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ANALYSIS OF HEAVY METAL COMPONENTS IN SOME URBAN PONDS IN RAJSHAHI, BANGLADESH

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Abstract: An experiment was conducted to determine the heavy metal pollution status of selected six ponds in Rajshahi City Corporation for a period of 7 months from June, 2008 to December, 2008. Among heavy metals the mean values of Cu, Mn, Zn, Fe and Pb varied from 0.05±0.02 (Pond-5) to 1.79±0.88 mg/l (Pond-4), 21.30±2.64 (Pond-6) to 76.57±30.90 mg/l (Pond-1), 0.08±0.02 (Pond-6) to 1.25±0.79 mg/l (Pond-4), 0.75±0.10 (Pond-3) to 1.87±0.53 mg/l (Pond-5) and 0.14±0.12 (Pond-6) to 4.92±1.66 mg/l (Pond-4) respectively. This study indicated that the Pond-2 covered by garbage, polythene and other wastes, Pond-3 and Pond-4 received industrial wastes were moderately polluted whereas the Pond-1 received City corporation wastes was less polluted.

Keywords: Heavy metal, pollution, urban ponds, Bangladesh

সারাংশঃ রাজশাহী সিটি কর্পোরেশনের নির্ধারিত ছয়টি পুকুরে ভারী ধাতব দূষণের অবস্থা নির্ধারণ করার জন্য জুন ২০০৮ থেকে ডিসেম্বর ২০০৮ পর্যন্ত ৭ মাস ব্যাপি একটি গবেষণা কার্যক্রম পরিচালনা করা হয়েছিল। ভারী ধাতব দূষণগুলোর মধ্যে Cu, Mn, Zn, Fe এবং Pb এর গড় মানের বিস্তার পাওয়া গেছে যথাক্রমে ০.০৫±০.০২ (পুকুর-৫) থেকে ১.৭৯±০.৮৮ মি. গ্রা/লি. (পুকুর-৪), ২১.৩০±২.৬৪ (পুকুর-৬) থেকে ৭৬.৫৭±৩০.৯০ মি. গ্রা/লি. (পুকুর-১), ০.০৮±০.০২ (পুকুর-৬) থেকে ১.২৫±০.৭৯ মি. গ্রা. (পুকুর-৪), ০.৭৫±০.১০ (পুকুর-৩) থেকে ১.৮৭±০.৫৩ মি. গ্রা./লি. (পুকুর-৫) এবং ০.১৪±০.১২ (পুকুর-৬) থেকে ৪.১২±১.৬৬ মি. গ্রা./লি. (পুকুর-৪)। এই গবেষণা থেকে জানা যায় যে, পুকুর-২ আবর্জনা, পলিথিন এবং অন্যান্য বর্জ্য, পুকুর-৩ এবং পুকুর-৪ এ শিল্পকারখানার বর্জ্য দ্বারা মোটামুটিভাবে দূষিত যেখানে পুকুর-১ সিটি কর্পোরেশন বর্জ্য দ্বারা তুলনামূলকভাবে কম দূষিত।

Introduction

Water pollution is a global problem, affecting both the industrialized and the developing nations. The water pollution problems in the nation, however, are quite different in many respects. Heat, toxic metals, acids, sediment, animal and human wastes, and synthetic organic compounds foul the waterways of developed nations. Human and animal wastes, sediment and pathogenic organisms head the list in the non-industrialized nations. All kinds of wastes, both solid and liquid forms are dumped indiscriminately into open waters resulting in pollution of the aquatic environment (IUCN 1991). The term 'water pollution' is referred to the addition to water of an excess of material (or heat) that is harmful to humans, animals, to desirable aquatic life or otherwise causes significant departures from the normal activities of various living communities in or near bodies of water (Trivedi and Raj 1997). Different types of water bodies get polluted due to the discharge of effluents from the industries, domestic waste, land and agricultural drainage. This results in the degradation of water quality of the water resources. Water pollution is greatly affected for the presence of heavy metal. Among the various means of pollutions of pond are washing of the clothes, cleaning of animals, dumping of the waste by unauthorized small scale units functioning in the surrounding to the pond. Haslam (1991) reported that due to the great expansion in the urbanization and industrialization, most of the water bodies especially developed countries are polluted. According to Bush et al. (1988), main sources of heavy metals in water due to municipal wastes, industrial wastes and infiltration waters from the top soil layers. Pollution due to industrial waste disposal has not come up as a major problem since our country is industrially less developed. Whatever industries we have (fertilizer, sugar, cement, refinery, electroplating units, plastic, textile etc.) are hardly equipped with any pollution control measure. The release of waste effluents into aquatic system have given rise to heavy localized contamination hazards and threatens the environment as a pollutant.

It is known by all that ponds are very important water bodies in the country. According to World Bank (1991) Bangladesh ranks at the top for production of fresh water fishes (4076 kg/sq.km.) and in terms of total production and per capita fish production of about 5.5 kg, it stands third after China and India. The total pond fisheries production was 1219736 mt (DoF, 2012) whereas in Rajshahi district the total fish production was 21764 mt (DoF 2008). The roles of these ponds are very functional for freshwater aquaculture. Most of the research works have been focused on the analysis of water quality like physic-chemical or biological parameters. But very little works have been done to generate data on the others components like heavy metal in fish ponds. Some related works in this point were done by Jop (1980), Manga (1983), Gaigher and Krause (1989), Tariq et al. (1996), Ehshan et al. (1997), Kabir et al. (1997), Hossain (1998), Saha and Hossain (2002) and Javed (2003). So, it is necessary to assess water pollution status and its impact on fisheries resources of pond considering the adverse effects of municipal sewage, industrial effluents on water quality.

The present study has been aimed to conduct the determination of heavy metal components in selected urban fish ponds in Rajshahi.

Materials and Methods

Water samples were collected once in a month at 10 a.m.-11 a.m. for a period of seven months from June, 2008 to December, 2008 in six fishponds which were situated at Hadirmore (1), Sonadighir more (2), BSCIC (Bangladesh Small and Cottage Industries Corporation) area (3, 4) and Kazihata (5, 6) of Rajshahi City Corporation. Collected samples were analyzed by the Institute of environmental sciences, University of Rajshahi. The heavy metal (Cu, Pb, Zn, Fe, Mn) concentration of water samples was determined by using Spectrophotometer (Model Shimadzu UV1601 PC, Made in Japan).

Results and Discussion

The data of heavy metal components on some ponds were recorded during the study period are presented below:

Copper (Cu): Copper concentration ranged between 0.01 mg/l to 3.52 mg/l in water samples Fig –1 but high concentration these elements in the water are toxic. Increased copper concentration in aquatic environment resulting from industrial development was favour copper uptake by aquatic animals including fish (Takasusuki et al. 2004). The highest values of Cu were recorded in the month of September at pond-4 and the lowest value was found in the month of December at pond-5. The mean value of copper was varied from 0.05±0.02 (Pond-5) to 1.79±0.88 mg/l (Pond-4). This finding clearly indicated water pollution due to industrial effluents and also agreed with the findings of Moore and Ramamoorthy (1984) and Meade (1989). Abel and Green (1981) reported that different wastes of industries and textiles cause serious pollution due to the presence of the heavy metal salts of copper.

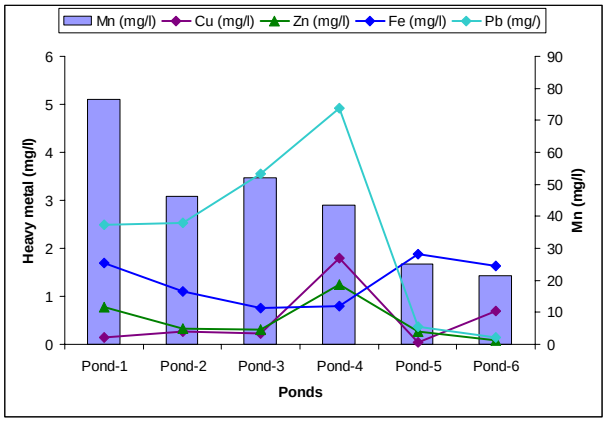

Figure 1 Mean variation in heavy metals

Manganese (Mn): The mean value of manganese was varied from 21.30±2.64 (Pond-6) to 76.57±30.90 mg/l (Pond-1) Fig–1. Significant concentration of manganese was found almost in the same range throughout the study period. According to Nazneen (1980), pond waters are known to contain relatively large quantities of manganese usually in the range of 500-5000 mg/m^3. Harvey (1949) has suggested that manganese content controls the productivity but affects more likely those factors which control plant and animal growth.

According to the report of WHO (1984), the drinking water should contain only 0.1 mg/l manganese while the observed values for streams and rivers are between 0.01-2200 mg/l as reported by McCutcheon et al. (1992). Javed (1999) reported high concentration of manganese causes metallic ion pollution.

Zinc (Zn): Zinc concentration varied from 0.05 mg/l to 5.19 mg/l in water samples Fig –1 but this element is toxic to fish and other aquatic organisms as well as human beings (Kupchella and Hyland 1993). The highest values of Zn were recorded in the month of September at pond-4 and the lowest value was found in the month of December at pond-6. The mean value of toxic ammonia was varied from 0.08±0.02 (Pond-6) to 1.25±0.79 mg/l (Pond-4). This finding clearly indicated water pollution due to municipal wastes, industrial effluents etc. and also agreed with the findings of Moore and Ramamoorthy (1984) and Meade (1989).

Iron (Fe): An irregular pattern of variations was observed in the distribution of total iron. The present data shows more fluctuations throughout the water of pond with a slight increase in the iron level. The mean value of iron was varied from 0.75±0.10 (Pond-3) to 1.87±0.53 mg/l (Pond-5) Fig –1. Iron also plays a very important role and it is evidently an oxygen carrying substance in the processes of respiration. It is considered toxic when it exceeds up to 5 mg/l. According to WHO (1984), its range should be between 0.3 mg/l in drinking while it varied between 1.94-5.76 mg/l in pond. Welch (1952) has also described that most natural waters contain more than 5 mg/l iron without being toxic due to the buffer action of organic compounds or calcium salts. Javed (1999) reported high concentration of iron causes metallic ion pollution.

Lead (Pb): The mean value of lead was varied from 0.14±0.12 (Pond-6) to 4.92±1.66 mg/l (Pond-4) Fig –1. The highest value of Pb (7.64 mg/l) was recorded in the month of November at pond-4 which indicates water pollution due to the inclusion of industrial effluents, municipal wastes etc. Abel and Green (1981) reported that different wastes of industries and textiles cause

serious pollution due to the presence of the heavy metal components like lead. Templeton (1995) has described that the lead entered into the water by wastes of industries. Javed (1999)also reported high concentration of Pb causes metallic ion pollution.

Conclusion: Present research work reveals significant variations in the concentration of heavy metals due to untreated industrial and sewage wastes added into the pond water. The effluents from these sources have adversely affected the quality of water. Among the study ponds those pond which were situated in industrial area (Pond-3 and 4) contributed significant metals pollution towards the pond ecosystem. In these ponds the concentrations of toxic heavy metals and effluent discharging were found moderately higher than the safe limits for sustainable conservation of freshwater fisheries and aquatic habitats. The findings have important implications for the development of effective watershed management strategies for the control of point and diffuse-source pollution. As well as further study will needed to assess the affect of heavy metals in fish muscle and total pond ecosystem in this region.

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