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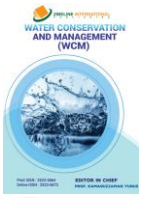

RESEARCH ARTICLE

WATER QUALITY ASSESSMENT OF BALU RIVER, DHAKA BANGLADESH

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ABSTRACT

Rivers of Bangladesh play important role for socio-economic development as well as balancing ecosystem. Unfortunately, Rivers especially in Dhaka city are being significantly polluting by industrial effluents discharge, solid wastes disposal, and connection of urban sewage. These effluents are containing different hazardous chemicals such as chromium, aluminum, sulphur, lead, salts etc. which have been affecting these River water quality severely. This study is aimed to assess the present status of water quality of Balu River in terms of heavy metals contamination. It is found the average pH in the water of Balu River was 7.76 and Electric Conductivity (EC) ranged from 910 to 1082 µS/cm. Besides, the study found the average Fe, Pb, Cd and Cr concentration were 950, 7.6, 0.56, and 200µg/L, respectively which representing the higher than the WHO and Bangladesh standards. Therefore, it is important to manage the Balu river water quality.

KEYWORDS

Balu River, Water Quality, Heavy Metal, Pollution, Dhaka, Bangladesh.

1. INTRODUCTION

Water is one of the main components of environment that has tremendous role in every mode of human life. It is unfortunate that the human activities everywhere in the world are continuously polluting water. Water pollution by harmful microorganisms is now a global problem. Pollution can also be caused by a wide variety of inorganic and organic compounds [1-3]. Many of the rivers get polluted with industrial effluents, municipal waste, agricultural waste, sewage disposal, etc. However, water resource is source of major serious concern, considering its contribution to the need of human beings and the natural environment. In fact, Bangladesh is one of those polluted countries, which currently holds 1,176 industries that discharge about 0.4 million m^3 of untreated waste to the rivers in a day. Pollution, nowadays, has become a serious concern for human life due to the industrial burst in the world. And, the rivers are the main choices to hold and bear the suffering from pollutants, especially in the developing countries. Water pollution caused by chemical substances such as heavy metals effects river ecology [4].

Heavy metals contamination in aquatic environment is of critical concern, due to toxicity of metals and their accumulation in aquatic habitats. Of the chemical pollutants, heavy metals being non-biodegradable, they can be concentrated along the food chain, producing their toxic effect at points after far removed from the source of pollution [5,6]. Heavy metals in the aquatic environment can affect aquatic biota and pose a risk to fish consumers, such as humans and other wildlife. Heavy metals may enter into aquatic ecosystem from different natural and anthropogenic sources, including industrial or domestic sewage, storm runoff, leaching from landfills or dumpsites and atmospheric deposits. Metals like Iron and Manganese are required for metabolic activities to organisms, but some other elements like Chromium, Copper, Mercury, Nickel and Lead exhibit toxicity effects on aquatic organisms. In aquatic ecosystem, heavy metals have received considerable attention due to their toxicity and accumulation in biota and fishes. Accumulation of heavy metals in fishes leads to bio-magnifications in the food chain [7,8]. Heavy metals from natural sources and anthropogenic activities are continually released into aquatic systems, causing serious threat because of their toxicity, bioaccumulation, long persistence and biomagnification in the food chain [9-12].

Dhaka is the second polluted mega city in the world. It is bounded by rivers, inter-connected with canals which have always formed a support for the city residents. In the last few years, unregulated industrial expansion, teeming infrastructures, rural-to-city population migration and ineffective enforcement of environmental regulations have all been proved very disastrous on surface water quality for example today's Buriganga [13,14]. Though industries are minor users of water in terms of quantity but have significant impacts on surface water quality. According to a study, about 10% of industries discharge treated effluent and the rest of the industries discharge effluent in the rivers or water body without any treatment or with minimal treatment [15]. Tejgaon metropolitan area is such a type of industrial area where more than 300 industrial units are located and these units dispose about 12000 m^3untreated waste per day which consists residue of soap, dyeing, pharmaceuticals, metals industries etc. Effluent of this industrial area is directly discharged into Begunbari and Narai canal which carries the waste through Balu River and ultimately flows on Sitalakha River which is used in Saydabad water treatment plant for meeting water consumption demand of Dhaka city dwellers [16,17].

Thus, Balu River in Dhaka east is the most polluted area which is responsible for polluting Sitalakkha day by day and the ultimate outcome of this pollution is being to be threat to Saydabad water treatment plant [18,19]. Sometimes it pollutes ground water also. This water quality deterioration is a great concern in this area not only for aquatic environment, but also a threat for human and animal health due to the spread of toxic substances [20,21]. About 80% of the diseases in developing countries are related to contaminated water and the resulting death penalty is as much as 10 million per year [22]. This water is also important for irrigation purposes. Due to having no central ETP plants or lowering of unit individual ETP plants, pollution concentration is increasing hazardously and threats for environment is also increasing day by day. Though there were some research work done previously on this study area by some researchers but regular monitoring of those parameters are necessary for estimating the up-to-date level of pollution by which we can be aware of the threats and the problems [23,24]. This study was conducted to assess physicochemical parameters and concentration of heavy metals in the Balu River. This study is expected to be important for maintaining the water quality as well as reducing the future pollution.

2. MATERIALS AND METHODS

2.1 Study area

Balu River is a common polluted area where toxic substances are mixing with water quality in an unscientific manner. Thus regular monitoring of this area is crucial for enforcing the appropriate steps of environmental management system. The study was conducted at Balu River of Dhaka district near the Demra. The exact study area is under the Bottola Bridge, Chanpara (23.732909 N, 90.496392E). Water samples were collected from the one station (total 5 samples) of the Balu River on 10 March 2018 afternoon. The samples numbers are A1, A2, A3, B2, and B3. Sample A and B sets were collected from south and North of Bridge, respectively (Figure 1).

2.2 Sample collection

Five samples were collected in 250 ml plastic bottles from various sampling points. Prior to sample collection, all bottles were cleaned with dilute acid followed by distilled water. Before sampling, the bottles were rinsed again three times with the water to be sampled. 250 ml of water sample in each bottle were collected from each sampling point from the surface of water. 5ml of 1M HNO_3 solution was added and sealed immediately to avoid exposure to air and to protect water samples from fungal and pathogenic attack.

2.3 Sample analysis

pH was measured using pH meter (HANNA Instruments) and electrical conductivity (EC) was measured by conducto-meter (HANNA Instruments). Heavy metals (Pb, Cr, Cd, and Fe) concentrations were measured with the help of Atomic Absorption Spectrophotometer (AAS).

Figure 1: Google map images and satellite image of Balu River near Demra. Sample station is Bottola Bridge (east side), Chanpara

3. RESULTS AND DISCUSSIONS

The various sites around the Bottola Bridge were monitored to collect the sample. Common pollution scenario was monitored around the Bottola Bridge. The east side of the bridge was selected to collect the samples. The watercolor in the sampling sites was light to dark black having bad organic odor, not at all suitable even for aquatic organisms. Noxious smell indicates extreme level of pollution in the river water. Various types of solid particles were found to float on the surface and bulk of water. Some aquatic organisms were also seen. The water and surrounding area are under pollution threat by dead plant matter, garbage, food wastes, etc. Therefore, the water in Balu River is not suitable for aquaculture, agricultural and domestic purposes.

The pH of the Balu river at Bottola Bridge point ranged from 6.89 to 7.33 (Table 1) which was within the range of Bangladesh Standard reflecting its suitability for aquatic life. As well, the average pH value was 7.76 which are slightly higher than earlier study and Buriganga though not crossed the found value for Turag river. The EC found to be ranged from 910 to 1082 µS/cm in Balu River which is almost within the Bangladesh standard (ECR, 1997), however, it is observed to be Buriganga and Turag had higher than Balu River. Meanwhile, the average concentration of Fe, Pb, Cd, Cr are 950, 7.6, 0.56, and 200µg/L, respectively (Table 2). These results show that the amount of Fe, Pb, Cd and Cr in Balu River water were comparatively higher than the WHO and Bangladesh standard.

Table 1: Physicochemical parameters (pH and EC) of the water of BaluRiver

Parameter	Balu river (present study)	Inland water standard [25]	Balu river [26]	Buriganga River [27]	Turag River [28]
pH	7.76	6.5-8.5	5.99	6.93	7.9
EC (μScm^{-1})	996	600 -1000	2065	1144	1980

Table 2: Heavy metal content in the sample of water of Balu River

Heavy metal	Balu river (present study) (µg/L)	Bangladesh standard [25]	Balu river [29] (µg/L)	Buriganga river [29] (µg/L)	Turag River [28] (µg/L)
Fe	950	0.3	1450	1230	1040
Pb	7.6	0.05	17.6	40.7	50
Cd	0.56	0.005	0.56	3.2	6.2
Cr	200	0.05	303	365	178

Based on the appearance, color, physicochemical parameters (pH and EC), and heavy metal abundances (Fe, Pb, Zn, Cd, Cr), the water of Balu river and the river bank area are highly threaten for environmental pollution. A significant reading of heavy metals concentration indicates the input of pollutants from various sources like industrial effluents, domestic sewage, municipal sewage, agricultural runoff and so on. This study identified some possible sources which contribute to contaminate heavy metals in Balu River along with alter its water quality:

Discharge of industrial effluent: Industrial installations include tanneries, dyeing industries, aluminium, iron and steel workshops, plastic, pharmaceuticals, battery manufacturing, washing, hardware and cold storage units.

Discharge of municipal wastewater and sewage: Some areas of Dhaka city are not not yet within the sewerage network of Water Supply and Sewerage Authority (DWASA). As a result, there is a tendency of having unauthorized connection of domestic sewer into the storm water pipes that end up into the Balu River. This causes discharge of massive amount of untreated municipal wastewater and sewage.

Population explosion: Throwing and dumping of wastes into the river water.

Encroachment and land grabbing: The encroachers have set up platform like structures on the rivers and gradually filled out the bottoms by piling up earth and rubbish. Even multi-storied structures have been built on encroached land. Politically backed influential land encroachers have created illegal structures including houses, bazaars, ghats (port), brickfields etc., on the river that has created obstacles on the flow of the river.

Disposal of solid & domestic waste: Dhaka City dwellers have been dumping domestic wastes and solid wastes into the rivers due to insufficient treatment facilities.

Sewage and industrial waste: Discharge of untreated influent from textile dying, tannery, printing, washing and pharmaceuticals are released into the main water bodies of Dhaka every day.

4. CONCLUSION

With increasing population the demand for water is increasing in such an extent that now a viable solution for the treatment of surface water has become mandatory. As discussed in this article, all the rivers around Dhaka city are threatened by pollution. In the present study, environmental condition of the Balu River in the Dhaka city area has been investigated during the period of March 2018. The measurement of physicochemical parameters which included watercolor, pH, and EC has been summarized. The data of different aspects have been analyzed and discussed. Heavy metal concentrations of the selected sampling point of Balu river are also measured. The obtained results revealed that the average concentration of Fe, Pb, Cd, Cr are 950, 7.6, 0.56, and 200µg/L, respectively. These data shows that the amount of Fe, Pb, Cd and Cr in Balu river water were much higher than the Bangladesh standards of DOE 2002. A significant reading of heavy metals concentration indicates the input of pollutants from various sources like industrial effluents, domestic sewage, municipal sewage, agricultural runoff and so on.

The present liberalized industrial policy in Bangladesh ignores environmental protection; private entrepreneurs do not require permission from any quarter. So, with the increase of unplanned and socially and environmentally degraded industries poses a new challenge to Bangladesh. The River management is now very much necessary to protect the river specially Balu River. The rehabilitation option is the best solution of the river management. There needs to be proper enforcement mechanisms in place, as the pollution and human -induced hazards have gone beyond a tolerable limit.

REFERENCES

[1] Higgins, I.J., Burns, R.G. 1978. The Chemistry and Microbiology of Pollution. Academic Press.

[2] Hellawell, J.M. 2012. Biological indicators of freshwater pollution and environmental management. Springer Science & Business Media.

[3] Ahmed, A. Reazuddin, M. 2000. Industrial pollution of water systems in Bangladesh. Environmental system of surface water systems of Bangladesh. University Press Limited, Dhaka, Bangladesh, Pp. 175-178.

[4] Sikder, M. 2012. Comparative assessment of water quality in the major rivers of Dhaka and West Java. International Journal of Environmental Protection, 2 (4), Pp. 8-13.

[5] Tilzer, M., Khondker, M. 1993. Hypertrophic and polluted freshwater ecosystems: Ecological basis for water resource management. Dept. of Botany, Dhaka University, Bangladesh.

[6] Rahman, M., Islam, M., Khan, M. 2016. Status of heavy metal pollution of water and fishes in Balu and Brahmaputra rivers. Progressive Agriculture, 27 (4), Pp. 444-452.

[7] Islam, M.S. 2015. Assessment of trace metals in foodstuffs grown around the vicinity of industries in Bangladesh. Journal of Food Composition and Analysis, 42, Pp. 8-15.

[8] Dar, M.I. 2017. Assessment of biotransfer and bioaccumulation of cadmium, lead and zinc from fly ash amended soil in mustard-aphid-beetle food chain. Sci Total Environ., 584-585: Pp. 1221-1229.

[9] Gupta, G.S. 2017. Laboratory Scale Microbial Food Chain to Study Bioaccumulation, Biomagnification, and Ecotoxicity of Cadmium Telluride Quantum Dots. Environ Sci Technol., 51 (3): Pp. 1695-1706.

[10] Li, H. 2017. Cadmium in rice: Transport mechanisms, influencing factors, and minimizing measures. Environ Pollut., 224, Pp. 622-630.

[11] Dey, S., Das, J., Manchur, M. 2015. Studies on heavy metal pollution of Karnaphuli river, Chittagong, Bangladesh. IOSR J Environ Sci Toxicol Food Technol., 9 (8), Pp. 79-83.

[12] Hasan, S.J. 2015. Physico-chemical characteristics and accumulation of heavy metals in water and sediments of the river Dakatia, Bangladesh. International Journal of Fisheries and Aquatic Studies, 2 (5), Pp. 300-304.

[13] Banu, Z. 2013. Contamination and ecological risk assessment of heavy metal in the sediment of Turag River, Bangladesh: An index analysis approach. Journal of water Resource and Protection, 5 (02), Pp. 239.

[14] Bhuiyan, M.A.H. 2015. Source apportionment and pollution evaluation of heavy metals in water and sediments of Buriganga River, Bangladesh, using multivariate analysis and pollution evaluation indices. Environmental monitoring and assessment, 187 (1), Pp. 4075.

[15] Satter, M., Islam, M. 2005. Quality assessment of river water around Dhaka city. Bangladesh Journal of Environmental Science, 10, Pp. 326-329.

[16] Roy, S. 2013. Effects of industrial wastewater reuse for crop production: A case study in Tejgaon metropolitan area of Dhaka, Bangladesh. Journal of the Bangladesh Agricultural University, 11 (2), Pp. 183-188.

[17] Zakir, H. 2012. Heavy metals and major ionic pollution assessment in waters of midstream of the river Karatoa in Bangladesh. Journal of Environmental Science and Natural Resources, 5 (2), Pp. 149-160.

[18] Islam, S. 2016. Assessing heavy metal contamination in the bottom sediments of Shitalakhya River, Bangladesh; using pollution evaluation indices and geo-spatial analysis. Pollution, 2 (3), Pp. 299-312.

[19] Islam, S., Huda, M. 2016. Water pollution by industrial effluent and phytoplankton diversity of Shitalakhya River, Bangladesh. Journal of Scientific Research, 8 (2), Pp. 191-198.

[20] Ali, M.M. 2016. Preliminary assessment of heavy metals in water and sediment of Karnaphuli River, Bangladesh. Environmental Nanotechnology, Monitoring & Management, 5, Pp. 27-35.

[21] Islam, M.S. 2018. Assessment of heavy metal pollution, distribution and source apportionment in the sediment from Feni River estuary, Bangladesh. Chemosphere, 202, Pp. 25-32.

[22] Malik, A. 2012. Water-borne diseases, cost of illness and willingness to pay for diseases interventions in rural communities of developing countries. Iranian journal of public health, 41 (6), Pp. 39.

[23] Rahman, M., Rana, M. 1995. Management of Buriganga River Water quality under Alternative Scenarios. Final report, Institute of Flood Control and Drainage Research, Bangladesh University of Engineering and Technology.

[24] Islam, M.Z. 2012. Assessment of the contamination of trace metal in Balu River water, Bangladesh. Journal of Environmental Chemistry and Ecotoxicology, 4 (14), Pp. 242-249.

[25] Rules, E.C. 1997. Department of Environment. Ministry of Environment and Forest. People's Republic of Bangladesh.

[26] Roy, S. 2014. Water quality of Narai canal and Balu river of Dhaka City: An impact of industrialization. Journal of the Bangladesh Agricultural University, 12 (2), Pp. 285-290.

[27] Ahmed, K. 2016. Assessment on the level of contamination of Turag river at Tongi area in Dhaka. Bangladesh Journal of Scientific and Industrial Research, 51 (3), Pp. 193-202.

[28] Hafizur, R., Nuralam, H., Rumainul, I. 2017. Investigation of physicochemical parameter, heavy metal in Turag river water and adjacent industrial effluent in Bangladesh. Journal of Science, Technology and Environment Informatics, 5 (1), Pp. 347-360.

[29] Mottalib, M.A. 2017. Comparative Study of Water Quality of Burigangaand Balu River Dhaka, Bangladesh. International Journal of Current Research, 9 (10), Pp. 59132-59137.