*The Agriculturists 13(1):189-195(2015)* ISSN 2304-7321 (Online), ISSN 1729-5211 (Print)
A Scientific Journal of Krishi Foundation ***Indexed Journal***

***Short Communication***

# Evaluation of Surface Waters Quality Obtained from Different Sources of Mymensingh District of Bangladesh

Zannatul Ferdous[1], M. F. Haque[2], M. A. Hosain[3], M. M. Rahman[4] and Abu Sayed[5*]

*[1]Department of Farm Structure, Bangladesh Agricultural University; [2]Assistan manager, Petrobangla, Dhaka; [3]WMM Division, Bangladesh Rice Research Institute; [4]Farm Machinery and Post-harvesting Process Engineering Division, Bangladesh Agricultural Research Institute; [5]Department of Agricultural Engineering, Exim Bank Agricultural University, Bangladesh*

**Corresponding author and Email: abu_982@yahoo.com*

Received: 19 April 2014 Accepted: 06 June 2015

**Abstract**

The present study was conducted to assess some chemical properties and heavy metals of surface waters collected from different sources at Bangladesh Agricultural University Campus and Mymensingh Sadar Upazila for common use. Twelve water samples were collected from 4 different locations during February to April 2011 for analyzing their chemical quality parameters. The recorded values of pH, EC (Electrical Conductivity), TDS (Total Dissolved Solid), DO (Dissolved Oxygen), As, Pb and Fe were found to range from 6.153 to 7.043, 0.194 to 0.679 mS/cm, 106.333 to 389.333 ppm, 4.433 to 4.9 ppm, 0.064 to 1.756 ppb, 0.00053 to 0.00083 ppm and 0.567 to 1.795 ppm, respectively. pH and TDS of the surface water were within the standard value but other parameters such as As, Pb, and Fe were significantly higher than the standard for drinking water. The correlation analysis among chemical and heavy metal properties indicated that all the parameters had significant contribution to pollute the water except DO. The correlation between TDS and EC was strongly significant (r = 0.99**). pH showed positive significant correlation with EC and TDS. Fe showed negative (r = -0.636) significant correlation with As. The above findings show that the surface water in Mymensingh area is being gradually polluted by unplanned discharge of chemicals and heavy metals contained effluents. It might be concluded that the water is not so harmful yet for irrigation, aquaculture and livestock usage.

***Key words:*** *Chemical properties, heavy metal, surface water, water quality*

Water is a universal solvent and various types of elements get dissolved in it but the concentration of any element or compound or foreign substances beyond the permissible limit is treated as polluted water, which becomes harmful for common usages. Water quality is deteriorated day by day due to physical, chemical and biological variables causing water toxicity. It causes problem when such water is used in industries, agriculture, fish culture, etc. (Salam *et al.*, 2012).

The quality of surface water is a very sensitive issue (Mahmud *et al.*, 2014). The quality of water is judged by its total salt concentration. The concentration of toxic substance such as As, Cd, Cr, Pb, Co, Mn, Fe, Mo, etc. as heavy metals vary with salt concentration. Heavy metals such

as Cd, Cr, As, Cu, Pb, Ni, Ar, Hg, Mo, Sn, Sb, etc. are consistently present in small amounts in the environment (Soil, Water, Crop, etc.) but they are potentially toxic and can affect many species of plants and animals (Anonymous, 2004). Surface water of Bangladesh at present is polluted by various ways (Islam and Shamsad, 2009). The sources of surface waters are mainly polluted by anthropogenic activities, such as inefficient use of ground water, unwise application of pesticides and fertilizers.

Water is the most essential requisite that nature provides to sustain life of plants and animals, and also has tremendous role in every mode of human life (Nwankwoala and Nwagbogwu, 2012). But the bad quality and odorous water creates different types of water carrying diseases and the health status of city population is becoming threatened (Hossain, 2010). The excessive concentration of heavy metals is destroying the ecosystem and causing unnatural death of water flora and fauna, and making living condition worst for the adjoining areas. On the other hand, irrigation water quality directly affects soils and crops, and their management. It is possible to produce high quality crops only by using high-quality irrigation water when other inputs are kept optimal (Mirza *et al*., 2012). The present work was undertaken to assess the quality of surface water of some selected sources.

Surface water samples were collected, from Sutiakhali pond, Pagharia bill, Brahmaputra river and Guest house drain of sadar upazilla under Mymensingh district, Bangladesh. Twelve samples were collected from 4 different places from February to April 2011. Each bottle was peeped accordingly and then washed with tap water followed by distilled water before sampling. Bottles were rinsed again 3 to 4 times with water to be sampled. About 100 ml water samples was collected in plastic bottles and sealed to avoid exposure to air and labeled properly.

After collection, all samples were filtered with Whatman No. 1 filter paper to remove unwanted solid and suspended materials before analysis. Then the water was transferred into another 100 m1 bottle which contained l0 ml 2M hydrochloric acid solution to protect the water samples from any fungal and other pathogenic attack. All water samples were then carried to the "Soil & Water Engineering Laboratory", the Agri-varsity Humboldt Soil Testing Laboratory, Water quality and Pond Dynamics Laboratory (BFRI) and Central Laboratory of Bangladesh Institute of Nuclear Agriculture (BINA).

The pH values of water samples were determined by KARL KOLB WTW pH meter. A 100 ml of water sample was taken in a 200 ml beaker and the pH electrode was inserted into the water. The automatic digital reading were recorded and tabulated for analysis. Electrical Conductivity (EC) of the water was measured by taking 100 ml samples in a beaker. The cell of conductivity meter was rinsed with distilled water and then placed in the collected water sample. The electrical conductance of samples was determined electrometrically using conductivity meter (KARL KOLB (company) WTW LF 521). The Total Dissolved Solids (TDS) in water mainly were determined electrometrically using conductivity meter (TDS meter Model-OAKTON $^{pH/con}$ 300, CAT NO. U 35631-00 Made in USA). DO of the water was measured by taking 100 ml samples in a black bottle. DO was measured in water quality and pond dynamics laboratory (BFRI) by DO meter model no. JENCO No-9173 made in USA.

As, Fe and Pb were determined with the help of Atomic Absorption Spectrophotometer (AAS, Model No: Nova 300) at the Central Laboratory of BINA following the method of Clesceri *et al*. (1989).

The pH value of water samples ranged from 6.153 to 7.043 with the mean value of 6.748 (Table. 1), which implies that studied water was slightly acidic. Individually the ranges of pH of Sutiakhali pond, Pagharia Bill, Barahamputra River and Guest House drain waters were 6.13 to 6.18, 6.73 to 6.97, 6.93 to 7.05 and 6.93 to 7.11, respectively (Table 1). Ayers and Westcot (1985) mentioned that normal pH of water for irrigation is usually from 6.0 to 8.5 and the recommended pH for aquaculture ranges from 6.5 to 8.0 (Meade, 1989). On the basis of their comments, tested water samples were suitable for irrigation and aquaculture purposes. Similar observations were also reported by Quayum (1995); Razzaque (1995). But Momtaz *et al*. (2012) found the pH value of surface water ranged from 7.58 to 12.45 in water bodies around Dhaka Export Processing Zone (DEPZ) industrial area, Savar, Dhaka which was 1.5 times higher than the observed values.

Although pH is not directly related to soil, plant and animal health, but water pH influences the other properties of water-body, activity of organisms and potency of toxic substances present in the aquatic environment (Yusuff and Sonibare, 2005 and Rouse, 1979). Excessive pH value is harmful for aquatic life like fish, microorganisms and aquatic plants.

The EC of all the collected water was within the limit of 0.19 to 0.679 mS/cm (Table 1). The highest value (0.679 mS/cm) was recorded from Gust house drain and lowest (0.194 mS/cm) from Sutiakhali pond. According to Richards (1968), the irrigation waters were classified into four groups based on the basis of EC values such as low salinity (EC ≤0.25 mS/cm), medium salinity (EC = 0.25 mS/cm - 0.75 mS/cm), high salinity (EC = 0.75-2.25 mS/cm) and very high salinity (EC ≤ 2.25 mS/cm). The water samples of Sutiakhali pond water had low salinity and rests of the samples had medium salinity. On the other hand, according to the Wilcox (1955) Classification of irrigation water on the basis of EC, water samples of Sutiakhali pond were excellent (<0.25), rest of the samples were good (0.25-0.75) for irrigation.

The TDS values of water samples ranged from 106.33 to 389.33 ppm with the mean value of 212.33 ppm. The highest amount (389.33 ppm) was recorded from water of Guest house drain and the lowest amount (106.33 ppm) was obtained from water of Sutiakhali pond (Table 1). According to WHO (2008), the palatability of water with a TDS level of less than 600 mg/L is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels above 1000 ppm. The most common range in case of city water is 200-400 ppm. The maximum contaminant level set by United States Environmental Protection Agency (USEPA) is 500 ppm. TDS greater than 1200 ppm may be objectionable to consumers (WHO, 2008). On the basis of the standard value, all the water samples were good for all purpose usage.

The Dissolved Oxygen (DO) values of the calculated samples ranged from 4.43 to 4.9 ppm with the mean value of 4.62 ppm (Table 1). The lowest value of DO was found at Pagharia Bill and the highest value of DO was found at Brahmaputra river. The Low value of DO might be due to higher microbial activities in decomposing waste released from the surrounding industries in to the river. It is assumed that oxygen demanding wastes removed DO; plants add DO during day, but remove it at night, and the respiration of organisms living in sediments removed oxygen (Gilbert, 2003). Alternately the DO of the surface water of DEPZ at Savar area, Hazaribag, Dholi Khal and Pagla were reported to be 1 and <1 ppm, respectively by Momtaz *et al*. (2012) and Islam *et al*. (2000). However, the standard acceptable value of DO for drinking water is 6 ppm (ADB, 1994). DO values lower than the acceptable value implies that the water was not suitable for other activities than irrigation.

The Arsenic concentration (As) in different water samples ranged from 0.064 to 1.756 ppb with the mean value of 0.914 ppb. The maximum value (1.756 ppb) was recorded from Brahmaputra river and the minimum (0.064 ppb) from Sutiakhali pond (Table 1). As concentration level in all water samples of the studied area were lower than WHO International Standard limit (10 ppb) and the maximum permissible limit in Bangladesh standard is 50 ppb, i.e. 0.05 ppm for drinking water. However, the highest concentration (1.756 ppb) as recorded in the present study is 8 times lower than that of the maximum permissible limit in Bangladesh standard. Besides As status was reported in other studies, 0.003 ppb by Mokaddes *et al*. (2013), in case of river waters in Dhaka Metropolitan area, 0.24 ppb in Buriganga river by Ahmad and Gani (2010) and the average 70 ppb in ground water of Gopalganj district by Alam *et al.* (2011). Similar study was also conducted in DEPZ, Savar area by Khanam *et al.* (2011). They reported the average concentration of As from surface water was about 70 times higher than the standard for drinking and 33 times higher than the standard for irrigation purpose.

The Fe values in surface water from different sources ranged from 0.567 to 1.795 ppm with the mean value of 1.304 ppm. The maximum value of 1.795 ppm was obtained from Pagharia Bill and the minimum value of 0.567 ppm was obtained from Brahmaputra river (Table. 1). The U.S. Environmental Protection Agency (EPA) recommended the concentration of Fe for drinking water is 0.30 ppm. The highest desirable and the maximum permissible limit of Fe for drinking water is 0.05 and 1.50 ppm, respectively (WHO, 1972). But all the values of Fe in present study were higher than the desirable limit. Momtaz *et at.* (2012) found the value of Fe 1.331-0.443 ppm in surface water of DEPZ, Savar area. Islam *et al.* (2012) recorded the concentration of Fe 1.79 to 50.15 ppm in water of Balu river, which was remarkably higher than the standard limit. According to Ayers and Westcot (1985) the recommended maximum concentration of Fe for water used continuously in soil to the 5.00 ppm. So, the concentration of Fe in the studied water samples were for below the recommended limit for irrigation water and these waters would not

The Pb values of surface water from different sources ranged from 0.00053 to 0.00083 ppm and the mean value was 0.00068 ppm. The maximum value (0.00083 ppm) was obtained from Pagharia Bill and the minimum (0.00053 ppm) was obtained from Sutiakhali pond (Table 1). International Standards for Pb in drinking water is 0.05 ppm and the maximum allowable limit is 0.1 ppm (WHO, 1972). The Pb values as recorded in the present study were below the maximum allowable limit. So, the studied waters would safely be used for all purpose and this not create Pb toxicity for irrigated crops. However, Momtaz *et al*. (2012) reported 0.002 ppm Pb in Dhaka metropolitan river water and Khanam *et al.* (2011) reported 3.65 ppm of Pb in dry season which was 160 times higher than that of the wet seasion (0.023 ppm) in surface water in DEPZ, Savar area.

Table 2 and 3 show the results of statistical analysis of chemical to chemical and metal to metal correlation matrix in terms of linear correlation coefficient (r) values, which are 0.05 and 0.01 in surface water samples, respectively. The coefficient of correlation analysis among chemical properties (Table 2) indicate that all the parameters had significant positive or negative contribution to pollute the water except DO. The correlation between TDS and EC was strongly positive. The correlation coefficient (r = 0.99**) showed that the value of TDS was proportional to the EC. pH showed positive significant correlation with EC and TDS. On the contrary, the coefficient of correlation analysis among heavy metal properties (Table 3) indicate that negative significant correlation with Fe and significantly positive correlation with Pb. The significant correlations indicate that they may have originated from common sources (chemicals, paints), and these metals may have been derived from anthropogenic sources, especially the industry and municipal sewage system.

**Table 1.** Water quality parameters of surface water as recorded from four different locations in Sadar upazia of Mymensingh

| Sources of surface water | Locations | EC mS/cm | As (ppb) | Pb (ppm) | Fe (ppm) | TDS (ppm) | pH | Do (mg/L) or ppm |
|---|---|---|---|---|---|---|---|---|
| Suthiakhali pond (S.P) | S.P-1 | 0.196 | 0.060 | 0.0004 | 1.690 | 105 | 6.15 | 4.8 (tem 27.1 °c) |
| | S.P-2 | 0.191 | 0.062 | 0.0006 | 1.592 | 106 | 6.13 | 4.6 (tem 27.0 °c) |
| | S.P-3 | 0.197 | 0.070 | 0.0006 | 1.700 | 108 | 6.18 | 4.5 (tem 26.9 °c) |
| | Average | 0.194 | 0.064 | 0.00053 | 1.660 | 106.33 | 6.153 | 4.633 |
| Pagharia bill (P.B) | P.B-1 | 0.347 | 0.89 | 0.0007 | 0.9843 | 161 | 6.73 | 4.5 (tem27.0 °c) |
| | P.B-2 | 0.360 | 0.91 | 0.0008 | 2.806 | 162 | 6.97 | 4.4 (tern 27.1 °c) |
| | P.B-3 | 0·354 | 0.85 | 0.0010 | 1.S97 | 169 | 6.77 | 4.4 (tem 27.0 °c) |
| | Average | 0.353 | 0.88 | 0.00084 | 1.795 | 164 | 6.823 | 4.433 |
| Brahmaputra river (B.P.R) | B.P.R-1 | 0.377 | 1.75 | 0.0009 | 0.5669 | 190 | 6.95 | 5.0 (tem27.1 °c) |
| | B.P.R-2 | 0. 381 | 1.78 | 0.0008 | 0.4777 | 190 | 7.0S | 4.9 (tem27.0 °c) |
| | B.P.R-3 | 0.385 | 1.74 | 0.0007 | 0.6586 | 189 | 6.93 | 4.8 (tem 27.0 °c) |
| | Average | 0.381 | 1.756 | 0.0008 | 0.567 | 189.66 | 6.976 | 4.9 |
| Guest house drain (G.H.D) | G.H.D-1 | 0.668 | 0.94 | 0.0006 | 1.165 | 385 | 7.11 | 4.5 (tem 27.0 °c) |
| | G.H.D-2 | 0. 680 | 0.99 | 0.0005 | 1.190 | 395 | 7.09 | 4.6 (tem 27.0 °c) |
| | G.H.D-3 | 0.690 | 0.93 | 0.0006 | 1.234 | 388 | 6.93 | 4.5(tern 27.0 °c) |
| | Average | 0.679 | 0.l53 | 0.00056 | 1.196 | 389.33 | 7.043 | 4.533 |

**Table 2.** Correlation among chemical properties of the water samples

| Parameter | pH | EC | TDS | DO |
|---|---|---|---|---|
| pH | 1 | | | |
| EC | 0.778** | 1 | | |
| TDS | 0.693** | 0.99** | 1 | |
| DO | 0.05 | -0.179 | -0.172 | 1 |

**Table 3.** Correlation among heavy metal properties of the water samples

| Parameter | As | Fe | Pb |
|---|---|---|---|
| As | 1 | | |
| Fe | -0.636** | 1 | |
| Pb | 0.548* | -0.111 | 1 |

**References**

ADB (Asian Development Bank). 1994. Training manual for environmental monitoring. USA: Engineering Science Inc. 2 -16 p.

Anonymous. 2004. Water: A millennial priority. The Acme Agrovat and Beverage Ltd. Bangladesh.

Ahmed, J. U. and Gani, M. A. (2010) Heavy Metal Contaminations in Water, Soil and Vegetation of the Industrial Areas in Dhaka, Bangladesh, *Environmental Monitoring Assessment*, 166 (1): 347-357.

Alam, F., Sarkar, B. C., Sultana, E., Ali, M. R. and Rahman, M. S. 2011. Assessment of arsenic and heavy metal in natural water of Gopalganj District in Bangladesh. *Bangladesh Research Publication Journal*, 6(1): 91-101.

Ayers, R. S. and Westcot, D. W. 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29 (Rev. I): 1-144.

Clesceri, L. S., Grenberg, A. E. and Trussel, R. P. 1989. Standard Method of the Examination of Water and Waste. 17th con. American public Assoc., Washington D. C. 1-30, 40-175 pp.

Gilbert, M. M. 2003. Introduction to Environmental Engineering and Science. Prentice Hall, Inc. New Jersey, USA, 127, 234 p.

Hossain M. A. 2010. Removal of ammonia pollution from surface water by nitrification and aquatic macrophytes. Ph.D. Thesis, Department of Microbiology, University of Dhaka, Bangladesh.

Islam, M. Z., Noori, A., Islam, R., Azim, M. A. and Quraishi, S. B. 2012. Assessment of the contamination of trace metal in Balu River water, Bangladesh. *Journal of Environmental Chemistry and Ecotoxicology*, 4(14): 242-249.

Islam, M. S. and Shamsad, S. Z. K. M. 2009. Assessment of irrigation water quality of Bogra district in Bangladesh. *Bangladesh Journal of Agricultural Research*. 34, 597-608.

Islam, M. R., Lahermo, P., Salminen, R., Rojstaezer, S. and Peuraniemi, V. 2000. Lake and reservoir water quality affected by metals leaching from tropical soils, Bangladesh. *Environmental Geology*, 39 (10): 1083-1089.

Khanam, D., Islam, M. S., Shaha, B., Akbor, M. A. and Beg, R. U. 2011.Seasonal Implication of Heavy Metal Contamination of Surface Water around Dhaka Export Processing Zone (DEPZ), Savar, Bangladesh. *Jahangirnagar University Journal of Science*, 34(2): 21-35.

Mahmud, M. S., Islam, M., Hossain, N., Kibria, M. G. and Alamgir, M. 2014. Surface Water Quality of Chittagong University Campus, Bangladesh. *Journal of Environmental Science, Toxicology and Food Technology*, 8(2): 01-04.

Meade, J. W. 1989. Aquaculture management. India: CBS Publishers and Distributors, 9 p.

Mirza, A. T. M., Rahman, T., Rahman, S. H. and Majumder, R.K. 2012. Groundwater quality for irrigation of deep aquifer in southwestern zone of Bangladesh. *Songklanakarin Journal of Science and Technology*, 34 (3): 345-352.

Mokaddes, M. A., Nahar, B. S. and Baten, M. A. 2013. Status of Heavy Metal Contaminations of River Water of Dhaka Metropolitan City. *Journal of Environmental Science & Natural Resources*, 5(2): 349-353.

Momtaz, H., Alam, F., Ahsan, M. A., Akbor, M. A. and Rashid, M. M. 2012. Surface water quality around DEPZ Industrial area, Savar, Dhaka. *Bangladesh Journal of Scientific and Industrial Research*, 47(3): 279-286.

Nwankwoala, H. O. and Nwagbogwu, C. N. 2012. Characteristics and quality assessment of groundwater in parts of Akure, South-Western Nigeria. *Journal of Environmental Science and Water Resources*, 1(4): 67-73.

Quayum, A. 1995. Impact of ground water irrigation on the grey terrace soils of Gazipur. *MS Thesis*, Dept. of Agril. Chemistry, Bangladesh Agricultural University, Mymensingh.

Razzaque, M. A. 1995. Assessment of toxicity in water sources and their long term effect on soil properties. *MS Thesis*, Dept. of Agril. Chemistry, Bangladesh Agricultural University, Mymensingh.

Richards, L. A. 1968. Diagnosi and Improvement of Saline and Alkali Soils. Agricultural Hand Book 60, USDA and IBH, Publishing Co. Ltd. New Delhi, India, 98-99 p.

Rouse, R. D. 1979. Water quality management in pond fish culture. In: *Research and Development Series* No. 22, Project: AID/DSAN-G 0039, Auburn University, Alabama, USA.

Salam, S. M. A., Mollah, M. A., Tasnuva, A. and Zaman, M. R. 2012. Physicochemical Evaluation of Ground and Surface Water of Mohanpur Upazila of Rajshahi District. *Journal of Environmental Science & Natural Resources*, 5(2): 275-280.

Wilcox, L. V. 1955. Classification and use of irrigation water. United States Department of Agriculture. Circular No. 969, Washington D.C, 19 p.

WHO (World Health Organization). 2008, Guidelines for drinking water quality, World Health Organization, Geneva.

WHO (World Health Organization). 1972. International Standards for Drinking Water. Cited from ground water assessment development and management. 248-249 pp.

Yusuff, R. O. and Sonibare, J. A. 2005. Characterization of textile industrial effluents in Kaduna, Nigeria and pollution implications. *Global Nest: the International Journal*, 6 (3): 212-22.