39 NTU ppm at Banani Bosti with a mean value of 2.79±0.97 NTU. Maximum value of TDS in water samples were found 269 ppm at Shyalbari Bosti and minimum value was 95 ppm at Banani Bosti with a mean value of 0.08±0.06 ppm. TSS in water samples were found with a mean value of 15 ppm. Maximum value of TS in water samples were found 284 ppm at Shyalbari Bosti and minimum value was 110 ppm at Banani Bosti with a mean value of 157.13±55.60ppm. Maximum value of CO_2 in water samples were found 27 ppm at Shyalbari Bosti and minimum value was 9 ppm at Mirpur–1 Sweeper Coloni with a mean value of 16.38±7.15 ppm. Maximum value of alkalinity in water samples were found 60 ppm at Rayar Bazar Bosti and minimum value was 17 ppm at Shyalbari Bosti with a mean value of 35.00±14.32 ppm. Maximum value of hardness in water samples were found 119 ppm at Shyalbari Bosti and minimum value was 110 ppm at Banani Bosti with a mean value of 115.38±3.38 ppm. Maximum value of chloride in water samples were found 108.10 ppm at Shyalbari Bosti and minimum value was 20.02ppm at Agargao Sweeper Coloni with a mean value of 37.90±29.17 ppm. Maximum value of iron in water samples were found 0.2 ppm at Shyalbari Bosti and minimum value was 0.01 ppm at Rayar Bazar Bosti with a mean value of 0.08±0.06 ppm. Maximum value of BOD in water samples were found 4.4 ppm at Shyalbari Bosti and minimum value was 1.90 ppm at Rayar Bazar Bosti with a mean value of 2.66±0.91 ppm. Maximum value of COD in water samples were found 11.70 ppm at Banani Bosti and minimum value was 5.50 ppm at Rayar Bazar Bosti with a mean value of 8.66±2.29ppm. Arsenic was found below 0.01 ppm from all the water samples. Maximum value of TC in water samples were found 4 cfu/100ml at Banani Bosti and minimum value was 0 cfu/100ml with a mean value of 1.88±1.36 cfu/100ml. Maximum value of FC in water samples were found 1 cfu/100ml Dhuary Para Bosti, Banani Bosti and TNT Coloni and minimum value was 0 cfu/100ml with a mean value of 0.38±0.52 cfu/100ml.

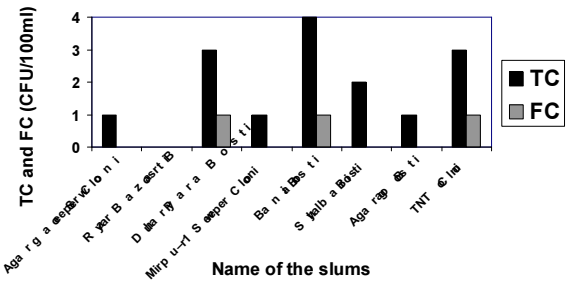


Figure 1 TC and FC of water samples of the slum areas in Dhaka City.

The water quality of the 8 selected slum areas of Dhaka City Corporation area are compared with Bangladesh Drinking Water Standards (BDWS) and World Health Organization Drinking Water Standards (WHO, 1996) which is presented in the Table 1. From the above results from water parameters tests table the water quality in the selected slum areas in Dhaka city is fit for drinking purpose except microbial considerations because the bacterial contamination was observed significantly. Slum areas water is unfit for drinking purpose without water treatment or simple boiling.

Sanitation System

Family and Economical Condition of The Slum Dwellers

It was observed that 38% family of slum areas have 2-3 members, 62% family of slum areas have 4-7 members (Figure 2A).

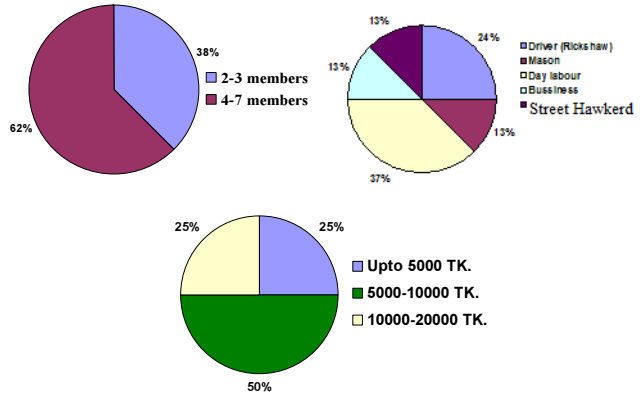


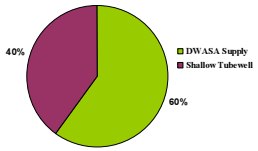
Figure 2A Family size. Figure 2B Occupation. Figure 2C Monthly Average Income.

Figure 2 Family and Economical Condition of the Slum Dwellers

Doing questionnaire survey it is obtained that 24% of people are rickshaw driver, 13% of peoples are working as street hawker, 37% of people are working as day labour and 13% of people are mason (Figure 2B). Monthly income level of the people living in this slum is very low. In that survey 25% slum dwellers income around TK. 3000-5000, 50% slum dwellers income are getting approximately TK.5000-10000 and remaining 25% are income level around TK. 10000-20000 (Figure 2C) per month. The low level of income bound them to lead a low standard of life (can not fulfills their fundamental needs). And such factors directly and indirectly affect the sanitary and water supply condition in the slums peoples.

Source of Drinking Water and Other Purposes

In most cases water supply facility in the slums is provided by the NGOs through water point from Dhaka Water Supply and Sewerage Authority (DWASA). Water point is basically water storage facility where water is stored from WASA main lines. In those slums where the above facilities are absent or inadequate, the inhabitants use maximum water from the Dhaka WASA and very few numbers depend on adjacent water bodies like ponds. However, the main source of drinking water is the Dhaka WASA supply water. Around 60% respondents use Dhaka WASA supply water and 40% respondents use shallow tube well for their drinking water and other purposes, respectively (Figure 3). We observed that collecting water from far away is a major problem. The peoples of the selected slum areas are not satisfied for the lack of proper water supply. 82% respondents are not satisfied while 18% are satisfied for the availability of water source in selected slum areas in Dhaka City (Figure 4).



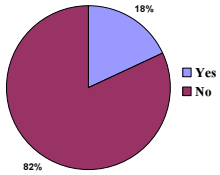
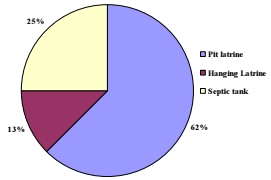


Figure 3 Sources of Water in Slum Areas.
Figure 4 Comments About Water Supply.

Latrine facilities and Mode of defecation

Sanitation situation is worse compare to water supply in the selected study areas. The commonly available sanitation facilities include pit latrines, hanging latrines and water seal latrines in slum area in DCC and pit latrines and over hanging latrines is low cost area in slum. The result obtained about mode of defecation for Pit latrine, septic tank system and water seal latrine are 62%, 25 and 13%, respectively in the study area (Fig 4A). All the latrines

are not hygienic and environmental friendly. So, it was observed that the sanitation system was found comparatively unsatisfactory for the slum area. We also saw that children are generally used the yard and the places near the tube-wells for defecating. However, no proper hygienic latrines such as water sealed latrine exist in any of the slum observed as shown in (Photo 1). The situation analysis of slums has pit latrines or sanitation and it block given by different source. Only two slum areas have septic tank system for the users. So, the sanitation facilities in Dhaka city slum are not sufficient.



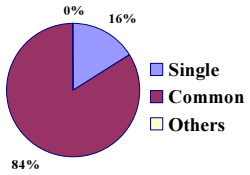
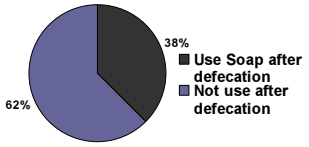


Figure 4A Types of latrines Figure 4B Comments About Existing latrine Facilities.

In case of analyzing existing latrine facilities we get for common 84% and single 16% in the slum area (Fig 4B). So, it is observed that the type of common latrine is gathering for slums area's i.e. unhygienic condition (Figure 15-18).

Sanitation Practices

Health and hygienic facilities of the selected slum area is in the worst condition. Therefore, different diseases frequently occur in that area. Besides safe distance between water point and latrine is not maintained in most cases that are very harmful for human health. Majority of the people (62%) of the sum areas are not use soap after defecation (Fig. 5A). Also it was found that the 49% of the house sweeps only single times a day (Fig. 5A).



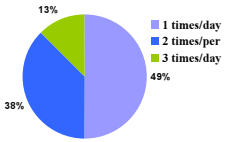


Figure 5A Practice of Soap Using or not Using Soap After Defecation.
Figure 5B Cleaning House Times of The Slum Areas in Dhaka City.

Water Borne Diseases

Data were collected from different sources and persons for common water borne diseases in the 8 selected slum areas in Dhaka City where the diseases of diarrhea, dysentery and cholera were 50%, 24% and 26%, respectively (Figure 20).

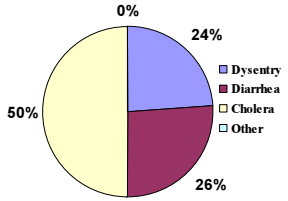


Figure 6 Common Water Borne Diseases in The Slum Areas.

Here we observed that major people affected by cholera. The respondents seem to have fair knowledge on the mode of transmitting germs from human excreta. Most of the households reporting to have at least one sick person in their households during last three months were asked about loss of working days.

Conclusion

The study in the selected eight slum area of Dhaka city found that the sanitary and water supply condition are improving very slowly. Majority slum people use tap water for drinking. Significant amount of open defecation is also found. On the other hand pit latrines which are no fully hygienic. These may cause ground- water contamination depending on the soil characteristics and distance between the water sources and latrines. The drainage system is the most neglected sector in the slums. Due to lack of proper sanitation knowledge rural as well as slum people under poverty limit do not construct latrines. As very few people go school after primary education they do not get enough awareness and knowledge about the harmful effect of unhealthy sanitary condition and water supply. Unhygienic latrines were the main sources of spreading diarrheal and other sanitation related diseases. Over flowing of excreta even in negligible flooding and rainfall occurred for most of the latrines of slum areas. Poor and unsuitable condition of superstructure of the latrines creates privacy problem especially for the women. Although overall quality of water is good except TC and FC. TC and FC were found 1.88 and 0.38 CFU/100 ml of water, respectively. The deteriorated scenario causes severe environmental degradation affecting the environment of entire Dhaka city. Slum people are fighting against poverty

and trying to improve their economic condition and standard of living. However, Government and in some cases, NGOs should be encouraged and offered the best facilities for taking more programs in slum areas on water supply, sanitation and solid waste management sectors.

Notes & References

1. American Public Health Association (APHA) (1995). Standard methods for the examination of water and wastewater, 19th edn, Washington DC, USA, pp.1467.
2. ADB Report, 1997.
3. BBS (Bangladesh Bureau of Statistics) 2012. Compendium of Environment Statistics of Bangladesh. Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
4. Choudhury, R.H. (1980). Urbanization in Bangladesh, Centre for Urban Studies, Dhaka.
5. Ersay, S.A.J.B, Potash, Robert, L. and Shiff, C., (1990). *Health Benefit from Improvement in Water Supply and Sanitation*, Wash Technical Report.
6. Islam, N. (1996). Dhaka: From City to Megacity, Perspectives on People, Places, Planning and Development Issues. Dhaka: USP, University of Dhaka.
7. Md Azahar Ali and Biplob Pramanik (2011). An experience of SPACE on ecological sanitation in Bangladesh. 35th WEDC International Conference, Loughborough, UK.
8. Moe C.L and Rheingans R.D. (2006). Global challenges in water, sanitation and health. Journal of water and health, 4.suppl, 41-57.
9. Rayhan, I. (2005). Coping with Floods: Does Rural -Urban Migration play any Role for Survival in Bangladesh? Journal of Identity and Migration Studies, 1(2), 82-98.
10. WHO (1996). Health criteria and other supporting information. Guidelines for drinking water, Vol.2, 2nd edn, Geneva.
11. WHO. Basic Environmental Health, Geneva, 1997.
12. Abebe Ls. Hygienic water quality; Its relation to health and the testing aspects in tropical conditions, Department of Civil Engineering, Tempe ere university, Finland, 1986.