

Analysis of Water Quality in Urban Water Supply System of Bangladesh

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Abstract

Supply of safe drinking-water is world-wide considered to be an important issue for public health safety and must be the key objective of water supply systems. The aim of this research is to analyze the supply water quality in urban water supply system of Bangladesh. This research was conducted in two Pourashava water supply systems namely Barguna Pourashava and Faridpur Pourashava of Bangladesh. Some concerned chemical, biological and physical parameters were tested for an initial assessment of the water quality of the source water. A total of ten ground water based production well's water samples were examined in those two Pourashava. A total of nine samples, one from each ward were collected from the entry point of the supply water to the user's house were analyzed for *E. coli* which represented the quality of the piped water. A total of three water samples were collected from each of the ward for microbiological (FC) quality analysis. Millipore microbiological field testing kits was used for *E. coli* testing, DR 2800 HACH spectrophotometer was used for determination of manganese, iron, and nitrate and Wegtech Digital Arsenator was used for arsenic determination. Physical parameters were tested by HACH potable instruments. The light brown yellowish color created an aesthetic problem among the water users of Barguna Pourashava. In addition, the fecal contamination rate was very high. The findings of *E. coli* analysis of Barguna Pourashava supply water indicated that 11% have intermediate risk, 37% have high risk and 52% have very high risk considering the health. The water of the production wells of Faridpur Pourashava has high concentration of the arsenic, iron and *E. coli*. The household's storage water sample analysis result indicated that 48%, 44% and 7% have very high risk, high risk and intermediate risk from the health point of view.

Keywords: Water quality; Water supply system; Health risks; Contamination; Monitoring; Management; Bangladesh

Introduction

Water supply and sanitation is characterized by a number of achievements and challenges. Urban water supply system has become a more critical issue in the socio-economic condition of a country. It is very important factor now a days and also it indicates the quality of urban life. Bangladesh is one of the most densely populated country in the world. The country has a population density of 1,115.62 people per square kilometer, (2,889.45/square mile), which ranks 10th in the world. Urban people faced a problem of safe drinking water due to lack of appropriate urban water supply system in Bangladesh. The extent and availability of safe drinking water is an important indicator of sustainable development, and access to clean water constitutes a principal components of the Millennium Development Goals (MDGs). There was an estimation that more than 70 percent of the urban population in the developing countries are either have an inadequate water supply or being supplied with unsafe water or both [1]. Safe water and improved sanitation are powerful determinants of health. The WHO program in Bangladesh aims at promoting preventive approaches to water quality management using Water Safety Plans (WSP) to enable utilities, small communities and the households to ensure safety of drinking water. 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 [2]. About 25 percent of the total population lives in urban Bangladesh, and only 44 percent of the urban people are served with tap water supply [3]. The lower income group is the worst sufferers as because they cannot afford to have safe drinking water for an active and healthy life [4,5]. Present study focus on the water quality analysis in the urban water supply system in Bangladesh with health risk assessment of urban people.

Materials and Methods

Two Pourashava water supply systems were selected considering

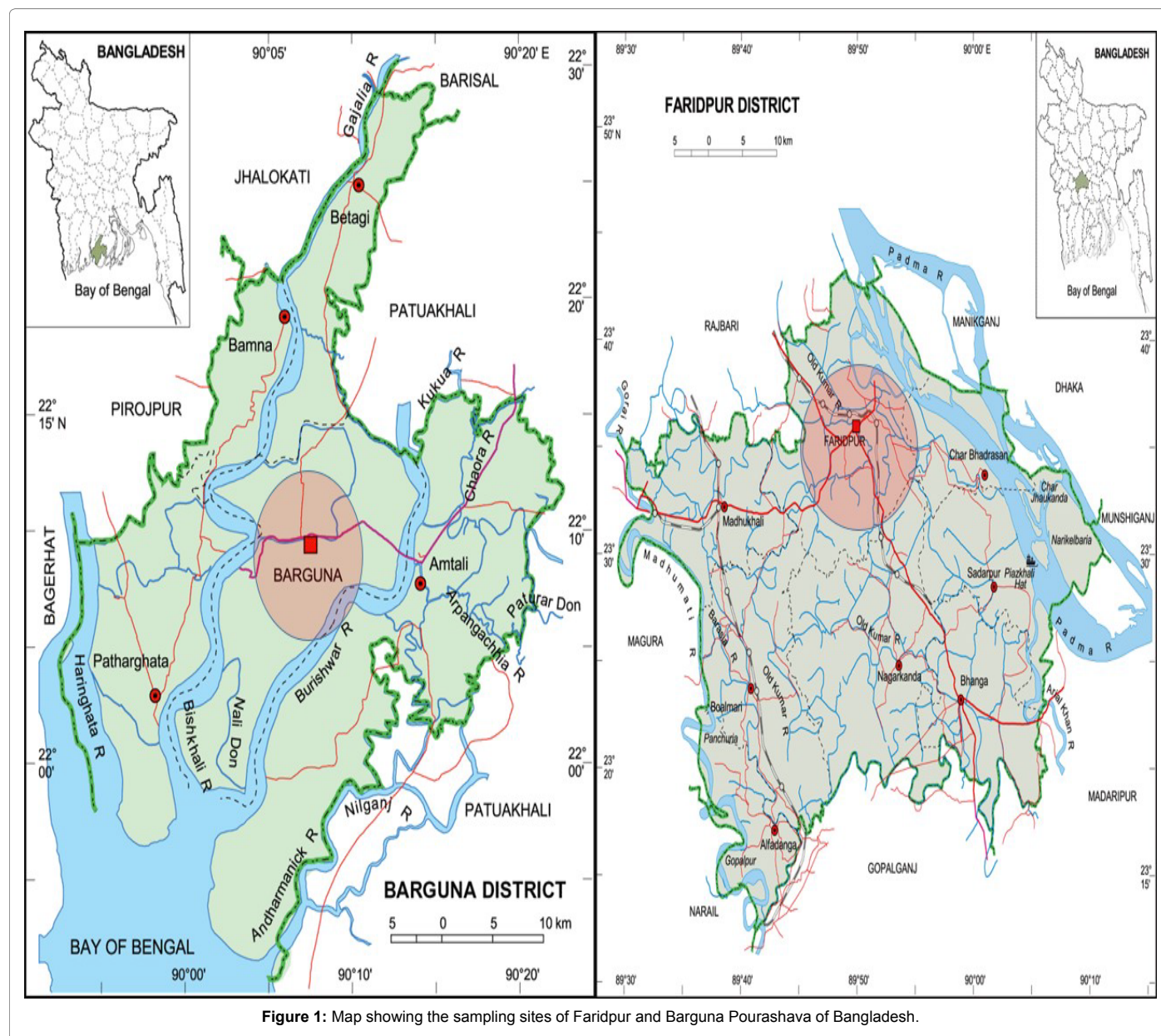
the geography namely Faridpur Pourashava of Faridpur District (as flood prone area) and Barguna Pourashava of Barguna District (as coastal area) for conducting this research (Figure 1). The Faridpur Pourashava water supply system has around 7600 users and the Barguna Pourashava have 3800 users. The user list was collected from each of the Pourashava which were proportionally distributed in each ward. Some concerned chemical, biological and physical parameters were tested for an initial assessment of the water quality of the source water. Only one ground water based production well's water was examined at Barguna Pourashava and total of nine production well's water were examined at Faridpur Pourashava. A total of nine samples, one from each ward were collected from the entry point of the supply water to the user's house were analyzed for *E. coli* which represented the quality of the piped water. A total of three water samples were collected from each of the ward for microbiological (FC) quality analysis. The water samples were collected from the nearest water users of the distribution line in any ward, middle and the farthest. A few household's samples were checked for arsenic. The source water was checked for FC, arsenic, iron, manganese occasionally nitrate. Millipore microbiological field testing kits was used for *E. coli* testing, DR 2800 HACH spectrophotometer was used for determination of manganese, iron, and nitrate and Wegtech Digital Arsenator was used for arsenic determination. Some physical parameters were also tested namely pH, turbidity, total dissolved solids, conductivity etc. Physical parameters were tested by HACH potable instruments. All the testing was conducted in the field. The water quality testing was conducted by the skilled professionals (Table 1).

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Water quality parameters	Units	Bangladesh standards	WHO guideline values
Odor		Odorless	Odorless
pH		6.0-8.5	6.0-8.5
Electrical conductivity	µs/cm	500	500
Turbidity	NTU	5.0	5.0
Arsenic	mg/l	0.05	0.01
Fe	mg/l	0.3	0.3
Mn	mg/l	150-600*	250
Nitrate	mg/l	40-50	50
<i>E. coli</i>	/100 ml	Absent	Absent

Table 1: Water quality parameters and standard [5].

Results and Discussion

Water quality in Barguna Pourashava water supply system

Only one ground water based production well's water was examined

for some concerned chemical, biological and physical parameters as presented in Table 2 for an initial assessment of the water quality of the source water. The light brown yellowish color created an aesthetic problem among the water users and the fecal contamination was too high.

No	Particulars	Unit	Results
1	Location		Tulatoli Pump House
2	Source Type		Deep Tube Well
3	Catchment Area/Depth	ft	940
4	Color		Light Yellowish Brown
5	Odor		Smell of Rotten Egg
6	pH		8.16
7	ORP	mV	-155.8
8	Electrical conductivity	µs/cm	1158
9	Salinity	mg/l	
10	LOD	mg/l	2.83
11	Turbidity	NTU	1.1
12	As	mg/l	0
13	Fe	mg/l	0.05
14	Mn	mg/l	0.4
15	Nitrate	mg/l	8.5
16	<i>E. coli</i>	/100 ml	TNTC
17	Other coli form	/100 ml	TNTC
18	Total coli form	/100 ml	TNTC

TNTC: To numerous to count) in the source water

Table 2: Water quality analysis result of production wells of Barguna Pourashava water supply system.

Ward No	Microbial Risk (HH's source water sample)				
	Low	Intermediate	High	Very High	Grand Total
Ward 1			1		1
Ward 2				1	1
Ward 3				1	1
Ward 4			1		1
Ward 5		1			1
Ward 6			1		1
Ward 7				1	1
Ward 8				1	1
Ward 9			1		1
Grand Total	0	1	4	4	9

Table 3: Microbiological analysis of the household's source water samples of Barguna Pourashava.

Ward No	Microbial Risk (% of household's storage water sample)			
	Intermediate	High	Very High	Grand Total
Ward 1	33 (1)	67 (2)		100 (3)
Ward 2	33 (1)		67 (2)	100 (3)
Ward 3		33 (1)	67 (2)	100 (3)
Ward 4			100 (3)	100 (3)
Ward 5	33 (1)		67 (2)	100 (3)
Ward 6		67 (2)	33 (1)	100 (3)
Ward 7		67 (2)	33 (1)	100 (3)
Ward 8		33 (1)	67 (2)	100 (3)
Ward 9		67 (2)	33 (1)	100 (3)
Grand Total	11 (3)	37 (10)	52 (14)	100 (27)

() indicated number of sample

Table 4: Microbiological analysis of the household's storage water samples of Barguna Pourashava.

A total of nine samples, one from each ward were collected from the entry point of the supply water to the user's house were analyzed for *E. coli* which represented the quality of the piped water. The analysis results are presented in Table 3. The result indicated that the supply line water in one wards has intermediate risk of microbiological contamination considering the health and the remaining have variable degrees of risk. Three household's storage samples were collected randomly from each of the 9 wards of the Pourashava for microbiological analysis and the total samples collected samples were 27. The analysis results were categorized by considering the *E. coli* concentration per 100 ml; namely

0 for low risk, 1-10 medium risk, and 11-99 high risk and above 100 is very high risk. The analysis result indicated that 11% have intermediate risk, 37% have high risk and 52% have very high risk of considering the health (Table 4).

Water quality in Faridpur Pourashava water supply system

The analysis results of water samples collected from nine production well of the Faridpur Pourashava water supply system is presented in Table 5. The result indicated for high concentration of the arsenic, iron and *E. coli* in the production well's water. A total of nine samples, one

No	Particulars	Unit	Goal Chamot 1	Goal Chamot 2	Goal Chamot 3	Goal Chamot 4	Jhiltuli 1	Jhiltuli 2	Jhiltuli 3	Jhiltuli 4	Jhiltuli 5
1	Location		In front gate	Salim's house	Bishorgon Ghat	Bus stand	Road side	Moshiur's house	Anis's house	Behind filter house	Mizan's house
2	Source Type		STW	STW	STW	STW	STW	STW	STW	STW	STW
3	Depth		380	300	290	300	290	290	295	290	300
4	Color		Reddish	Reddish	Reddish	Reddish	Light Reddish	Light Reddish	Light Reddish	Light Reddish	Light Reddish
5	Odor		Fishy Smell	Fishy Smell	Fishy Smell	Fishy Smell	Fishy Smell	Fishy Smell	Fishy Smell	Fishy Smell	Fishy Smell
6	pH		7.50	7.09	7.42	7.18	7.24	7.44	7.34	7.26	7.16
7	ORP	mV	150.1	155.4	148.4	168.7	53.9	102.3	20.6	58.8	22.4
8	Conductivity	μs/cm	1462	1693	1040	1091	1035	1019	852	894	440
9	Salinity	mg/l									
10	LOD	mg/l	6.99	7.28	6.85	7.47	4.24	4.77	3.07	4.74	7.56
11	Turbidity	NTU	57.6	64.3	82.4	136.0	69.6	67.0	81.5	69.2	58.8
12	As	mg/l	170	235	225	135					
13	Fe	mg/l	6.8	8.9	14.6	11.6	6.3	4.1	3.2	2.6	2.45
14	Mn	mg/l	0.4	0.3	0.3	0.9	0	0	0.3	0.3	0.4
15	Nitrate	mg/l	0	0	0	0	0	0	0	0	0
16	<i>E. coli</i>	/100 ml	30	25	31	TNTC	36	112	12	54	53
17	Other coli form	/100 ml	280	37	192	TNTC	80	204	35	43	47
18	Total coli form	/100 ml	310	62	223	TNTC	116	316	47	97	100

TNTC: To numerous to count) in the source water

Table 5: Water quality analysis result of the production tube wells of Faridpur.

Ward No	Microbial Risk (HH's source water sample)				
	Low	Intermediate	High	Very High	Grand Total
Ward 1		1			1
Ward 2			1		1
Ward 3		1			1
Ward 4		1			1
Ward 5	1				1
Ward 6	1				1
Ward 7			1		1
Ward 8				1	1
Ward 9			1		1
Grand Total	2	3	3	1	9

Table 6: Microbiological analysis of the household's source water samples of Faridpur Pourashava.

Ward No	Source	Microbial Risk (HH's storage water sample)				
		Low	Intermediate	High	Very High	Grand Total
Ward 1	Intermediate			100 (3)		100 (3)
Ward 2	High		33 (1)	67 (2)		100 (3)
Ward 3	Intermediate			33 (1)	67 (2)	100 (3)
Ward 4	Intermediate			67 (2)	33 (1)	100 (3)
Ward 5	Low			67 (2)	33 (1)	100 (3)
Ward 6	Low		33 (1)		67 (2)	100 (3)
Ward 7	High				100 (3)	100 (3)
Ward 8	Very High				100 (3)	100 (3)
Ward 9	High			67 (2)	33 (1)	100 (3)
Grand Total			7 (2)	44 (12)	48 (13)	100 (27)

Table 7: Microbiological analysis of the household's storage water samples of Faridpur Pourashava.

from each ward were collected from the entry point of the supply water to the user's house were analyzed for *E. coli* which represented the quality of the piped water. The analysis results are presented in Table 6. The result indicated that the supply line water in two wards has low risk of microbiological contamination considering the health and the remaining have variable degrees of risk. The Table 7 represents the analysis result of *E. coli* of the household's storage water sample. The

result indicated that 48%, 44% and 7% have very high risk, high risk and intermediate risk from the health point of view.

Conclusion

Urban water supply system in Bangladesh is not satisfactory because it possess human health risk. It is a threat to urban people as they suffer from different diseases due to drink these contaminated

supply water in Bangladesh. There observe in both Barguna and Faridpur Pourashava that *E. coli* have a great negative impact on human health of Bangladeshi people. It causes very high health risk to urban people. Government should take necessary steps for reducing the risk of supply water contamination.

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