Investigation of Some Water Quality Parameters of Pond Water under Mymensingh Municipality

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Abstract

A study was conducted to evaluate the water quality parameters of pond water at Mymensingh Urban region. The water samples were collected from 30 ponds located at Mymensingh Urban Region during August to October 2010. The chemical analyses of water samples included pH, EC, Na, K, Ca, S, Mn and As were done by standard methods. The chemical properties in pond water were found pH 6.68 to 7.14, EC 227 to 700 μScm^{-1}, Na 15.57 to 36.00 ppm, K 3.83 to 16.16 ppm, Ca 2.01 to 7.29 ppm, S 1.61 to 4.67 ppm, Mn 0.33 to 0.684 ppm and As 0.0011 to 0.0059 ppm. The pH values of water samples revealed that water samples were acidic to slightly alkaline in nature. The EC value revealed that water samples were medium salinity except one sample and also good for irrigation. According to drinking water standard Mn toxicity was detected in pond water. Considering Na, Ca and S ions pond water was safe for irrigation and aquaculture. In case of K ion, all the samples were suitable for irrigation but unsuitable for aquaculture.

Key words: Mymensingh municipality, Water pollution, Water quality

Introduction

Water is the basic requirement of life and is the most important natural resource. But the quality of water deteriorated day by day. The primary causes of deterioration of surface water quality are decomposition of municipal, domestic, industrial and agricultural wastes (Todd, 1980). Among soluble constituents in water, common major and secondary constituents are Ca, Mg, Na, Fe, B, MO_3, HCO_3, SO_4, and Cl but minor or trace constituent are As, Cd, Cr, Cu, Mn, P and Zn (Davis and Weist, 1966). Water quality is deteriorated due to change of biological, physical and chemical variables causing water toxicity. Water is a universal solvent and various types of elements are dissolved in it, but the concentration of any element or compound beyond tolerance limit for organisms and other usage, treated as pollutants. Pure water is needed for survival of all life. However, clean water has become a scarce commodity and water pollution has reduced the availability of clean water. Water is essential to production of food, the processing of raw material and the construction of many of the product we use. Water shortage, water pollution food and environmental (pond, lake and river etc) contamination are the great problems which cause food shortage, increase contagious diseases and occasion international disputes over limited water sources. Contaminated water directly affects the health of inhabitants, fish resources flora and fauna. Pollution and contamination of the rivers, lakes and ponds water has impacts on the aquatic resources. About 80% of the diseases in developing countries are related to contaminated water the resulting death in as 10 million per year (Anonymous, 2004). Mymensingh is one of the 16 old districts of Bangladesh which was constituted by the British East India Company on 1 May 1787. Population of Mymensingh urban region increasing every year due to job opportunities which are not available or are inadequate in rural areas. Consequently slums continuously are increasing which is further deterioratеting the living environment, especially the water environment. In the study area the surface water is used for irrigation (for home gardening and field crop irrigation), drinking and domestic uses, air-conditioning, confectionary, laundering, dyeing, ice factory and other industries. In view of the above mentioned multidirectional uses, a study was conducted to assess the water quality from different sources of the ponds of Mymensingh urban region with the objectives are; to determine the chemical constituents of pond water and their degree of toxicity; and to identify the suitability of fresh water for irrigation, drinking and aquaculture on the basis of international standard.

Materials and Methods

Selection of study area: The district of Mymensingh is situated between 24°02‘03" and 25°25‘56" north latitude and 89°39‘00" and 91°15‘35" east longitude. Mymensingh city is clearly marked by the old Brahmaputra River flowing along its north. Management of water environment spatially pond water in this densely populated Mymensingh urban region is difficult and costly but crying need for better livelihood and in the point of health.

Collection of water samples

Thirty samples were collected from different ponds of Mymensingh urban region during August to October 2010. The water samples were kept and preserved in 100 ml plastic bottles after collection.

Table 1. Water sampling locations from different ponds water at Mymensingh urban region

Sample No.	Sample location	Sample No.	Sample location
1	Zilla School	16	Cantonment Road, Shankipara
2	Zilla School Hostel	17	Majar Sheriff Road, Shankipara
3	Madrasha Quarter	18	Notun palli, Shankipara
4	Fulbaria Road	19	Pocha Pucker, Sehora
5	Nasirabad Collage	20	Annondo Mohon Collage
6	Nasirabad Collage Field	21	Eidgha Moidan
7	Islami Academy Collage	22	Mominonnesha Women's Collage
8	Firuz Library More	23	Vidyamayee Govt. School
9	Jubli Qurter, Aqua	24	Laboratory High School
10	Nazirbari, Aqua	25	Teachers Training Collage
11	Morolbari, Aqua	26	Corpara More
12	D. C. Office	27	Technical Training Centre, Mascanda
13	C. O. Office	28	Polytechnical Institute, Mascanda
14	Eye Hospital, Dupakhola	29	Gohailkandi
15	A. D. B. Road, Sehora	30	Academy Road

Analytical methods of water samples

The analyses were accomplished at the "Humbold Soil Testing Laboratory" of Bangladesh Agricultural University, Mymensingh and Department of Public Health Engineering (DPHE), Mymensingh. The following analyses have been done from the collected water samples.

Table 2. Water sampling parameters with determination instruments and methods

Sl. No.	Parameters	Instruments and methods
1	Hydrogen ion concentration (pH)	pH meter (Model WTW pH 522) by APHA (1995)
2	Electrical conductivity (EC)	Electrode of the conductivity meter (Model WPACM 35) by Tandon (1995)
3	Calcium (Ca)	Flame emission spectrophometer (Model Jenway PEP3) by Golterman(1971) and Ghosh et al. (1983).
4	Potassium (K)	Flame emission spectrophometer (Model Jenway PEP3) by Golterman(1971) and Ghosh et al. (1983).
5	Sodium (Na)	Flame emission spectrophometer (Model Jenway PEP3) by Golterman(1971) and Ghosh et al. (1983).
6	Manganese (Mn)	Atomic absorption spectrophometer (AAS, UNICAM 969) by Clesceri *et al*. (1989).
7	Arsenic (As)	Atomic absorption spectrophometer (AAS, UNICAM 969) by Clesceri *et al*. (1989).

Statistical analysis

After chemical analysis data were statistically analyzed with the help of computer following the standard procedure (analysis of variance) as described by Gomez and Gomez (1984), Correlation studies were also done by computer with standard procedure.

Results and Discussion

Chemical parameters in pond water

The mean values and the ranges of the various chemical parameters of the pond water are presented in the Table 3. The value of water pH at different pond water was found as 6.68 to 7.14 with mean 6.948 indicated near neutral pH. Basher (2005) reported that the pH value of pond water ranged from 6.88 to 7.88. According to Ayers and Westcot (1985), the acceptable range of pH for irrigation water quality is from 6.0 to 8.5. According to this, all the water samples collected were suitable for aquaculture. The EC of water samples ranged from 227 to 700 μScm^{-1} with the mean value of 457.767 $\mu S\ cm^{-1}$ (Table 3). On the basis of EC values, Wilcox (1955) classified irrigation water into four groups such as low salinity (EC<0.25 $mS\ cm^{-1}$), medium salinity (EC=0.25-0.75 $mS\ cm^{-1}$), high salinity (EC=0.75-2.25 $mS\ cm^{-1}$), vary high salinity (EC>2.25 $mS\ cm^{-1}$). On the basis of this classification, one sample from Madrasha Quarter ($0.227 \mu Scm^{-1}$) was low salinity and rest of the samples were medium salinity. According to the classification all pond waters were "good" class except one sample (S_3). The EC content of these samples were similar to

the findings to Salhea (2005) that the electrical conductivity (EC) varied from 256 to 788 μScm^{-1} in dry season and 247 to 785 μScm^{-1} in wet season. The ranges of Na content in water samples collected from the different ponds of Mymensingh Urban Region was found 15.57 to 36.00 ppm with the mean value of 22.286 ppm (Table 3).

According to Ayers and Westcot (1985), all the irrigation waters contain less than 40.00 ml L^{-1} or 920 ppm Na. In respect of Na content, all the collected water would use safely for long-term irrigation without the hazardous effect on soil and crops. The acceptable content of Na in water samples for aquaculture is 75.00 mg L^{-1} or 75.00 ppm (Meade, 1989). All the water under test contained less than 75.00 ppm Na. For this reason, all the tested waters were suitable for aquaculture in the study area. Potassium status of the tested pond water was within the range of 3.83 to 16.16 ppm with the mean value of 9.137 ppm (Table 3). The presence of high amount of K in surface water might be due to the surface runoff agricultural water, farm refuges, and unwanted sewage. The acceptable content of K for aquaculture is less than 5.00 mgL^{-1} (Meade, 1989). On the basis of K content, sample no 20 (Anondomohon College) was suitable for aquaculture and rest of the samples were unsuitable for aquaculture. Calcium (Ca) content in ponds water sample were with the limit of 2.01 to 7.29 ppm, and the mean value of 4.445 ppm. Irrigation water containing less than 20 mgL^{-1}Ca was "suitable" for irrigating crop plants Ayers and Westcot (1985). On the basis of Ca content, the entire water sample studied was suitable for long term irrigation. The concentration of S in the collected water samples varied from 1.61 to 4.67 ppm where the mean value was 2.811 ppm (Table 3). Mokaddes (2008) concluded that the sulphur concentration of river waters and lake water samples of Dhaka Metropolitan City ranged from 0.46 to 4.61 ppm and 1.29 to 6.19 ppm, respectively. According to Ayers and Westcot (1985), the acceptable limit of SO_4 in irrigation water is less than 20 mg L^{-1}. On the basis of this limit, all the waters under investigation were not problematic for irrigation without any toxic effect on soils and crops grown in the study area. In the study area, all the collected water samples were suitable for aquaculture because SO_4 content did not exceed the recommended limit 50 mg L^{-1}(Meade 1989). The range of Mn in the collected water samples was found 0.033 to 0.684 ppm with the mean value of 0.340 ppm (Table 3). The recommended concentration of Mn for drinking is $0.05mgL^{-1}$ (USEPA, 1975).

According to the recommendation of the above mentioned agency all the tested water samples were unsuitable for drinking except one. According to Ayers and Westcot (1985) the recommended concentration of Mn for water use continuously on all soil is 0.20 mg L^{-1}. According to their findings Zilla School, Fulbaria Road, Nazirbari Aqua, Morolbari Aqua, C.O. office, Shahora Road, Mominunnissa Govt. Women's college, Vidyamayee Govt. Girls' High School, Teacher Training Collage, Itakhola Road and Academy road pond waters were suitable for irrigation and other experimental water bodies were unsuitable for irrigation. Arsenic (As) content in different pond water was observed from 0.0011 to 0.0059 ppm with the mean 0.003 ppm (Table 3). Out of 30 samples, 12 samples were below the mean value (0.003 ppm) and the rest 16 samples were above the mean value. The highest concentration (0.0059) ppm was found in Chorpara More (S_{26}) and the lowest was found in C.O. Office. The results indicated that all the collected surface water samples contained trace amount of As (< 0.05 ppm/ mgL^{-1}) which was below the allowable level (WHO International standard 0.01 mgL^{-1} and WHO Bangladesh standard 0.05 mgL^{-1}). The recommended and tolerance limits of As for drinking water are 0.01 and 0.05 mg L^{-1}. (USEPA, 1975). According to the criteria to this agency, all the water samples would safely be used for drinking purpose. Ayers and Westcot (1985) reported that As concentration of water used continuously on all the soils and livestock consumption are 0.1 and 0.2 mgL^{-1}, respectively. According to their view all the collected samples were found to be safe for irrigation and drinking purpose.

Table 3. pH, EC, K, S, Ca, Na, Mn, and As contents of different ponds of Mymensingh urban region

Sample	Smapling Location	pH	EC µS cm^{-1}	K (ppm)	S (ppm)	Ca (ppm)	Na (ppm)	Mn (ppm)	As (ppm)
1	Zilla School	6.97	316.00	6.65	2.15	2.01	16.54	0.181	0.005
2	Zilla School Hostel	6.97	301.00	6.50	1.81	2.31	17.91	0.59	0.0033
3	Madrasha Quarter	6.98	227.00	16.16	2.25	3.02	27.95	0.23	0.0034
4	Fulbaria Road	6.94	700.00	5.85	2.55	2.01	15.57	0.19	0.0044
5	Nasirabad Collage	6.97	290.00	6.30	3.59	3.47	20.34	0.58	0.0041
6	Nasirabad Collage Field	6.97	298.00	6.50	2.05	4.38	22.27	0.60	0.0049
7	Islami Academy Collage	6.98	548.00	15.53	2.20	3.02	36.00	0.51	0.0056
8	Firuz Library More	6.90	620.00	12.16	2.11	4.67	18.61	0.50	0.0035
9	Jubli Qurter, Aqua	6.91	560.00	7.53	1.69	4.28	17.92	0.32	0.0051
10	Nazirbari, Aqua	6.89	630.00	8.37	3.82	5.49	18.48	0.17	0.003
11	Morolbari, Aqua	6.99	610.00	9.48	3.19	5.61	20.64	0.15	0.0031
12	D. C. Office	6.88	563.00	10.62	4.417	4.67	22.19	0.21	0.002
13	C. O. Office	7.14	310.00	7.64	2.64	7.29	20.93	0.18	0.0011
14	Eye Hospital, Dupakhola	6.94	590.00	12.47	4.67	3.47	26.61	0.32	0.0026
15	A. D. B. Road, Sehora	6.95	448.00	12.31	2.94	2.01	27.73	0.64	0.0043
16	Cantonment Road, Shankipara	7.10	527.00	6.85	2.69	7.11	20.18	0.40	0.0012
17	Majar Sheriff Road, Shankipara	7.06	590.00	6.05	2.74	5.34	22.27	0.30	0.0022
18	Notun palli, Shankipara	6.98	498.00	7.24	1.61	7.29	26.16	0.20	0.0036
19	Pocha Pucker, Sehora	6.97	637.00	16.14	2.70	3.02	20.64	0.03	0.0019
20	Annondo Mohon Collage	6.96	305.00	3.83	2.45	5.04	20.43	0.61	0.002
21	Eidgha Moidan	6.97	326.00	10.29	3.03	3.48	20.43	0.31	0.0047
22	Mominonnesha Women's Collage	6.68	298.00	6.58	3.82	5.83	22.29	0.18	0.0025
23	Vidyamayee Govt. School	6.87	316.00	8.37	3.46	4.67	24.38	0.11	0.002
24	Laboratory High School	7.05	545.00	7.58	4.35	4.38	22.48	0.43	0.0038
25	Teachers Training Collage	6.89	406.00	6.81	2.64	2.31	22.92	0.17	0.003
26	Corpara More	6.88	637.00	9.27	4.35	5.69	25.61	0.58	0.0059
27	Technical Training Centre, Mascanda	6.99	375.00	9.48	2.91	4.28	25.92	0.59	0.005
28	Polytechnical Institute, Mascanda	6.81	430.00	8.37	1.82	5.17	26.37	0.43	0.0049
29	Gohailkandi	6.84	527.00	10.53	2.03	6.43	18.61	0.18	0.0021
30	Academy Road	6.98	305.00	12.64	1.66	5.61	20.18	0.15	0.002
Mean		6.94	457.767	9.13	2.811	4.445	22.286	0.340	0.003
SD		0.084	141.30	3.18	0.8891	1.5782	4.217	0.1885	0.00137
CV%		1.4	4.21	3.23	7.85	8.92	2.81	16.37	25.16

Table 4. Pearson correlation co-efficient (r) of pH, EC and ionic concentration for ponds water (Correlation matrix)

	pH	EC µS/cm	K(ppm)	S(ppm)	Ca(ppm)	Na(ppm)	Mn(ppm)	As(ppm)
pH	1							
EC µS/cm	-000598	1						
K (ppm)	0.002723	0.1692	1					
S (ppm)	-0.14838	0.2592*	0.001349	1				
Ca (ppm)	0.037138	0.087421	-0.21685	0.012998	1			
Na (ppm)	-0.02909	-0.04817	0.4880**	0.118333	-0.05682	1		
Mn (ppm)	0.122183	-0.13767	-0.14708	-0.00716	-0.17928	0.2843*	1	
As (ppm)	-0.1401	0.037612	0.022494	-0.10977	-0.4439**	0.2639**	0.4729**	1

**Correlation is significant at the 0.05 level; ** Correlation is significant at the 0.01 level*

Correlation analysis for ponds water

The correlation status results among eight parameters viz., pH, EC, Na, K, Ca, S, As and Mn in thirty ponds were presented in Table 4. The values of combinations of 8 parameter were reported that pH-EC (-0.00598), pH-K (0.002723), pH-S (-0.14838), pH-Ca (0.037138), pH-Na (-0.02909), pH-Mn (0.122183), pH-As(-0.1401), EC-K (0.1692), EC-S (0.2592^{*}), EC-Ca (0.087421), EC-Na (-0.04817), EC-Mn (-0.13767), EC-As (0.037612), K-S (0.001349), K-Ca (-0.21685), K-Na (0.4880^{**}), K-Mn (-0.14708), K-As (0.022494), S-Ca (0.012998), S-Na (0.118333), S-Mn (-0.00716), S-As (-0.1097), Ca-Na (-0.05682), Ca-Mn (-0.17928), Ca-As (0.4439^{**}), Na-Mn (0.2843^{*}), Na-As (0.2639^{*}), and Mn-As (0.4729^{**}). Among these, Mn-As, Ca- As, K-Na combination were found significantly correlated at 1% level of significant and Na-Mn, Na-As and EC-S combination were also significance at 5% level of significant. Because their respective calculated r value were greater than the tabulated r values.

Conclusions

From the study it may be concluded that the ponds of Mymensingh urban region contained acceptable amount of Na, K, S and As where Mn exceeded the recommended limit for drinking water, irrigation water and for aquaculture. In that sense it is hazardous for health, crops and aquaculture. All the water of ponds of Mymensingh urban region can safely be used for specific purpose after proper treatment. Routine research work with wide public awareness, government participation and regulations can save the water of Mymensingh urban region and thus a safe and sound water environment can be made for future generations.

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