

A Study on Water Quality Parameters of Water Supply in Sylhet City Corporation Area

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Abstract: An investigation was carried out to assess the water quality parameters of water supplied by Sylhet City Corporation (SCC). The supplied water quality is at risk to deteriorate during its flow through the delivery system and/or due to the possibility of high elemental concentration in ground water. In SCC, there are 23 pumps available that continually supply water for city dwellers. The parameter analyzed are like pH, turbidity, hardness, chloride, TDS (Total dissolved solid), arsenic, iron, FC (Fecal Coliform) and TC (Total Coliform). All results are compared with the World Health Organization (WHO), Bangladesh Standard (BD) and the Indian Standard Institute (ISI). The investigation discovers that the value of turbidity and iron in the location of Christian Mission designated by S-11 crosses the all three standard. The measurement of TDS and chloride shows that the values are within the safe limit. Analysis of arsenic and FC water quality parameter revealed that there are no arsenic and fecal coliform contamination. The water treatment facilities of SCC have to be enhanced; necessary steps should be taken to reduce the contamination and adequate treatment facility should be promoted.

Keywords: Water Quality Parameter, Water Supply, pH, Iron, Turbidity

1. Introduction

The important consideration and the main responsibility of the modern public health engineering is to supply potable water to the general people. Potable water is one which is safe to drink, pleasant to taste and suitable for domestic uses. About 80% of all diseases and two third of deaths in developing countries are attributed to consumption of low quality water, and on an average 10% of ones' productive time is sacrificed to such diseases[1]. Water is involved in the spread of communicable diseases in essentially two ways. The well-known direct ingestion of infectious agent is the contaminated drinking water. The second is due to a lack of sufficient water for personal hygiene purposes. The quality of drinking water is at high risk in Bangladesh. Problems are severe, particularly in the urban areas due to high migration rate of rural people and increased economic growth as well [1, 2].

Most of the city dwellers in Sylhet depend on the SCC water supply even though some people fulfill their requirements by themselves. As most of the city dwellers rely on this water supply, the quality of water distributed by SCC is vital for the health of the city dwellers. There are mainly three

types of constituents or parameters for describing the quality of water, i.e. physiological, chemical and biological parameters. Observation about water quality, based on visual examination such as, color, taste, and odor is often unpredictable.

In Sylhet City Corporation, 23 pump station and Surface Water Treatment Plant (SWTP) supply water to city dwellers for drinking and household-usage purpose. In this study different water quality parameters like pH, total hardness (TH), total dissolved solids (TDS), chloride, iron, arsenic, total coliform, fecal coliform are tested from samples collected near the sources of the pump station and the results are compared with the WHO, BD and ISI standards. The result of this study will be beneficial for the planners and decision makers to device policy guideline for efficient management of water supply source.

2. Study Area, Materials and Methodology

Sylhet City is situated by the side of the Surma River- at the northeast region of the country and situated at 28.85° latitude

and 98.80° longitude [3]. Sylhet Pourashava established in the year 1878 and promoted to the City Corporation during the

year 2002 covering an area of 26.5 sq. km [3] and sub-divided into 27 # of Wards (Fig. 1).

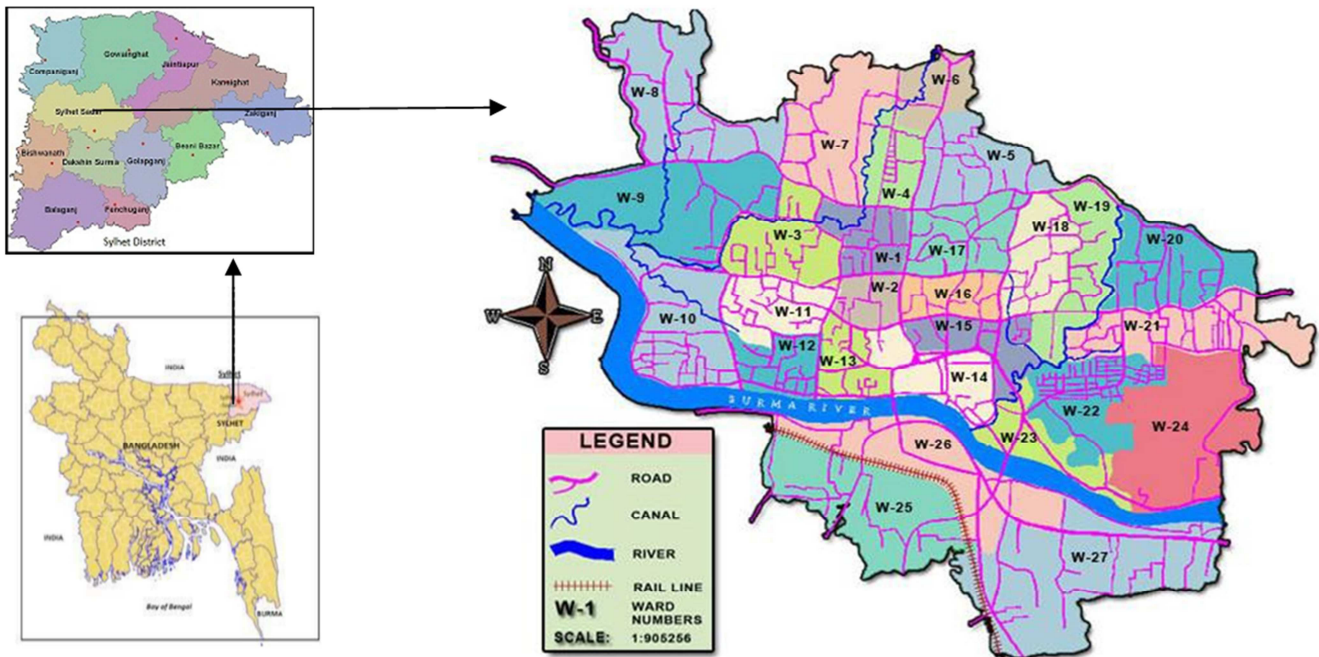


Figure 1. Study area and location of sampling points [9].

Table 1. Comparison of water quality parameter with WHO [5], BD[6] and ISI[7] standards.

S No.	Name of the source Pumping Stations	pH	Turbidity (NTU)	TDS (mg/L)	Hardness (mg/L)	Chloride (mg/L)	IRON (mg/L)	ARSENIC (mg/L)	FC (N/100g)	TC (N/100g)
S-1	Old Medical Colony	6.30	3.42	281	50.00	8.50	0.44	0	0	0
S-2	Bornomala School	6.01	0.57	241	69.40	13.80	0.43	0	0	0
S-3	Dept. of public Health	6.60	1.02	172	64.60	6.60	0.61	0	0	0
S-4	Rikabibazar	6.76	5.20	292	39.30	12.00	0.33	0	0	0
S-5	Osmani Medical	6.76	1.10	316	74.00	11.33	0.51	0	0	1
S-6	Ansar Camp	7.10	0.41	318	16.67	12.67	0.48	0	0	0
S-7	Korer Para	6.50	1.52	235	62.00	3.90	0.59	0	0	0
S-8	MotshoVobon opposite	6.80	0.00	365	266.00	4.30	0.57	0	0	0
S-9	PTI	7.18	0.00	209	284.00	17.00	0.40	0	0	0
S-10	Kazitula	6.95	0.00	280	41.00	10.00	0.47	0	0	0
S-11	Christian Mission	7.17	4.65	208	43.30	15.67	1.30	0	0	2
S-12	Mazar side	7.43	0.00	171	32.67	10.00	0.54	0	0	0
S-13	ShahiEidgahUchasorok	6.93	0.32	274	37.00	12.67	0.28	0	0	0
S-14	HazaribaghAbasik	7.13	0.00	186	43.30	11.33	0.12	0	0	0
S-15	TT gate point	6.90	1.46	237	60.67	10.00	0.37	0	0	1
S-16	Baluchor point Pump 1	6.90	0.82	180	44.00	8.67	0.39	0	0	2
S-17	Baluchor point pump 2	7.10	1.65	235	74.67	6.60	0.45	0	0	0
S-18	Choukidekhi	6.60	1.97	213	96.30	12.33	0.42	0	0	1
S-19	Near Biman Office	7.13	1.20	226	60.30	12.67	0.65	0	0	1
S-20	Pathantula	6.60	0.76	199	66.00	7.00	0.35	0	0	0
S-21	DorshonDeuri	6.20	0.49	227	47.00	11.00	0.61	0	0	1
S-22	Police Line Pump	6.34	1.22	197	88.30	4.73	0.54	0	0	0
S-23	Goai Para pump	6.24	1.40	244	30.00	8.00	0.48	0	0	0
Standards	WHO	6.5-8.4	5	1000	500	250	0.3	0.01	0	0
	BD	6.5-8.5	10	1000	200-500	150-600	0.3-1	0.05	0	0
	ISI	6.5-8.6	5	500	300	250	0.3	0.05	0	0

Groundwater with Deep Tube Well (DTW) is the main source of the present water supply system in Sylhet City Corporation and there is an existing Surface Water Treatment

Plant (SWTP) at Sylhet constructed in 1918, which is producing about 600 m³/day, i.e., 0.6 MLD (1% of surface water and 99% from ground water). Moreover, in the southern part of the city,

there is no suitable groundwater aquifer within the city and as such in order to improve the situation conjunctive use of surface and groundwater has been recommended by decreasing groundwater abstraction gradually.

There are 23 pump stations in the SCC area; 3 water samples from household near the every station, so total 69 samples are collected in 2 liter capacity airtight sterile containers. The household connections are chosen as far as possible from the main station so that any significant pollution from pipe leakage or other purpose can easily be identified. Physical and chemical parameters like pH, turbidity, total dissolved solids (TDS), hardness, chloride, iron, arsenic, fecal chloroform (FC), and total chloroform (TC) have been tested in the collected sample water.

The pH and turbidity were measured by digital pH meter (HANNA, HI 8014) and digital turbidity meter (HANNA), respectively. Total dissolved solids (TDS) was determine according to standard method of ASTM D 5907 [4].

Total hardness (TH) was determined by the Soda Reagent method. Chloride was determined in Mohr's method by titration with a standard silver nitrate solution in the presence of potassium chromate indicator. Iron was determined by the production of red colored iron compound (ferric thiocyanate), by the addition of potassium thiocyanate. The Ultraviolet Spectrophotometer was used for detection of the amount of color change. Arsenic concentration in the water sample was determined by silver diethyldithiocarbamate (SDDC). Membrane filter technique and biological kit box was used for determining fecal chloroform (FC) and total chloroform (TC), respectively.

3. Results and Discussion

In this investigation, the current condition of the quality of water distributed by SCC is determined by measuring the physico-chemical and microbial properties. pH, turbidity, total dissolved solids (TDS), hardness, chloride, iron, arsenic, fecal chloroform (FC) and total chloroform (TC) are determined in the laboratory through water sample test and results are compared with WHO [5], BD [6] and ISI [7] standard value in Table 1.

3.1. pH

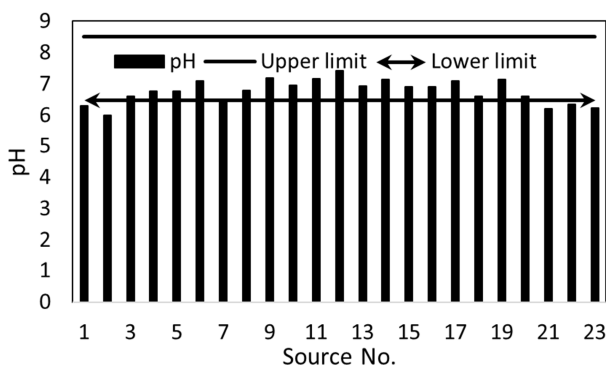


Figure 2. pH value of different water samples.

The pH of all sources varies between 6.01 and 7.43 (Fig. 2).

All three standard (WHO [5], BD [6] and ISI [7]) recommended that the pH values should be in the range of 6.5 to 8.5. Out of 23 sources; the water sample of 18 sources are within the standard range and that of remaining 5 sources are below the guideline value varying between 6.01 and 6.34. At lower pH water is likely to be corrosive due to acidity [1]. So lower pH water from those sources must be controlled to minimize the corrosion of the distribution system. Failure or leakage of delivery system due to corrosion may contaminate the water or affect adversely on its odor, taste and appearance. In 2010, Hoque *et al.* [1] investigate the water quality of 20 samples from different ward and found 7 samples that below the acceptable limit. An investigation revealed that the ground water provides lower pH value within the dumping zone [8].

3.2. Turbidity

The study shows that the turbidity of all sources is found in the range between 0 to 12.45 NTU (Fig. 3). According to WHO [5] and ISI [7] (acceptable values ≤ 5 NTU), source no. 4 (Rikabibazar) and 11 (Christian Mission) are found to be unacceptable for drinking purposes. However, according to BD [6] (acceptable values ≤ 10 NTU), 1 source (Christian Mission which is denoted by source no. 11) is found to be affected with excess turbidity.

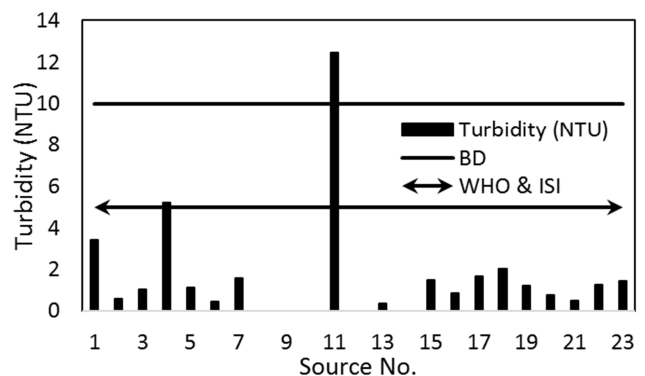


Figure 3. Turbidity in water samples (NTU).

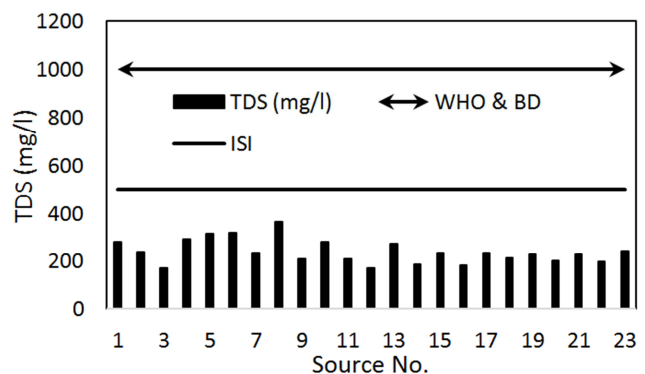


Figure 4. TDS value of different water samples (mg/L).

3.3. Total Dissolved Solids (TDS)

For WHO [5] and BD [6], the acceptable limit is 1000 mg/L and for the ISI [7], it is 500 mg/L. The total dissolved solids (TDS) of all sources vary between 171 mg/L and 365 mg/L (Fig.

4). So the values of TDS concentration in the water of all sources follow the standard limit.

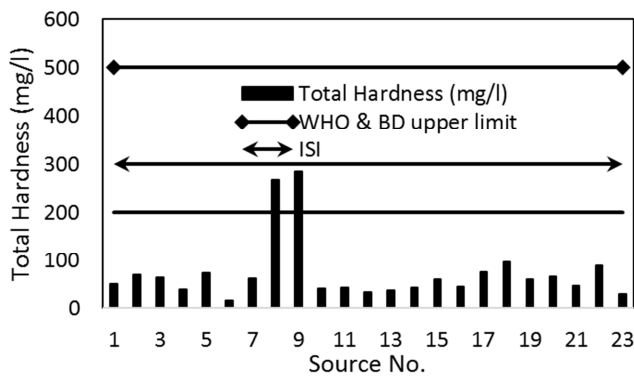


Figure 5. Total Hardness in water samples (mg/l).

3.4. Total Hardness (TH)

The total hardness is defined as the sum of the calcium and magnesium concentrations. The main problem of hardness is that the hard water consumes too much soap. All sources provide total hardness (TH) ranging from 16.67 mg/L to 284 mg/L (Fig. 5). So they are soft to very hard water and all values are in acceptable limit (WHO [5] 500 mg/L, Bangladesh Standard [6] 200-500 mg/L and ISI [7] 300mg/L).Hoque et al. [1] found that all sample values are lying in the range of 56-150 mg/L. An investigation exposed that total hardness in Sylhet City groundwater are: within dumping place is 4564mg/L, near dumping place is 610 mg/L and remote from dumping place is 204mg/L[8].

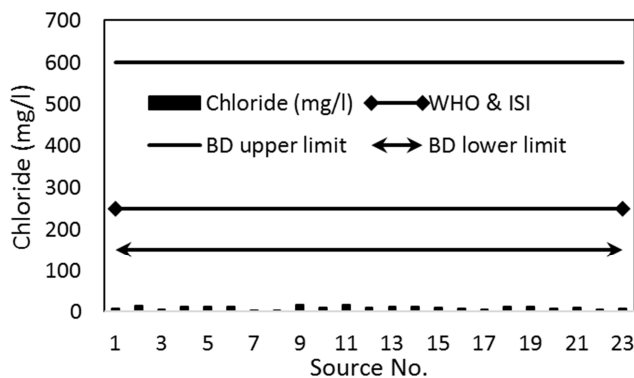


Figure 6. Chloride in water samples (mg/L).

3.5. Chloride

Naturally chlorides rise in water in changeable concentrations. No proof has been established to specify that consumption of chloride is dangerous to human though high chloride content may damage metallic pipes and structures as well as growing plants [1]. The chloride concentrations range between 3.9 mg/L and 17 mg/L (Fig. 6) which is safe for human according to all standards. The investigation of Hoque et al. [1] found the similar result. But Alam et al. [8] found that chloride concentrations (mg/L) in Sylhet City increased up to 3458 mg/L in groundwater within the dumping zone.

3.6. Iron

Several milligrams per liter of ferrous iron concentration may contain in the anaerobic ground water. The ferrous iron oxidizes to ferric iron when it exposes to the atmosphere and turns into disagreeable reddish brown water. The excessive amount of iron concentration causes pipe clogging, growth of iron bacteria, reddish water color, undesirable taste in beverages, staining of clothes, etc. [1]. According to this study, the iron of all sources fluctuated from 0.12 mg/L to 1.3 mg/L. Fig. 7 shows that 21 sources out of 23 crosses the acceptable limit according to WHO[5] and ISI [7]. In contrast, all sources except sources no. 11(1.3 mg/L) are not within the range of 0.3 mg/L to 1 mg/L according to Bangladesh Standard. Hoque et al. [1] found 3 sources of water sample (0.31mg/L, 0.53mg/L and 3.65 mg/L) out of 20 in the study area cross the standard limit of WHO [5] and ISI [7]. Alam et al. [8] found that iron concentrations (mg/L) in Sylhet City groundwater are within dumping place is 133.5, near dumping place is 1.48 and remote from dumping place is 0.21.

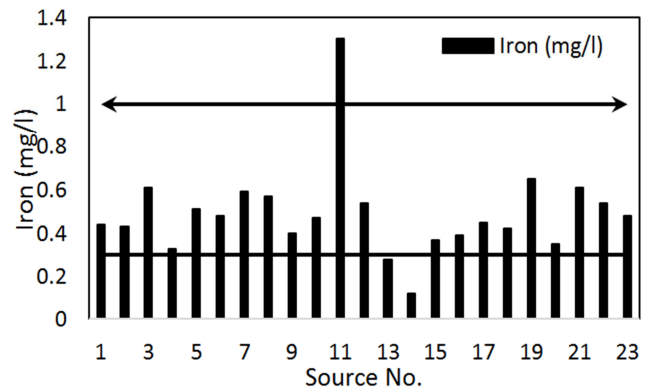


Figure 7. Iron in water samples (mg/L).

3.7. Arsenic

Arsenicosis is a recognized and extensive crisis in Bangladesh. It possesses the greatest threat of cancer. However, all the samples collected from different sources from SCC are free from arsenic.

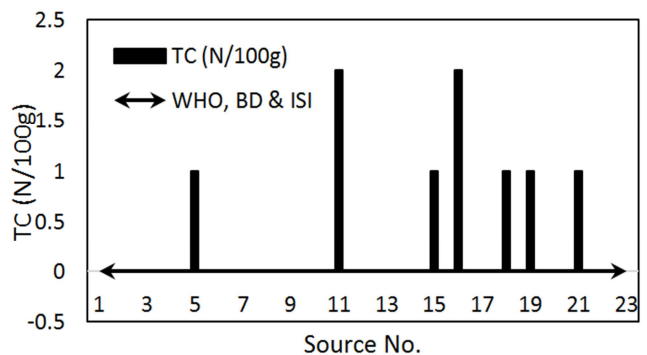


Figure 8. Total Coliform in water samples (N/100 ml).

3.8. Fecal Coliform (FC) and Total Coliform (TC)

Fecal coliform is the group of the total coliforms that are

considered to be present specifically in the gut and feces of warm-blooded animals. Fecal coliform is responsible for micro-organic borne diseases in the human body which is often discovered in human feces. The fecal coliform differs from other coliforms in that the fecal coliform can raise at 45°C, i.e., they are thermo tolerant [1]. No fecal coliform found in any sources of water sample in the study area. But Alam *et al.* [8] found that in Sylhet City, the drinking water of each restaurant is contaminated with fecal coliforms.

Total coliforms include bacteria that are found in soil and water that has been influenced by surface water, and with human or animal waste. The presence of total coliforms vary from 0 to 2N/100ml of TC (Fig. 8). 7 sources out of 23 are affected with TC according to the three standards used in comparison in this study. Among 7 sources, sources no. 11 (Christian Mission) and 16 (Baluchor point Pump 1) provide 2 N/100ml of TC.

4. Conclusion

The study was done to monitor the existing water quality supplied by the Sylhet City Corporation and to find out significant pollution in supply water from the source. The result of this study will be helpful to provide safe, drinkable water to the people living in Sylhet City Corporation area. As an emerging mega city the water supply authority of Sylhet must be concerned about water quality as like quantity. After analyzing the present situation, the study has come to its conclusion remarks as followings:

1. The Sylhet City Corporation has very little or no regular monitoring activity to check the quality of water it provides to the consumer. Most of the water pump stations provide acceptable drinking water, which is excellent for drinking and household uses considering the turbidity, total dissolved solids, chloride, arsenic and fecal coliform.
2. There are 5 sources of water having low water pH, but none of this is life-threatening. All sources are free from hardness except source no. 8 (MotshoVobon opposite) and 9 (PTI), though they are in acceptable range according to WHO[5] and ISI [7]. Only 2 sources (ShahiEidgahUchakorok and HazaribaghAbasik) are totally safe for drinking purpose considering iron contamination, according to WHO[5], Bangladesh standard[6] and Indian standard[7].
3. Most of the sources require treatment facility to reduce the iron concentration level. Source no. 11 (Christian Mission) requires treatment for turbidity, iron and total coliform to ensure the safe drinking water. Source no. 5 (Osmani Medical), 15 (TT gate point), 16 (Baluchor point Pump 1), 18 (Choukidekhi), 19 (Near Biman Office) and 21 (DorshonDeuri) required treatment to remove total coliform.

In 2009, Zuthi *et al.* [2] investigate the supply water quality in the Chittagong City of Bangladesh. In this study, though the measured value of pH, turbidity, alkalinity, hardness was largely within the acceptable range, BOD₅ value of almost all

the selected samples was considerably higher and faecal coliform as well as total coliform was also found at some locations of the distribution system. In 2013, Fahmida *et al.* [10] studied on the supplied water quality (parameters include pH, color, turbidity, iron, chloride, arsenic, hardness, BOD₅, total solid, total suspended solid, total dissolved solid, total coli form and *Escherichia coli*) of Khulna WASA of Bangladesh and found that the water inflowing the distribution system was not meet the desired chemical and microbial quality except pH, turbidity, chloride and iron.

There are significant chances of pollution in supply systems from sources to households. There may be leakage in the pipes for construction works, pressure, etc. which may create pollution of water in the system. The supply mains should be clean, free from cracks, and close monitoring of the water at number of points have to be implemented.

List of Symbols and Abbreviations

BD	Bangladesh Standard
FC	fecal coliform
ISI	Indian Standard Institute
SCC	Sylhet City Corporation
SDDC	silver diethyldithiocarbamate
SWTP	surface water treatment plant
TC	total coliform
TDS	total dissolved solids
TH	total hardness
WHO	World Health Organization
DTW	groundwater with deep tube well

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