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Supply Water Quality in Urban Bangladesh: A Case Study of Chittagong Metropolitan City

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Abstract: Drinking water quality in urban Bangladesh is at high risk. The port city of Chittagong is not only facing the problem of inadequate water supply but also serious threat due mainly to the scarcity of safe water. This paper attempts to characterize and analyze the supply water quality in Chittagong Metropolitan City (CMC) from health and environmental perspective using a set of parameters: physical, chemical and micro-biological. The paper focuses on key challenges facing the sector today, especially in the provision of urban water service delivery. The thrust there has been to identify weaknesses in current water supply management, and explore options to address the chronic lack of service provisions. The overall finding is that the dwellers of CMC have been suffering from irregular, inadequate and unsafe water supply due mainly because of inefficient management practices. The situation is worse in low income residential areas. Regular monitoring of water quality along the distribution networks, timely repair and maintenance, improving information systems, uses of advanced technology, provisions for staff training, awareness building among users and stakeholders, and promotion of community-based co-management governing systems have been strongly suggested.

Key words: Water quality, environment, contamination, health impacts, monitoring, management.

Introduction

Urban water supply has become a critical factor in socio-economic development in most parts of the world. This is now a major public health issue in Bangladesh, especially in addressing the quality of urban life. The extent and availability of safe drinking water is an important indicator of sustainable development, and access to clean water constitutes a principal component of the Millennium Development Goals (MDGs). Yet, more than 70 percent of the urban population in the developing countries either have an inadequate water supply or are being supplied with unsafe water or both (Kamal, 2003). Since the quality of drinking water is closely associated with human health, providing safe drinking water is one of the most important public health priorities. An estimated 80 percent of all diseases and one third of deaths in developing countries are caused by the consumption of contaminated water (UNCED, 1992). In the case of Bangladesh, roughly 80 percent of all diseases are linked with contaminated drinking water, and some 28 percent of the children's death is attributed to water-borne diseases, caused mainly by pathogenic microorganisms (Aziz et al., 1990). About 25 percent of the total population lives in urban Bangladesh, and only 44 percent of the urban people are served with tap

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water supply (BBS, 1995; Population Census, 2001). The lower income group is the worst sufferers as they cannot afford to have safe drinking water for an active and healthy life (Rahman and Jahan, 2003).

Objectives

This paper attempts to characterize and analyze the supply water quality in Chittagong Metropolitan City (CMC) from health, environment and residents perspective, using a set of parameters: physical, chemical and micro-biological. The ultimate objective of the study is to examine the supply water quality and quantity in Chittagong Metropolitan City with a view to identify key problems. The paper then focuses on key challenges facing the sector in the provision of urban water service delivery; it identifies weaknesses in the current water supply management practices, and explores options to address the chronic lack of service provisions.

Study Area

Chittagong Metropolitan City (CMC) is situated on the right bank of the Karnaphuli river, constituting an area of about 1145 square kilometres (the area of Chittagong City Corporation is 168 sq km) with 11 police stations (*Thanas*) and 41 administrative wards. The city lies latitudinally between 22º14′ and 22º24′ North and longitudinally between 91º46′ and 91º53′ East (Figure 1). CMC is the second largest city (commercial capital) of Bangladesh, and is inhibited by over 4.02 million people (Amin, 2006). About 0.4 million people are served by 21,000 house connections and 0.2 million people collect water from 588 street hydrants (Amin, 2006; BBS, 2007) that are installed

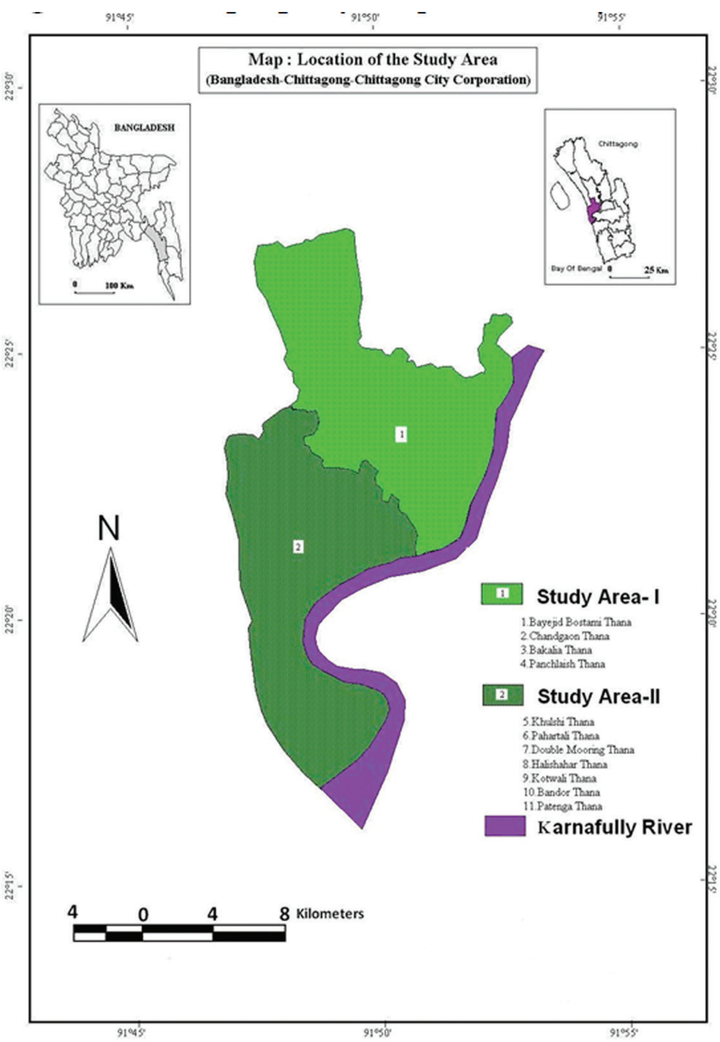

Figure 1: Chittagong City Corporation study area.
Source: Base map collected from CWASA, 2011.

and maintained by the Chittagong Water Supply and Sewerage Authority (CWASA), and the Chittagong City Corporation (CCC).

Demand-Supply Analysis

CWASA is the sole organization that supplies water to the city dwellers through its limited distribution networks, but capable of supplying only 30 percent of the total demand (585 million litres water per day, MLD) generated by over 4 million city population. History of water demand and supply in CMC indicates that between 1990 and 2007, the total demand of supply water in the city has increased from 270 MLD in 1990 to 585 MLD in 2007—a 46 percent increase over the period. In response, the total supply (ground and surface water capacity) of CWASA has increased from 134.5 to 190 MLD or 71 percent. While the capacity of groundwater supply increased from 45 to 99 MLD (46 percent) between 1990 and 2007, the capacity of surface water supply rose very slightly—from 89.5 to 91 MLD (0.98 or less than 1 percent) during the reference period (Table 1). It is striking to note that in the year 2006 CWASA was able to meet only 30 percent (175 MLD) of the total supply water demand in CMC. Although the capacity of groundwater supply has increased steadily in the city to meet the growing demand, in reality CWASA's overall supply capacity has fallen from 50 percent to 30 percent in fulfilling the collective demand. Since CWASA is responsible for construction and installation of water supply systems in the city, operations and maintenance, connecting the households to the water supply network, licensing tube-wells and providing public taps outsides the households etc., it is this organization which has to be more efficient in water service delivery.

Material and Methods

Sampling, Environmental Survey and Water Quality Parameters

In order to conduct field study (between February and October, 2011), the city corporation area has been divided into two broad regions based on the dominant sources of water supply—Northern treated surface water and Southern groundwater zones (Figure 1). To collect primary data, an environmental survey was conducted as an exploratory device. Water samples were collected for physical, chemical and biological parameters from different stations. Sample sizes were selected on the basis of residential (household) structure. For collecting, preserving and analyzing the selected samples, methods used by the American Public Health Association (APHA, 2003) have been followed as the standard. The collected samples were analyzed in the Industrial Microbiological Research Division of the Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratory, Chittagong.

For environmental survey, a total of 42 samples on 20 parameters were taken from both the study areas (Table 2). For laboratory analysis, 13 physicochemical parameters including pH, turbidity, total dissolved solid (TDS), electric conductivity (EC), dissolved oxygen

Table 1: Water demand and supply capacity in CWASA by types, 1990-2007

Year	*Demand (MLD)*	*Water supply capacity*			*% Fulfill of demand*
		Ground water	*Surface water*	*Total*	
1990	270	45	89.5	134.5	50%
1996	366	55.3	89.3	144.6	40%
1997	382	58.4	89.7	148.0	39%
1998	400	73.5	89.8	163.3	41%
1999	418	78.0	90.1	168.1	40%
2000	450	73.0	90.7	163.7	36%
2001	470	70	90.5	160.5	34%
2002	491	72	90.4	162.4	33%
2003	513	77	91.6	168.6	33%
2004	536	83.7	91.3	175	33%
2005	560	84	91	175	31%
2006	585	84	91	175	30%
2007	------------	99	91	190	

Source: CWASA 2010 and MPWS, 2009.

Table 2: Location of the sampling station

Study areas (Location of the sampling station)		*Residential structure**	*Selected sample size***
Study Area I (Northern zone)	Bakalia Thana	41410	02
	Chandgaon Thana	36064	04
	Panchliash Thana	34079	04
	Bayejid Bostami Thana	35208	05
Total residential structure		146761	15
Study Area II (Southern zone)	Kotwali Than	57179	04
	Double Mooring Thana	53849	03
	Khulshi Thana	52011	05
	Pahartali Thana	25768	05
	Halishahar Thana	24763	04
	Chittagong Port	41466	03
	Patenga	15542	03
Total residential structure		270578	27
MOD-I and MOD-II		417339	42

Source: Field Survey, 2011, Population Census, 2001 and Master plan for water supply CWASA, 2010.
*Residential structure is to be considered as population census, 2001 and Master plan for water supply CWASA, 2010.
**Selected Sample Size has been selected by spot random sampling techniques on households' level and availability of CWASA connected line.

(DO), biological oxygen demand (BOD), hardness, chloride, nitrite (NO_2^-), nitrate (NO_3^-), iron (Fe), arsenic (As) and Chlorine (Cl^-) have been employed. Microbiological parameters (7) include total coliform, fecal coliform, *Salmonella* sp., *Shigella* sp., *E. coli*, total viable count and *Vibrio Cholerae* (Table 2). Findings of the research have been assessed according to the World Health Organization (WHO, 1993) drinking water quality guidelines and Bangladesh Standards (BSTI, 2001) as well. Finally, in-depth interviews were taken from CWASA representatives including managers and professionals to learn how to improve water service delivery in the city.

Data Processing and Analysis

The collected data were processed and analyzed (where appropriate) with the help of various computer software, especially Statistical Package for Social Sciences (SPSS-version 18). Base maps were collected from the GIS Section of the Chittagong Development Authority (CDA) and CWASA. Collected base maps were digitized and modified using Arc View 3.3 and Arc GIS 9.1 software for showing the distribution of sampling stations and zoning of the study area. A new map was also produced (Figure 2) from the Global Positioning System (GPS) input data collected during the survey period.

Results and Discussion

The measured values of water quality parameters of the selected water samples are summarized in Table 3. The laboratory analysis reveals that out of 13 physicochemical parameters, eight parameters including TDS, turbidity, pH, Fe, NO_3, As, hardness and Cl^- are found within the permissible range. However, the values of five parameters i.e. EC, NO_2, DO, BOD and free chlorine are noticed astonishingly high. Quite a few parameters are observed in critical condition in the Southern than in the Northern zone. Among microbiological parameters (seven), total coliform and fecal coliform are present in almost all the water samples. Of the total viable count of bacteria, 19 samples are found contaminated that crossed the acceptable limit. Pathogenic organisms such as *salmonella* spp., *shigella* spp., *Escherichia coli* and *Vibrio cholerae* are also present in the study samples. The following section presents the results of individual water quality parameters.

Analysis of Physico-chemical Parameters

Electric Conductivity (EC)

Electric conductivity of the water samples were determined by Conductivity meter, Model no. EC214, Hanna Instruments the values of which crossed the

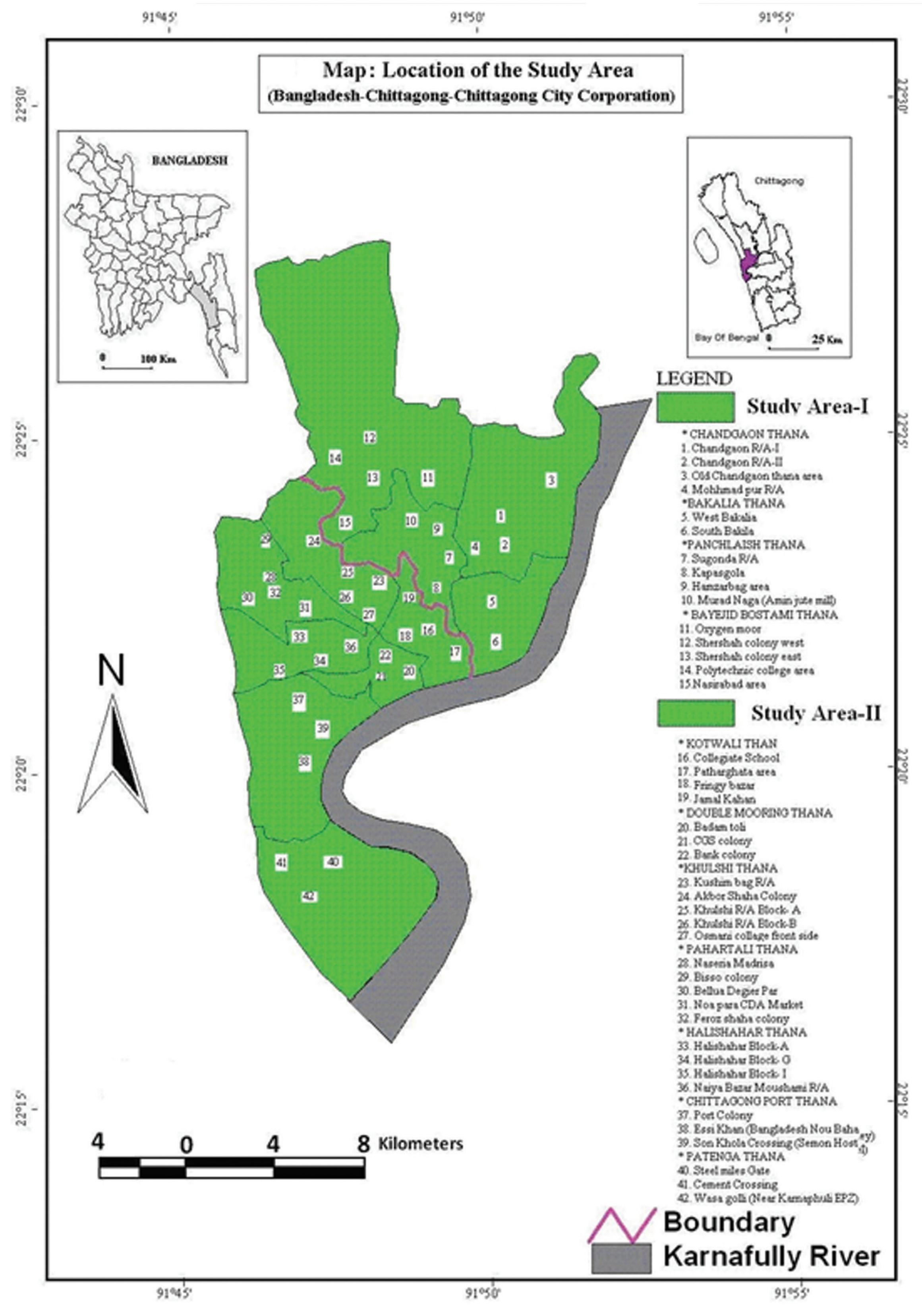

Figure 2: Selection of the sampling location.
Source: Base map collected from CWASA, 2011.

Table 3: Summary of measured water quality parameters in CWASA's supply

Parameter	Study Area-I				Study Area-II			
	*Max^m^*	*Min^m^*	*Mean*	*Std. dev^n^*	*Max^m^*	*Min^m^*	*Mean*	*Std. dev^n^*
EC (μScm^{-1})	2637.0	53.67	583.511	558.274	2637.0	53.67	733.455	641.114
TDS (mg/l)	1450.30	74.44	394.814	327.569	1450.3	128.00	500.982	356.564
Turbidity (NTU)	256.86	0.12	8.6083	39.3495	256.86	0.12	10.9307	49.158
pH	11.80	5.50	6.8969	1.03752	8.47	5.50	6.8989	0.732
Arsenic (mg/l)	0.00	0.00	0.0000	0.00000	0.00	0.00	0.0000	0.000
Iron (mg/l)	1.50	0.00	0.4671	0.32726	0.80	0.30	0.4933	0.163
Nitrate (mg/l)	60.00	0.00	17.8643	16.8045	60.00	0.00	25.2037	16.301
Nitrite (mg/l)	14.00	0.00	1.1845	3.52080	0.60	0.00	0.0659	0.156
DO (ppm)	33.50	6.00	11.5262	4.62169	33.50	7.20	11.2704	5.294
BOD (ppm)	67.00	6.00	25.0845	16.1433	67.00	6.00	28.2815	18.875
Chlorine (mg/l)	40.56	0.00	1.7800	6.16414	40.56	0.00	2.4393	7.653
Hardness (mg/l)	430.00	32.00	140.500	84.9175	430.00	40.00	161.333	83.101
Chloride (mg/l)	909.90	20.28	195.977	224.672	909.90	20.28	270.410	247.178

Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.

acceptable limit (above 500 μScm^{-1} for drinking water as set by the World Health Organization, Figure 3) in both the study areas: Zone I (surface water 60 percent) and Zone II (ground water, 82 percent).

Total Dissolved Solid (TDS)

TDS in water samples were determined by the Portable Turbiditivity meter, Model no. Turb350IR, the values of which are found in acceptable limit (500 mg/l for drinking water) (BDS, 2001). However, some 37 percent of the samples in Zone II are found to have crossed that limit.

Turbidity

Turbidity values of the water samples were determined by the Portable Turbiditivity meter, Model no. Turb350IR, the acceptable limit of which is 5.0 NTU (max.) for drinking water (BSTI, 2001; WHO, 1993). In majority of the samples (93 percent), the values of turbidity are found in acceptable limit (below 5 NTU).

pH

pH values of the water samples were determined by a Digital pH meter. Figure 4 depicts the pH values in CWASA pipe water in CMC. The maximum pH values were observed 11.80 and 8.47 in study areas I and II respectively, while the minimum and average pH values were 5.50 and 6.8969 in both the areas (Table 3). However, the permissible range is 6.5-8.5 according to WHO guidelines and Bangladesh Environmental Conservation Rules, 1997.

Arsenic (As)

Arsenic values in water samples were determined by Atomic Absorption Spectrometry (AAS). Laboratory analysis reveals that there is no presence of arsenic contents in supply water in both the supply systems (ground and surface water) in Chittagong Metropolitan City.

Iron (Fe)

Iron values in water samples were determined by Atomic Absorption Spectrometry (AAS); the acceptable limit of iron is 0.3 mg/l for drinking water, according to World Health Organization (WHO) guidelines values and standard values. The maximum concentration of iron in water was 1.50 mg/l and minimum was 0.00 mg/l in study area I while maximum and minimum concentration in the study area II were 0.80 mg/l and 0.30 mg/l respectively. Average concentration (0.4671 mg/l) of iron in supply water was same in both areas (Table 3). Hence, high iron concentration in the distribution system might be due to corrosion of old pipeline (metal) and improper treatment of ground water before supply of distribution networks of CWASA.

Nitrate (NO_3)

Nitrate (NO_3) content of water samples were determined by titrimetric methods (APHA, 2003). The acceptable limit of nitrate is 45.0 mg/l for drinking water according to WHO standard. Although the study areas have the same maximum (60.0 mg/l) and minimum (0.00 mg/l) nitrate concentration, the average concentration of nitrate was higher (25.2037 mg/l) in study area II, compared to study area I (17.8643 mg/l, Table 3). The nitrate values have crossed the acceptable limit (Figure 5) in both the study areas.

Nitrite (NO_2)

Nitrite (NO_2) concentration of water samples were also determined by titrimetric methods (APHA, 2003). The acceptable limit of nitrate is 0.005 mg/l for drinking water. Nitrite values found in study area I ranged between maximum 14.00 mg/l and minimum 0.00 mg/l, while in the study area II the maximum concentration was found 0.60 mg/l and minimum 0.00 mg/l (Table 3). The value of nitrite crossed the acceptable level (Figure 6) of Chittagong Metropolitan City. Thus, high concentration of nitrate (NO_3) and nitrite (NO_2) in the distribution system especially ground water dominated areas might be due to municipal waste and heavy industrial residues entering the pipeline during non-suction period through leaching point of pipeline and not properly closed unauthorized connection of CWASA pipeline network in Chittagong metropolitan city.

Dissolved Oxygen (DO)

Dissolved oxygen (DO) standards of water samples were determined by Winkler titrimetric methods (Iodometric, APHA, 2003). The maximum DO values for both the areas were same (33.50 ppm); whereas the minimum values were 6.00 ppm and 7.20 ppm in study areas I and II respectively (Table 3) although the acceptable limit of DO is 4-6 ppm for drinking water.

Biological Oxygen Demand (BOD)

Biological oxygen demand (BOD) standards of water samples were determined by BOD_5 Winkler titrimetric methods (APHA, 2003). The maximum (67.00) and minimum (6.00) BOD values were same in both the study areas but the average value of BOD was higher (28.2815) in study area II than study area I (25.0845) (Table 3). All the collected water samples of both study areas of CWASA had BOD_5 concentration greater than the acceptable limit (above 4-6 ppm). High DO and BOD_5 concentration in the distribution system might be due to cross-contamination through leaching pipes, unauthorized connection, improper and unhygienic domestic storage facilities etc.

Free Chlorine

Free chlorine concentration of water samples were determined by Atomic Absorption Spectrometry (AAS). Both the areas had the same maximum (40.56) and minimum (0.00) chlorine concentration but the average value of chlorine was higher (2.4393) in study area II than study area I (1.7800) (Table 3). However, the acceptable limit of chlorine is nil for drinking water. Chlorine concentration has been used in positive sense in the distribution network because it will kill all possible microorganisms present in the supply water. Although chlorine is effective in destroying pathogen and preventing the spread of communicable disease, it may be an indirect non-infectious health problem caused by the chlorination process (Chhatwal, 1998). CWASA authority already uses high quantity of chlorine in supply system and it crosses the acceptable level (Figure 7) in some spot in Chittagong metropolitan city.

Hardness ($CaCO_3$)

Hardness in water samples was determined by titrimetric methods (APHA, 2003). The acceptable limit of total hardness is 300 as $CaCO_3$ mg/l for drinking water. On an average hardness values were found below the acceptable limit, although the maximum value was higher than that limit. The maximum (430.00) hardness was same in both the areas and minimum values were 32.0 and 40.0 in study area I and II respectively. Average value of hardness was higher (161.333) in study area II than it was in study area I (140.500) (Table 3).

Chloride (Cl^-)

Chloride concentrations of water samples were determined by titrimetric methods (APHA, 2003) and the acceptable limit of Cl^- is 250 mg/l for drinking water. The average values of chloride (Cl^-) were above the acceptable limit. The maximum and minimum values of Cl^- were same in study area I and II. The values were 909.90 and 20.28 respectively. Average value of chloride (Cl^-) was higher (270.410) in study area II than it was in study area I (195.977) (Table 3). High chloride concentrated values may be due to saline water intrusion problem during non-suction period, corrosion of distribution network and illegal linkage in CWASA pipe line of Chittagong metropolitan city.

Analysis of Microbiological Parameters

Among the 42 samples in study areas I and II, 24 detected presence of Total Coliform and Fecal Coliform in supply water in Chittagong metropolitan city and majority contain in study area II than study area I. Nearly all the samples had contents of Total Coliform and Fecal Coliform in supply water of Chittagong metropolitan city. Test results of the presence of selected samples in the supply water are given in Table 4).

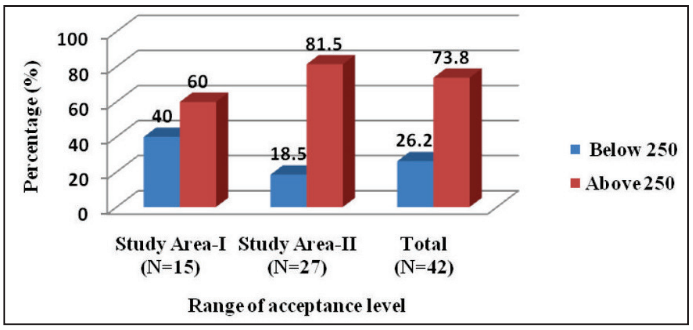

Figure 3: Electric conductivity in the supply water.
Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011

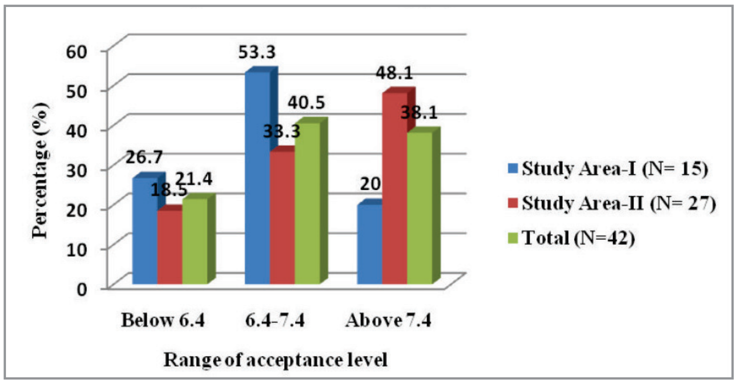

Figure 4: pH content in supply water.
Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.

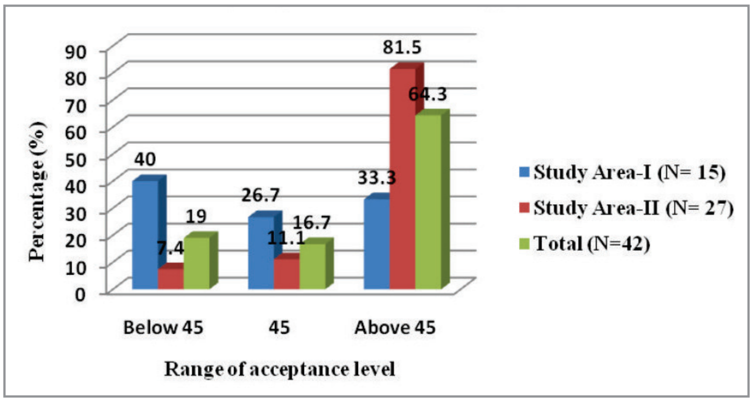

Figure 5: Nitrate (NO_3) content in supply water.
Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.

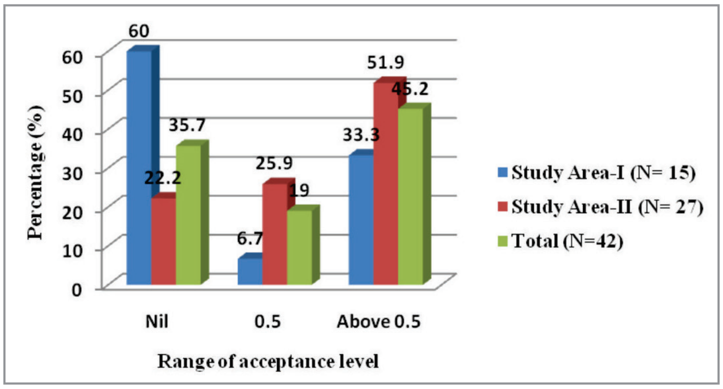

Figure 6: Nitrite (NO_2) content in supply water.
Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.

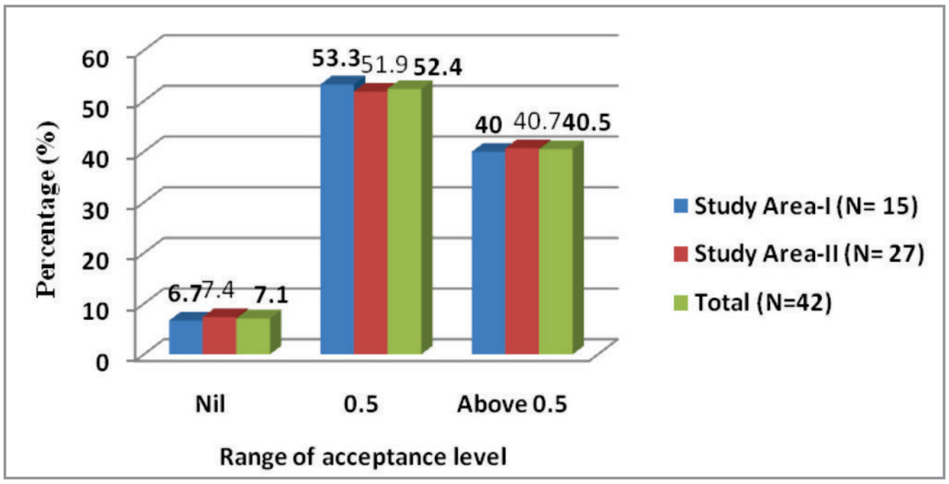

Figure 7: Free chlorine content in supply water.
Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.

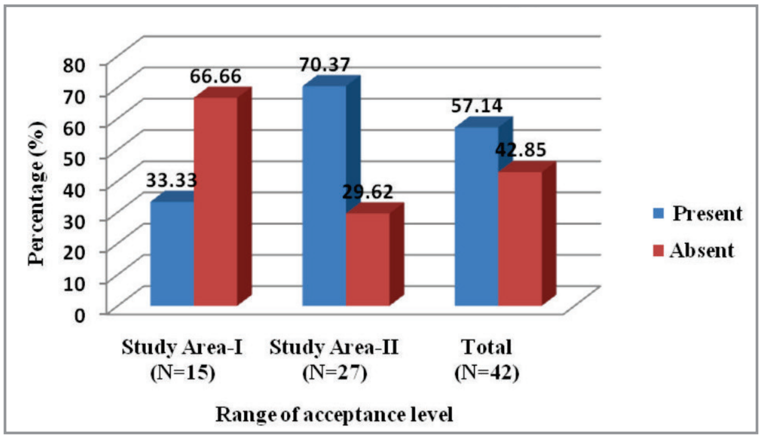

Figure 8: Total coliform content in supply water.
Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.

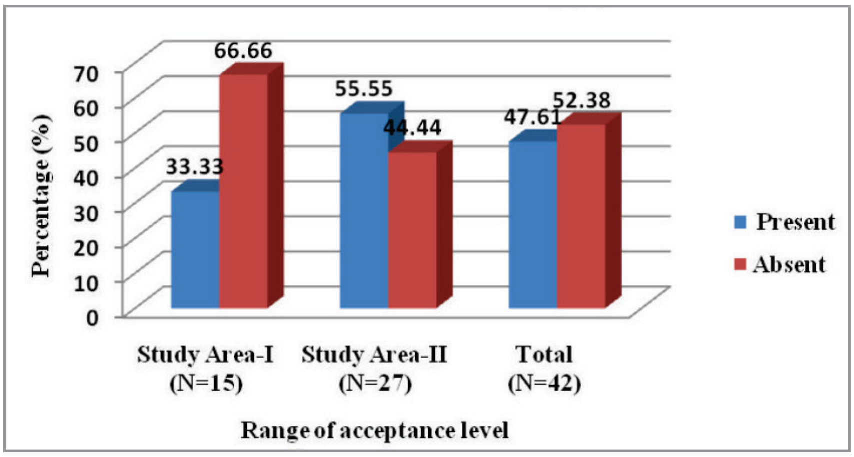

Figure 9: Fecal coliform content in supply water.
Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.

Table 4: Results of microbiological parameter of supply water in Chittagong metropolitan city

Total coliform (/100 ml)												
*S.L.	*01*	*07*	*08*	*09*	*10*	*16*	*17*	*18*	*19*	*20*	*21*	*22*
Values	210	1100+	93	120	1100+	1100+	23	9	240	1100+	1100+	1100+
S.L.	*23*	*25*	*28*	*30*	*32*	*34*	*35*	*38*	*39*	*40*	*41*	*42*
Values	15	23	43	9	1100+	23	64	1100+	1100+	9	240	42
Fecal coliform (/100 ml)												
*S.L.	*01*	*07*	*08*	*09*	*10*	*16*	*17*	*18*	*19*	*20*	*21*	*22*
Values	150	1100+	43	9	1100+	1100+	–.	9	210	1100+	1100+	210
S.L.	*23*	*25*	*28*	*30*	*32*	*34*	*35*	*38*	*39*	*40*	*41*	*42*
Values	23	9	23	–	1100+	–	39	1100+	240	4	150	–

Source: Lab. Analysis (BCSIR Laboratories, Chittagong), 2011.
*S.L. – Sample Location.

Total Coliform

Values of total coliform of water samples were determined by Most Probable Count Methods (MPN) and the acceptable limit is 0/100 ml for drinking water. Figure 8 shows that 57.14 percent samples were beyond the acceptable limit in the supply water of Chittagong metropolitan city with 70.37 percent samples in study area II and 33.33 percent in study area I.

Fecal Coliform

Values of fecal coliform of water samples were determined by Most Probable Count Methods (MPN) and the acceptable limit is 0/100 ml for drinking water. Out of total samples, 47.61 percent were beyond the acceptable limit of fecal coliform (Figure 9) in supply water of Chittagong metropolitan city with 55.55 percent samples in study area II and the 33.33 percent samples in study area I.

Total Viable Count

Total viable count was determined by nutrient agar, plate count and the acceptable limit is 10^4/ml for drinking water. Total viable count of bacteria was in critical position in 19 samples which directly crossed the acceptable limit and in rest of samples the values of total viable count was near unacceptable limit in Chittagong metropolitan city. Total 54.76 percent samples crossed the acceptable limit of total viable count in supply water and it is notable that 73.33 percent samples crossed the acceptable limit (above 10×10^4) in the study area I.

Pathogenic Organism Analysis

The pathogenic organism such as *Salmonella* spp., *Shigella* spp., *Escherichia coli* and *Vibrio cholerae* were present in both study areas. *Salmonella* spp. was detected in samples 02 and 34. Sample 02 was collected in Chandgaon residential area (Block B) of Chandgaon Thana and sample 34 in steel mills of Potenga Thana. *Shigella* spp. were detected in sample 07 under Baparipara Kulgaon, Bayzid Bostami Thana. *Escherichia coli* were detected in samples 15 and 21. Sample 15 was collected in Sharshah Colony in Bayzid Bostami Thana and sample 21 from Agarabad Badamtoli in Double Mooring Thana. *Vibrio Cholerae* is detected in different places in the study area II such as, 16, 28, 29, 38 and 41. The sample no. 16, 28, 29, 38 and 41 were taken from East Nalapara Collegiate School in Kotwali Thana, Akborshah in Pahartali Thana, Block-A in Khulshi R/A, Port Colony in Bandor Thana and Block I in Halishahar Thana respectively.

Causes

Water contamination in the distribution systems may be attributed to leaks in the old pipes and through linkage faults. According to a study, about 25 percent of the water produced in Dhaka city is lost by leakage through pipes and fixtures. Various illegal connections and visible linkage faults were observed during the period of sample collection. It was also observed that if water can leak out of the pipes, contaminated water can enter into the system through the same route during non-supply hours (Choudhury et al., 1997). The nature of water supply is also responsible for causing the inadequate supply. Absence of water pressure is a regular phenomena at most suction point during non-supply hours. Suction is also produced by installation of unauthorized pumps in the service line to suck more water from the low pressure zone.

Recommendations

The present study reveals that supply water quality in CMC is unsuitable for drinking and cooking. To avoid health risks, the following consideration can be recommended.

Regular Monitoring of Water Quality along the Distribution Networks

Uses of disinfectant residuals control the growth of microorganisms in distribution systems and also act as a final barrier to help maintain the microbial safety of supply water. Realistic residual concentration at least inactivate the least resistance microorganisms such as *E. coli* and thermo tolerant coliforms that are used as the main indicators of water safety.

Timely Repair and Maintenance

Contamination via cross-connection, disclosed pipe joints or pipe breaks may influence water quality. Pathogens may enter the system through contaminated supply water, in line reservoir etc. System personnel need to immediately repair the fault points of supply and water holding system. The best way to control leakage is to replace the deteriorated pipelines as planned by CWASA.

Improving Information Systems, Planning and Appropriate Funding

CWASA should immediately take steps to establish data-base management systems including demand assessment for future service provisions. This could be done in conjunction with on-going population growth projection in the study area. CWASA should explore alternative sources of funding to meet not only the growing demand of safe supply water in the city but also to ensure efficient service delivery.

Uses of Advanced Technology

CWASA should use thick PVC pipeline which is neither corrosive nor easy to leakage.

Online Quality Control Assessment

CWASA should also promote online quality control assessment of system from treatment plant to consumer (households).

Provisions for Staff Training

CWASA should arrange training camps and workshops at different levels for employees including Lab. Assistants, scientific officers, engineering, and field personnel. Thematic areas that should receive priorities are assurance of water quality, selection of materials such as PVC pipe for installation, ensuring proper service connection, rehabilitating old pipes and setup new pipes, sluice valves and chamber repair, identifying leakage or fault line with immediate repairing skills.

Awareness Building among Users/Stakeholder

Every morning before using the water for drinking or cooking, the water from the taps should run for several minutes. Users should also be very careful in storing water. Storing pot should be washed on a regular basis by bleaching powder to store water safely and hygienically**.** CWASA should organize different types of initiative such as seminar, symposium, advertisement and campaign etc. and ensure the participation of all income groups (elite to poor) in awareness building activities, including discouragement of unauthorized connections and fair water pricing in the city area.

Participatory and Co-management Approach

A participatory and co-management approach including all stakeholders—local community, non-governmental organizations, local-government representatives and CWASA officials—can ensure an effective, efficient and sustainable water supply delivery system in the Chittagong metropolitan city.

Conclusion

In Bangladesh, drinking water quality in urban areas is at high risk, supply is irregular, quantity is inadequate, systems are conventional, and management approaches are inefficient. In particular, the dwellers of CMC have been suffering from irregular, inadequate and unsafe water supply due mainly to poor management. The situation is worse in low class residential areas i.e. slums. The existing water supply system of CMC is far from being satisfactory due mainly to old fashioned management practices. Water contamination in the distribution systems may be attributed to leaks in the old pipes and through linkage faults. Various illegal connection and visible linkage faults were observed during the period of sample collection.

The nature of water supply is also responsible for causing the inadequate supply. Absence of water pressure is a regular phenomena at most suction point during non-supply hours. Suction is also produced. Regular monitoring of water quality along the distribution networks, timely repair and maintenance, cleaning the pipe line, using proper chemical to protect water-borne disease, supplying safe water, water conservation, using water for vital causes, improving information systems, uses of advanced technology, provisions for staff training and awareness building among users/stakeholder have been strongly suggested.

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