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Investigation of Coliform Load, Supplied Water Quality and Sanitation Status of Sherpur Municipality of Bangladesh

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Authors' contributions

This work was carried out in collaboration between all authors. Authors SM and SAL designed the study, performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript and managed literature searches. Authors ASAS, MFH, RZT managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Water is indispensible for the survival of living organisms, therefore easy access of adequate and safe water is a basic need for human beings. Various health problems are caused by consumption of unsafe water. Sherpur is one of the oldest municipality of Bangladesh where about major part of the household has been suffering shortage of safe water supply; as a result sanitation status is affected negatively. The supplied water of the municipality seems to be quite good at least in terms of physicochemical water quality parameters, as most of the physicochemical water quality parameters were within the Bangladesh drinking water quality standards. The survey showed that sanitation facilities are quite good as 78% of the respondents use pit latrines, 16% use septic tank latrine and only 6% use hanging latrine. The study also showed that people are not conscious enough for the disposal of their household sewage and sludge as 46% of the respondents dispose their household sewage and sludge into municipal drainage system that cause cross-contamination, 39% dump it on the open field and only 15% buried the domestic wastes. In this regard, the municipal authority should proper monitoring the water supply system; carry out different programs and introducing different project for improving sanitation status.

Keywords: Water supply; sanitation; sewage and public health.

1. INTRODUCTION

Water is very important component of the environment and without it; life on earth would not exist. Clean and sanitary environment largely depend on easy access of safe water. The needs of water include drinking, cooking and preparation of food, bathing, cleaning, washing and personal hygiene, watering in gardens, and water for livestock and sanitation etc. Inadequate and poor quality of supplied water causes various health problems like infant mortality due to various waterborne diseases; the mortality rate would be high due to unsafe water supply [1]. Globally, an estimated 2,000 children under the age of five die every day from diarrhoeal diseases and of these some 1,800 deaths are linked to water, sanitation and hygiene. If 90 school buses filled with kindergartners were to crash every day, with no survivors, the world would take notice. But this is precisely what happens every single day because of poor water, sanitation and hygiene [2]. Due to the consumption of contaminated water about eighty percent of all diseases and one third of deaths in developing countries are occurred [3]. In Bangladesh the quality of drinking water is also at high risk. Especially, in the urban and semi-urban areas of Bangladesh; the problems are acute due to increased migration of rural people and economic growth as well [4]. Diarrhoea, dysentery, jaundice, worm infections and typhoid fever are the predominant waterborne diseases in Bangladesh [5]. Supplied water should be completely free from pathogenic microorganisms, fairly clear and aesthetically attractive -low turbidity and color and should not be saline, should not contain any compounds that cause offensive odor and taste, should not cause corrosion, scale formation, discoloring or staining and should not have a temperature unsuitable for consumption [6].

For the prevention and control of waterborne diseases, drinking water quality and sanitation management has been a key pillar of primary prevention for over one and a half centuries and it continues to be the foundation [7]. A statistic of WHO in 2003 revealed that 4% of all deaths and 6% of the global burden of diseases are the result of inadequate sanitation, water and hygiene. The fecal-oral pathway of water-borne disease transmission includes contamination of drinking-water catchments, water within the distribution system or of stored household water as a result of unhygienic handling [8]. Water quality may be acceptable in drinking water systems when the water just leaves treatment plants [9]. A study estimates that 1.1 billion people lack access to improved water supplies and 2.6 billion people lack adequate sanitation [10]. The improvement of health is not possible without proper sanitation system. In Bangladesh sanitation is one of the problems that threat the public health. In this regard, water supply and sanitation facilities in terms of quality and quantity are utmost necessary for assessing the living environment of the urban and semi-urban area [4]. The objectives of the study were: (i) to investigate the supplied water quality and (ii) to investigate the sanitation system of Sherpur Municipal area of Bangladesh.

2. MATERIALS AND METHODS

2.1 Study Area

Sherpur town is 200 km. from Dhaka and situated on the bank of the river Mrigi at northern part of the country Bangladesh. Sherpur municipality is one of the oldest municipalities in Bangladesh, established in 1st April in 1869. It has an area of 24.75 km^2 with 22462 households. The study was conducted from June 2014 to January 2015.

2.2 Sampling

Total 90 water samples from 9 wards (10 samples from each ward) were randomly collected and analyzed. Samples were collected in sterilized bottles and prior to filling; the sample bottles were rinsed two to three times with the water to be collected. The bottles used for collecting samples for metal analysis were filled with acid to keep the pH of the water samples low. Special caution was taken to restrict the overflow of sample water (with acid) from the bottle. The samples were carried to the laboratory within the six hours of collection. A field investigation and random questionnaire survey of 100 respondents of the study area was conducted to determine the sanitation status of Sherpur municipal area.

2.3 Sample Analysis

The water samples were analyzed at water quality laboratory in Bangladesh to know the water quality and sanitation status of Sherpur Municipal area. Some samples also analyzed in the Laboratory of Department of Public Health and Engineering (DPHE), Tangail to know the presence of coliform. The water quality parameter such as pH was determined by the digital pH meter (Model: pH Scan WP 1, 2 and made in Malaysia). Buffer solution containing pH 7.0 was used to calibrate the digital pH meter. Digital Electrical Conductivity (EC) and Total Dissolved Solids (TDS) meter (Model: HM digital and made in Germany) was used to determine EC and TDS, respectively. The Dissolved Oxygen (DO) was determined by digital DO meter (Model: D.46974 and made in Taiwan) where sodium thiosulphate (0.025N) was used as a reagent. Simple laboratory method was applied to assess acidity. Alkalinity was determined by titration method with 0.1 N HCl after addition 2-3 drops of methyl-orange indicator. The Ethylenediamine Tetra-acetic Acid (EDTA) method was used to determine the hardness of water where Eriochrome Black T was used as indicator titration with EDTA solution. Arsenic and iron were determined by test kit developed by HACH Company, USA. To count total coliform and faecal coliform in the sample water, bacterial culture was formed in the microbiology laboratory of DPHE, Tangail.

3. RESULTS AND DISCUSSION

The physiochemical properties of water are very significant for the study of water quality, thus the properties are used as indicator. The physicochemical properties of the collected water samples has summarized in the Table 1.

Table 1. Physicochemical properties of the water

Ward no.	pH	EC (µS/cm)	DO (mg/l)	TDS (ppm)	Acidity (mg/l)	TA (mg/l)	TH (mg/l)	As (ppb)	Fe (mg/l)
1	6.26	456	3.2	480	14.84	190	206	ND	0.6
2	7.18	390	3.4	550	12.60	215	218	ND	0.8
3	6.93	496	3.3	390	10.50	170	244	ND	0.8
4	6.52	585	3.0	580	13.77	209	220	ND	0.7
5	6.98	515	3.1	470	11.95	198	216	ND	0.6
6	6.73	392	2.8	420	12.90	202	198	ND	0.7
7	7.10	560	3.4	460	13.95	210	204	ND	0.6
8	6.96	426	3.0	560	15.00	196	242	ND	0.7
9	6.88	488	2.9	400	14.65	194	226	ND	0.5
Min	6.26	390	2.8	390	10.50	170	198	-	0.5
Max	7.18	585	3.4	580	15.00	215	244	-	0.8
Mean	6.84	478	3.1	478	13.35	198	220	-	0.7
SD	0.29	69.1	0.2	70.6	01.50	13.4	16.0	-	0.1

Note: EC=Electrical Conductivity; DO=Dissolved Oxygen; TDS=Total Dissolved Solid; TA=Total Alkalinity; TH=Total Hardness; As=Arsenic; Fe=Iron; ND=Not Detected; SD=Standard Deviation

The pH values of all the wards in Sherpur municipality were within the standard limit 6.5-8.5 as set by WHO, where the maximum pH was7.18 in the ward 2 (Narayanpur) and minimum was 6.26 in the Ward 1 (Purba-Nabinagar) (Table 1). The mean pH of the study area was 6.84 which depicted that the water was safe for drinking. The result of the study showed that the electrical conductivity (EC) of all water samples were within the standard value of drinking water in Bangladesh. The maximum permissible limit of EC in Bangladesh is 1200 µS/cm [11]. The maximum EC was 585 µS/cm in the samples collected from Ward4 (Paschim Sheri) and the minimum EC was observed 390 µS/cm in the sample collected from Munsi Bazar in ward 2 (Table 1).

The mean DO contents of all water samples were 3.1 mg/l. The maximum concentration of DO was 3.4 mg/l in the two water samples collected from Gopal Bari (Ward 2) and Gauripur (Ward 7), whereas the minimum concentration was found 2.8 mg/l in Ward 6 (Mollah Para). The values of Dissolved Oxygen of all water samples were not satisfactory level as the standard value (6 mg/l or more) of Bangladesh drinking water set by DoE (Table 1) [11]. The highest TDS concentration was found 580 ppm in the water sample from Chak Bazar (Ward 4) and the minimum was 390 ppm in the water sample from ShitalPur in Ward 3 (Table 1). The TDS concentration of all water samples were within the Bangladesh drinking water quality standard valueas 1000 ppm, DoE (1993) of Bangladesh.

The result showed that the maximum value of acidity 15 mg/l was found in from Barek Para (Ward 8). In SekhHati (Ward 3) the acidity contents was 10.50 mg/l and it was the minimum value too (Table 1). The study revealed that the acidity of all the water samples were within the permissible value. The highest alkalinity was 215 mg/l in the Kalir-Bazar area (Ward 2) and the lowest was 170 mg/l found in the water sample collected from ShitalPur in Ward 3 (Table 1). The alkalinity of all water samples were within the standard value of Bangladesh drinking water (200-500 mg/l) as set by DoE of Bangladesh. The permissible value of the Bangladesh drinking water quality standard is 200-500 mg/l [11]. The result showed that total Hardness in all supplied water samples were within the permissible limit. In ShitalPur of Ward 3, maximum hardness was found 244 mg/l and the minimum concentration was 198 mg/l in the Mollah Para of Ward 6 (Table 1).

Field Kit Test which was developed by HACH Company; U.S.A. was used for measuring arsenic. Arsenic concentration of all selected supplied water samples on color chart of Field Kit Test was not detected. For iron the standard value of Bangladesh drinking water is between 0.3-1 mg/l [11]. The level of iron concentration of all water samples was within the standard limit where the maximum concentration of iron was 0.8 mg/l in Kalir Bazar (Ward 2) and Chak bazar (Ward 3), and the minimum concentration of Iron was 0.5 mg/l found in the Dakshin-Naohata of Ward 9 (Table 1).

Only nine (9) selected samples among ninety (90) samples were subjected to coliform test to know the presence of coliform. The result of the coliform test is given in the following Table 2.

A questionnaire survey was conducted in the Sherpur municipality using the prepared questionnaires, the respondent's awareness on health, sanitation status, and hygiene also investigated. The survey showed that 16% respondents use municipal supply water, 25% use both supply water and tube-wells water where as 1% use other sources and rest 58% of the households depend on private tube-wells. Fig. 1 shows the detail of primary water sources for domestic uses.

The survey showed that 45% of the respondents use filter and 7% boil making supplied water safer to drink whereas the rest of the 48% respondents let supplied water stand and settle (Fig. 2).

The survey revealed that most respondents of the municipal area have sanitary latrine access. From the survey it was found that 78% of the respondents have pit latrine, 16% have septic tank latrine and only 6% have hanging latrine (Fig. 3).

The 46% of the respondents dispose their household sewage and sludge into municipal drainage system that cause cross-contamination where 39% dump it on the open field and only 15% buried (Fig. 4).

From the questionnaire survey it was found that 52% of the respondents dispose their children's faeces into toilet, 44% thrown into garbage and rest of the 4% respondents buries children's faeces (Fig. 5).

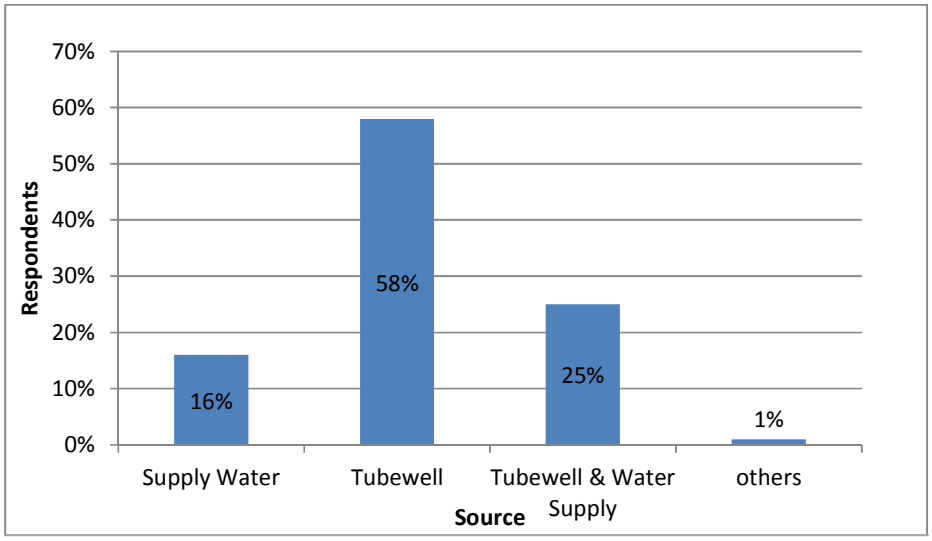

Fig. 1. Drinking water sources for the respondents

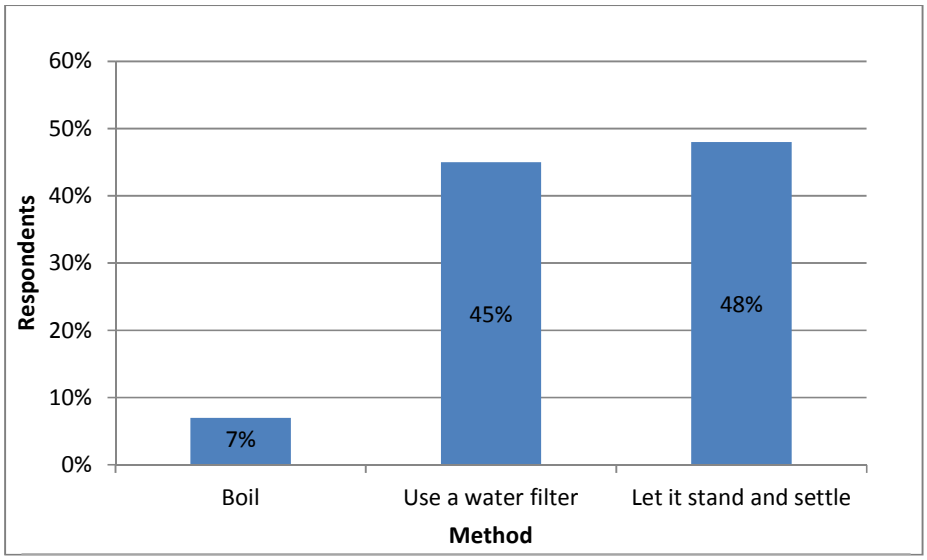

Fig. 2. Respondents water purification activities

Table 2. Coliform present in water

Ward no.	Parameter	
	Total coliform (No./100ml)	Faecal coliform (No./100ml)
	Drinking water quality standard (ECR,97-Bangladesh)	
	0	0
1	5	2
2	7	4
3	8	6
4	4	3
5	6	4
6	4	2
7	3	2
8	4	3
9	2	2

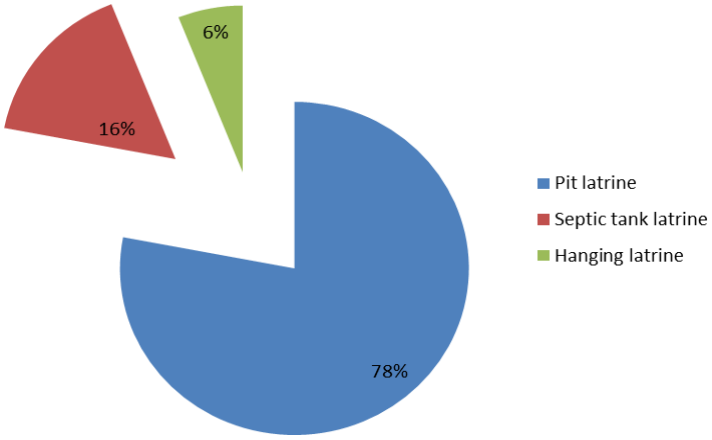

Fig. 3. Type of toilet using by the respondents

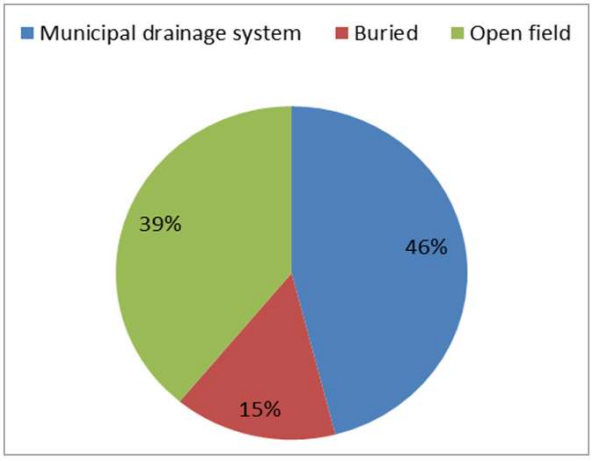

Fig. 4. Household sewage and sludge disposal activities

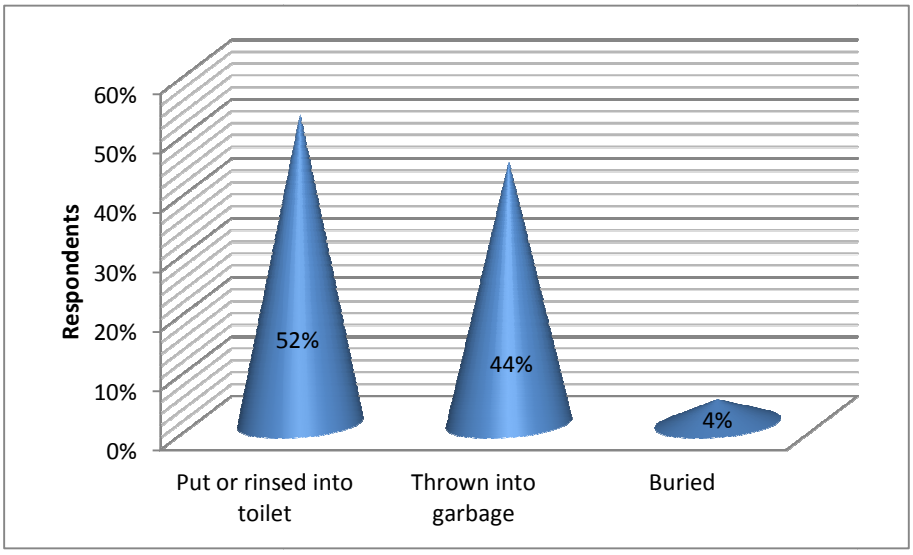

Fig. 5. Disposal activities of children faeces

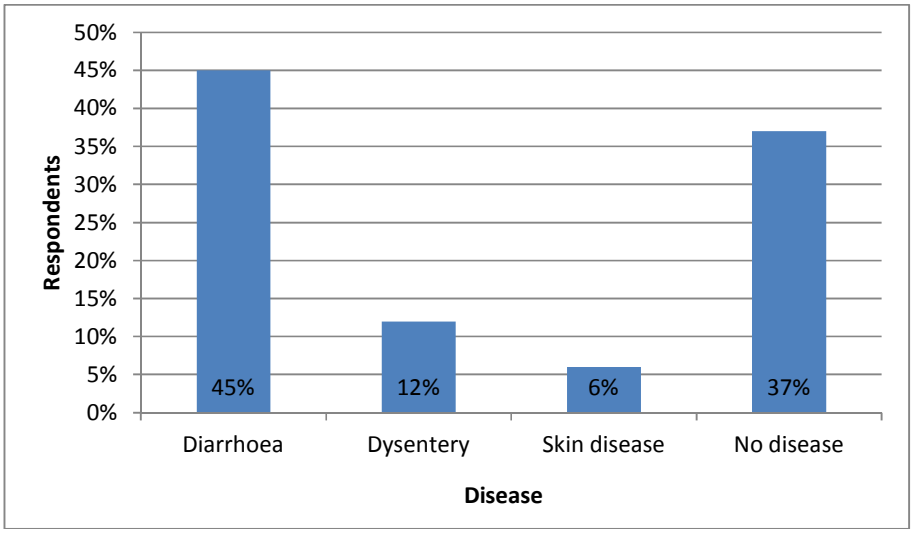

Fig. 6. Types of disease suffered by the respondents

From the survey it was observed that due to lack of hygienic practices; inadequate, contaminated and unsafe supplied water, inhabitants of municipality were suffered by various water related diseases. It was found that 45% of the respondents affected by diarrhoea (20% male and 25% female), 12% by dysentery (4% male and 8% female), 6% by skin diseases (2% male and 4% female) and rest of the 37% respondents were not suffered by any disease yet (Fig. 6) above.

4. CONCLUSION

From the study it is concluded that the water supply system in the municipality is not adequate and reliable and a major portion of people depends on private tube-wells. Though the measured value of pH, EC, TDS, acidity, alkalinity, hardness, iron and arsenic was mostly within the permissible range of Bangladesh drinking water quality standards, DO values of all the selected samples and pH values of few samples were under Bangladesh drinking water quality standards which is a concern for public health. In case of sanitation facilities, it is improved as most of the municipal people have sanitary latrine. Due to consumption of contaminated water some people of the municipality have been suffered by water related diseases like diarrhoea, dysentery and skin diseases and spend a lot for the medication of those diseases. Therefore, municipality should implement projects for rehabilitation of existing treatment plants and replacement of old pipes to ensure best water quality standards and increase water use efficiency for the municipal people.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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