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RESEARCH ARTICLE

RELATIVE STUDY OF HEAVY METAL CONTAMINATION IN FISHES OF BURIGANGA RIVER DUE TO UNTREATED TANNERY EFFLUENT AND IN FISHES FROM ANOTHER SOURCE IN BANGLADESH

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ABSTRACT

This study was undertaken to assess the level of heavy metals and the extent of pollution in surface water, sediment and fishes of Buriganga River near the discharge point of tannery effluents. Water, sediment and two species of fish samples were collected by typical process. Those Samples were analyzed to determine the heavy metal content by Flame Atomic Absorption Spectrophotometer (FAAS). Accumulation levels in fish were then compared with the concentration levels of fishes collected from the local market. In Heteropneustes fossilis (Stinging catfish) average bioaccumulations of Cr, Pb, Cd, and Zn were varied from 437.85 to 8.4 mg/kg, 26.3 mg/kg to Below Detection Limit (BDL), 2.75 to 0.05 mg/kg and 338.5 to 29.7 mg/kg in dry weight respectively. While in Channa punctata (Spotted snakehead) average bioaccumulations of Cr, Pb, Cd, and Zn were varied from 81.05 to 1.35 mg/kg, 27.75 to 1.6 mg/kg, 2.9 to 0.4 mg/kg and 244 to 67 mg/kg in dry weight respectively. Mean concentration of metals in sediments were; Cr-271.6, Pb-16.02, Cd-0.43 and Zn-54 mg/kg in dry weight and in water these levels were Cr-0.285, Pb-0.056, Cd-0.002 and Zn-0.757 mg/L. Amongst the Heavy metals Cr recorded the highest concentration in the head of H. fossilis with a value of 437.85 mg/kg and Cd recorded the lowest in water with a value of 0.002 mg/L. This study was intended to evaluate the effects of tannery effluents on aquatic life and water quality at the discharged point of tannery effluents. Cr content which mainly comes from the tannery effluents was found excessively high in the Fishes of Buriganga River than that of Local Market in this study. These findings indicate a major threat to human health as the concentration of heavy metals was higher than the WHO approved standard level.

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INTRODUCTION

Tanneries, the most contamination creating industries of Bangladesh are largely concentrated in Hazaribagh in the south-western part of Dhaka city. Among 270 registered tanneries in Bangladesh, around 90-95 %is located at Hazaribagh on about 25 hectares of land. Most of these tanneries use old, outdated, and inefficient processing methods (Environmental Concerns regarding Hazaribagh Tannery area and Present Relocation Scenario, 2011). In Tanneries, During the leather processing various type of chemicals like basic chromium sulphate, wetting agents, bactericides, sodium sulphite CaO, ammonium sulphide, soda ash, and enzymes are used in the soaking, tanning and post tanning operation (Imamul, 1998).

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It has been reported that only about 20% of chemicals is absorbed by leather in tanning operation and the rest is discharged as waste (Blacksmith Institute's World´s Worst Pollution Problems Report 2010). Everyday at least 60,000 tons of hides and skins are processed which discharge around 95,000 liters effluent directly to environment (Rasul *et al.*, 2006). In another estimation it is reported that Hazaribagh tanneries generate 88 million tons of solid waste and 7.7 million liters of liquid waste every day. As a result, the ground and surface water contaminated with chromium, as well as cadmium, arsenic, and lead (Bhuiyan, 2011). Cr is an inherent product of the tanning process. Although other significant amounts of pollutants like Zn, Mn, Cu Cd, Pb, As, Ni, B, Se, Mo, N and P have also been found to be discharged (Akan, 2009; Ogbonna, 1998). The tannery effluent are directly discharge to natural water bodies or open lands which cause pollution to waters, soil flora and aquatic environment (Tariq, 2006). The consequence of this accumulation could result in loss of lively hood, loss of biodiversity and degradation of water quality, which in general affects the ecosystem (Babatunde, 2008). Most of the tanneries are situated on the bank of the Buriganga, this river has been the dumping place of both liquid and solid wastes of tannery resulting in the annihilation of fish species and water quality. Heavy metal pollution in aquatic environment is of dangerous concern due to their indestructible nature and potential toxic effects and capability to get bio accumulated in aquatic ecosystems (MacFarlane *et al*., 2000; Censi, 2006). Heavy metals that enter into the aquatic environment are eventually incorporated into the aquatic sediment; organisms living in these sediments accumulate this heavy metal to variable degrees (Cross *et al*., 1970). Contamination extent largely relies on the contaminant category, fish species, sampling location, trophic level, and their style of feeding (Asuquo, 2004). Heavy metals can be classified into three groups such as: potentially toxic like chromium, arsenic, cadmium, lead and mercury since they are poisonous even in trace amount semi-essential like nickel, vanadium, cobalt also necessary like copper, zinc etc. since they play an important role in biological ecosystem (Szentmihalyi and Then, 2007). Both essential and non-essential heavy metal elements render a particular significance in ecotoxicology (Ebrahimpour and Mushrifah, 2010) because of their poisonousness, lengthy perseverance, bioaccumulation, and bio-magnification in the food chain (Yousafzai, 2010). Essential metals are must be taken up from water, food or sediment for the normal metabolism of the fish (Canli and Atli, 2003). If these essential metals are taken up in excessive amounts they can also cause carcinogenic effects (Tüzen, 2003). Heavy metals are normal constituents of aquatic organisms in minute amount but at higher concentrations, they exert various toxic effects which are metabolic, physiologic, behavioral and ecological in nature (Kebede and Wondimu, 2004). Chromium is known as human carcinogen are harm to the gastrointestinal, respiratory, immunological systems, reproductive and causes developmental problems (Azom, 2012). A certain level of Zinc is good for body but beyond this limit cause appetite, decreased immune function, slow wound healing, and skin sores (Gerberding, 2005). Lead exposure has been associated with elevated blood pressure and hypertension (Martin, 2006). Cadmium toxicity has been linked to prostate cancer and cancer in liver, kidney and stomach (Waalkes, 2000). To evaluate the ecosystem health biomonitoring of trace elements is necessary (Llopis, 2006). Monitoring of heavy metal concentrations in aquatic ecosystems of usually done by measuring their concentrations in water, sediments and associated biota (Camusso, 1995). Heavy metals normally exist in low levels in water and their considerable concentration is found in sediment and biota (Namminga, 1976). Sediments have been testified as the key source of heavy metal in aquatic system. Bioaccumulation and enlargement is capable of leading to poisonous level of these metals in fish, even when the exposurce is low. The attendance of metal impurity in fresh water is recognized to distract the delicate balance of the aquatic ecosystem. Fishes are infamous for their capability to concentrate heavy metals in their muscles and since they keep significant role in human nourishment, they essential to be carefully screened to assure that poisonous metals are not being transfer to man through fish consumption (Adeniyi and Yusuf, 2007; Mertz, 1981; Chari and Abbasi, 2005). Fish samples can also be considered as one of the most important indicative factors in freshwater systems for the assessment of metal pollution level (Papagiannis, 2004) This study was carried out to assess the adverse effects of heavy metal containing tannery effluents on aquatic ecosystem and water quality. Buriganga River surrounds the main part of Dhaka city and so highly contaminated by tannery wastes and effluents along with community and industrial wastes. Local publics use its water for several of their regular activities and fishes for consumption. Considering all these things, the key purposes of this investigation were to determine the pollution levels of heavy metals in sediments and water as well bioaccumulation in aquatic organisms like fish and relating this accumulation level with fishes of a different source.

MATERIALS AND METHODS

Study area

Fish, water and sediment samples were collected from Buriganga River near the Rayerbazar discharge point during the months of April, 2016. The geographical co-ordination of the study area is latitude 23.73 N longitude 90.35 . Fishes of another source were collected from the local market (West Shewrapara, Mirpur, Dhaka) during the same period of time. Figure 1 shows the sampling site for fishes, sediment and water from Buriganga river. Sampling point has been denoted with the black circle.

Sampling

About 0.5 L of water sample was collected from Buriganga river sampling site from 0.3m below the water surface with the help of 1L plastic bottle which was previously leached with a mixture of distilled water and acid (10% HNO_3). Sediment sample was collected in a plastic zip bag by a vertical corer and a grab sampler. The water and sediment samples were acidified immediately with 2 ml of HNO_3 per liter of water. The water sample was filtered through Whitman no 40 filter paper and then preserved in refrigerator at4^0 C for laboratory analysis. The two species of fishes were collected from the Buriganga river sampling site while other fishes of same spices were collected from the local market. The length of the fishes varied between 15.5 to 17.5 cm and their weight varied from 220 to 230 gm. After collecting the sediment and fish samples were washed, weighed and dried in an oven at 105^0C until acquiring constant weight. After cooling in a desiccator all the samples were grounded by a carbide mortar and pastel to make powder and homogenized. The powdered fish and sediment samples were finally stored in a pre-cleaned dry glass bottle and preserved in a desiccator for further analysis.

Digestion and Analysis

Digestion of Fish samples

For the quantitative analysis of Cr, Pb, Cd and Zn, fish samples were digested by CEM microwave digester (MARS Xpress, USA; Model-907511) according to the method of www.cem.com.mathews NC28106. 1.0000g sample was taken by a chemical balance and put into a Teflon vessel and then was digested with 10 ml of concentrated HNO_3 acid (69%, Merck, Germany) and 2 ml of HCl acid (38%, Merck, Germany) at 200^0C in microwave digestion system. The samples were predigest by standing open for a minimum of 15 minutes before the vessels were closed and then proceeded to the heating program (CEM system). Microwave digestion was coducted with a 1600W power supply, temperature ranging from 180^0C-220^0C, and holding time of 15 minutes.

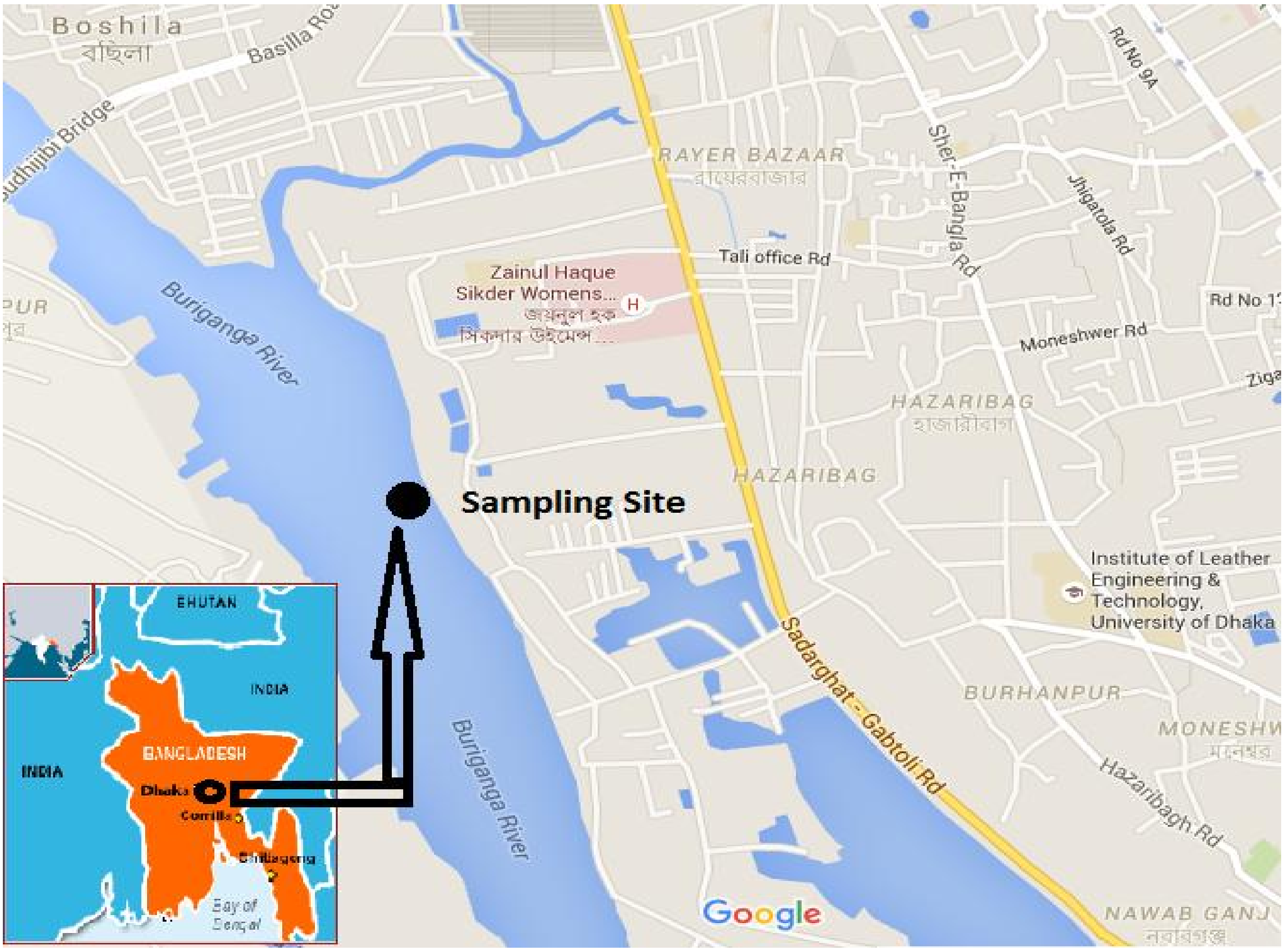


Fig. 1. Location of the sampling sites in Buriganga River, Dhaka, Bangladesh

After digestion, the content in the taflon vessel was dissolved in de-ionized water and filtered into a 25 ml volumetric flask quantitavely and brought up to the mark with de-ionized water.

Digestion of sediment sample

Digestion of sediment sample was done following ISO 11466 thermal heating method. At first 3g of sample in the form of fine dust was weighed and taken into a beaker. Then the weighed sample was moistened with 1 ml distilled water. After that 21 ml HCl and 7 ml HNO_3 were added drop by drop and then 15 ml of dilute HNO_3 (0.5M) was added to the beaker and this sample was allowed to stand at room temperature. The mixture was then refluxed on a heating plate for two hours and was filtered through filter paper (Whitman no 40) after cooling and kept into room temperature for further determination.

Digestion of water sample

The digestion of water sample was performed according to the method of Zhang (2007). 50 ml of sample water was taken in a 100 ml beaker. 5ml concentrated HNO_3 acid (Analytical grade) was added and the system was heated on a hot plate at 100^0 C to boil until volume get reduced to 20 ml. Another 5ml of concentrated HNO_3 acid was added and heated for 10 minutes and allowed to cool. About 5 ml of Nitric Acid was used to rinse the side of the beaker and finally the solution was filtered into a 50 ml volumetric flask through filter paper (Whitman no 40) and topped up to the mark with de-ionized water kept in room tempereture until further analysis.

Total Heavy metals concentration measurement

After digestion the samples were sent to the Centre for Advanced Research and Science (CARS), University of Dhaka for thesubsequent analysis for metals Cr, Pb, Cd and Zn with a Perkin-Elmer atomic absorption spectrometer (Model- A Analyst 800, USA). Flame AAS Cadmium (wavelength 228.8 nm), Chromium (Wavelength 357.9 nm), Lead (Wavelength 283.3 nm), and Zinc (Wavelength 213.9 nm) specific hollow cathode lamp was used to analyse the samples. Minimum finding limit of 0.01 mg/L for Cd, 0.10 mg/L for Cr, 0.20 mg/L for Pb and 0.01 mg/L for Zn in the flame method. Samples were aspirated through nebulizer and absorbance was measured with a blank as reference.calibration curve was obtained using standard samples (containing 0.2, 0.4, 0.6, 0.8 and 1,0 mg/L for Cd; 0.2, 0.5, 1.0, 2.0 and 4.0 mg/L for Cr; 0.5, 1.0, 2.0, 4.0 and 8.0 mg/L for Pb and 0.2, 0.4, 0.6, 0.8 ,1.0 and 2.0 mg/L for Zn). The corellation coefficient was found for Cd 0.999, Cr 0.996, Pb 0.999 and for Zn 0.998.

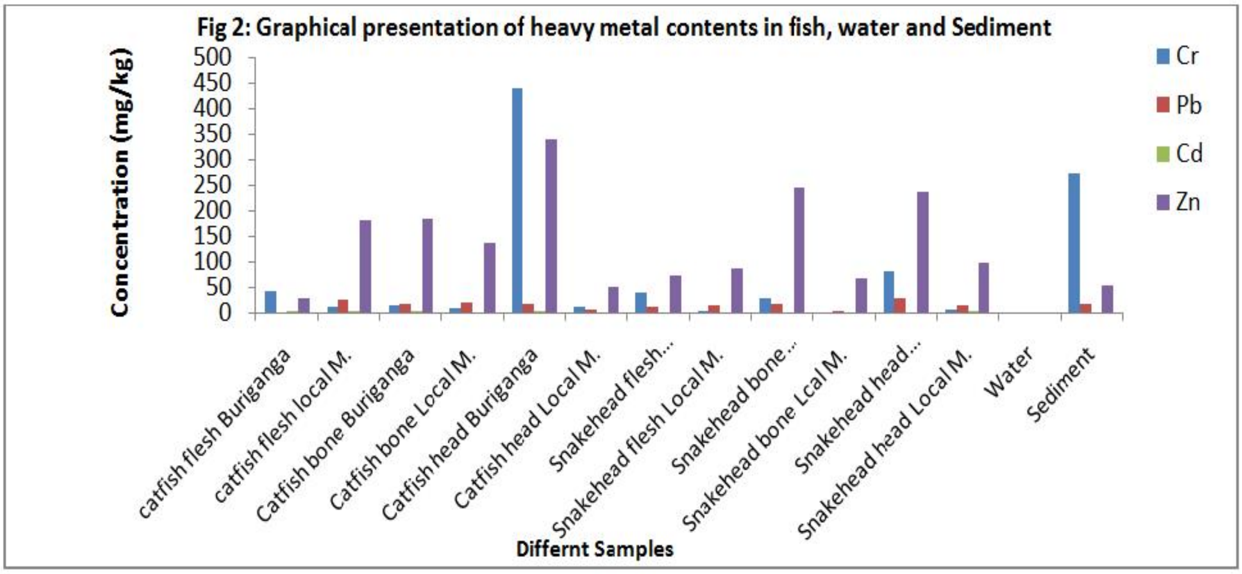
Risk assessment

For the evaluation of Risk assessment in this study Daily Intake of Metal (DIM) and Health Risk Index (HRI) were determined according to methods by Khan *et al*. (2009) and Okunola *et al*. (2011). The daily intake of metals (DIM) was calculated to assess the daily loading of metals into the body system (via the consumption of fish) of a specified body weight of aconsumer. It demonstrates the relative bioavailability of the metals. The daily intake of metals (DIM) was determined by the following formula:

$$DIM\ \frac{(C_{metal} \times D_{fish\ intake})}{B_o}$$

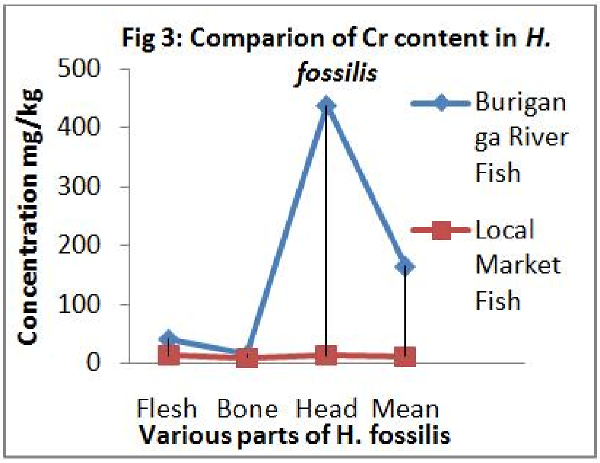
Where C_{metal} is the concentration of heavy metals in the fish (mg/kg−1), $D_{fish\ intake}$ is the daily intake of fish (mg/kg day−1), B_o is average body weight. In Bangladeshi average fish intake per person per day is23 g (Thompson *et al*., 2002). The average body weight was taken as 70 kg for adults (WHO 1993).The health risk index (HRI) was calculated as the ratio of Daily Intake of Metals (DIM) and reference oral dose (RfD). This index justifies individual's risk of heavy metals. If HRI value is less than one (1) it is safe and considered acceptable; otherwise, the fish is not considered safe for human health and may pose severe health risk. The following formula was used to calculate HRI - HRI = $\frac{DIM}{RfD}$

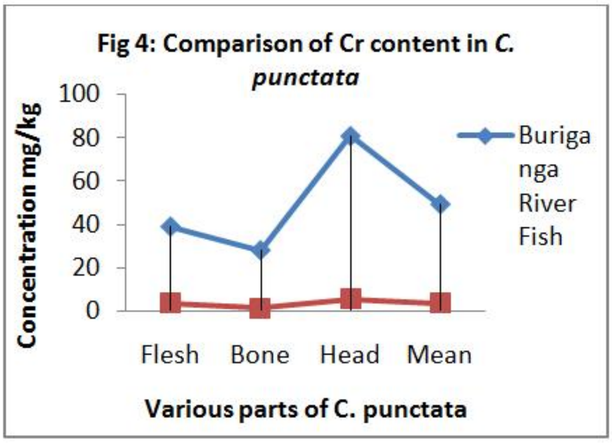
Where reference oral doses (RfD) for Cr, Zn, Pb, and Cd are 1.5x 10^{-3}, 3.0 x 10^{-1}, 3.5x 10^{-3} and 1.0 x 10^{-3} mg/kg/day respectively (USEPA, 2009).



RESULTS AND DISCUSSION

From the overall results shown in Figure 2, it is found that heavy metal content in fishes was much lower than that of sediment while metal content in fishes was higher than that of water. Heavy metal content in sediment is much higher than that of water and fishes because sediment is the main repository of heavy metals holding more than 99 percent of the total amount of a metal present in the aquatic system (Demirak, 2006; Öztürk, 2009). Higher concentration of metals in the sediment more than in water may also be linked with the fact that pollutants that is discharged into the aquatic environment does not remain in aqueous phase but instead are adsorbed onto the sediments (Edward, 2013). Amongst all the metals analyzed, Cr and Zn were observed to have the highest concentrations in all the water, sediment, and fish samples. All the metals were also observed to have mean values higher than the WHO/FEPA recommended limits in water, sediment and fish. In comparison with levels in some other water bodies in other areas, this study recorded higher metal levels than in the Turag river (Mandal *et al*., 2014), Dhaleshwari river (Ahmed, 2009) and in the Shitalakhya river (Islam, 2014). Figure 3 and figure 4 show the comparison of Cr content in *Heteropneustes fossilis* and *Channa punctate* respectively of Buriganga River and Local Market. Cr was found highly excessive in fishes of Buriganga River than that of local Market. In *H. fossilis* of Buriganga Cr content was 41.1 mg/kg in flesh, 15.25 mg/kg in bone and 437.85 in head while it was 12.4 mg/kg in flesh, 8.4 mg/kg in bone and 12.6 mg/kg in the head of *H.fossilis* from Local Market. On the other hand in *C. punctata* Buriganga Cr content was found 39.00 mg/kg in flesh, 28.05 mg/kg in bone and 81.05 mg/kg in head while it was 3.85 mg/kg in flesh, 1.35 mg/kg in bone and 5.65 mg/kg in the head of *C. punctate of* Local market. In water and sediment it was 0.285 mg/L and 271.6 mg/kg respectively as shown in figure 11 and figure 12. Chromium content in the fishes of Buriganga was much higher than that of Local Market. Cr was found most abundant in the head of both H.fossilis and C.punctata from Buriganga while it was least abundant in bones of both species. Cr content was found in the order of Head>Flesh>bone in both H.fossilis and C.punctata fishes of Buriganga river. The order was also similar in case of Local Market fish. The mean values of Cr in fishes, water and sediment of Buriganga River was found much higher than the WHO recommended limits that is 7.0 mg/kg for fish, 25 mg/kg for sediment and 0.05 mg/L for water (Joint, 1993).The level was also higher in fishes of local market. The higher level of heavy metal in Buriganga river fishes could be for being exposed to large amount of untreated tannery effluent every day. Tannery industry is one of the most possibly contamination causing industry for the Buriganga River as it process raw skins and hides by chrome tanning generating effluent that contain hexavalent chromium which is the potentially carcinogenic and mutagenic in nature (Saranraj *et al*., 2013). Every day, the tanneries commonly discharge 22,000 cubic liters of poisonous waste, including cancer-causing hexavalent chromium (Human Rights Watch_ Taneries_Bangladesh, 2012). Chromium in the Buriganga River most likely originated from the tanning process. Anthropogenic sources of emission of Cr in the surface water are from municipal wastes, laundry chemicals, paints, leather, and road run off due to tirewear, brake wires, radiators (Dixit and Tiwari, 2007). Low-level of chromium exposure can harm the skin as well as cause ulceration. Long-term exposure responsible for kidney and liver injury as well as injury to the circulatory and nerve tissues. Chromium often accumulates in aquatic life, adding to the threat of consumption fish that may have been exposed to high levels of chromium (Lenntech. Heavy-metals, 2010). Cr poisoning also responsible for asthma, chronic bronchitis, chronic irritation, chronic pharyngitis, chronic rhinitis, congestion and other acute diseases (Agency for Toxic Substances and Disease Registry, 2013).





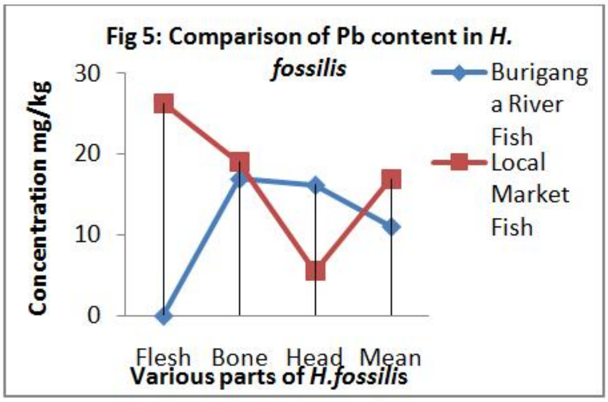
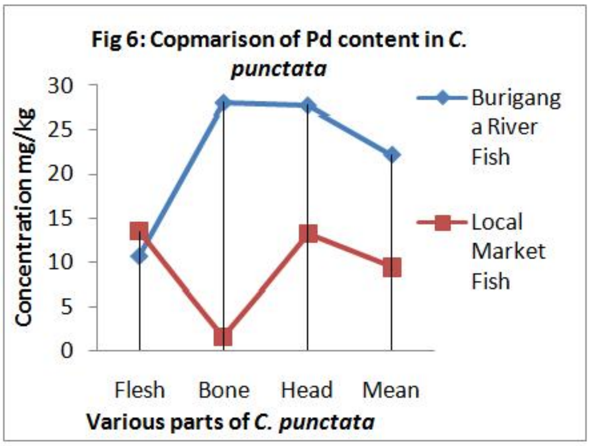
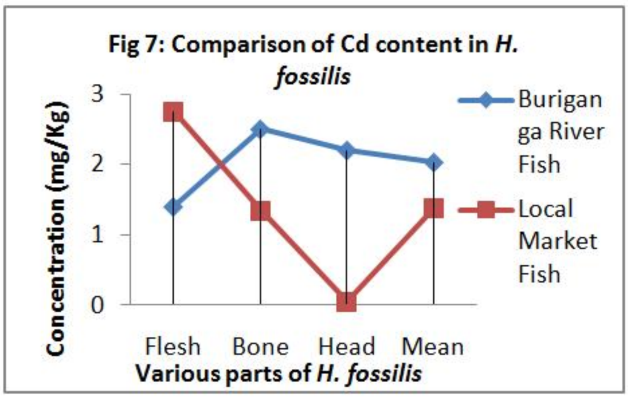
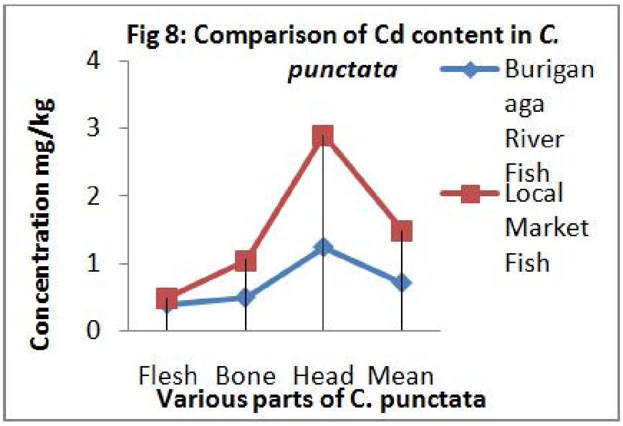


Figure 5 and Figure 6 show the comparison of Pd content in *Heteropneustes fossilis* and *Channa punctata* respectively of Buriganga River and Local Market. Pb content in *H. fossilis* fishof Buriganga was below detection level in flesh, 16.95 mg/kg in bone and 16.2 mg/kg in head while it was 26.3 mg/kg in flesh, 19.0 mg/kg in bone and 5.5 mg/kg in the head of *H.fossilis* from Local Market.

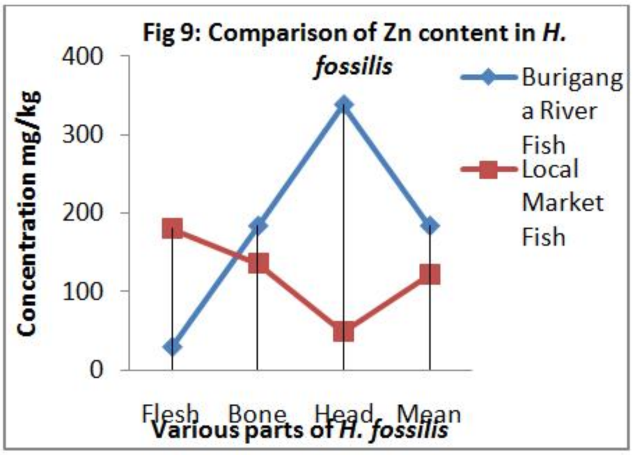


On the other hand in *C.punctata* of Buriganga Pb content was found 10.7 mg/kg in flesh, 16.05 mg/kg in bone and 27.75 mg/kg in head while it was 13.5 mg/kg in flesh, 1.6 mg/kg in bone and 13.14 mg/kg in the head of *C. punctata of* Local Market. In water and sediment concentration of Pb was 0.056 mg/L and 16.02 mg/kg respectively as shown in figure 11 and 12.The values did not show much regularity. In case of head, Pb content in both species was higher in Buriganga river fish than those of Local market. Similar was the case for the bone of Spotted Snakehead. On the contrary, Pb content was higher for both of the Buriganga River and Local Market species when flesh was considered. This was the case for the bone of stinging catfish also. Pb was found most abundant in the flesh of the local market catfish while it was below detection level in the flesh of Buriganga River Catfish. The mean concentration of Pb in fishes of both Buriganga River and Local Market exceeded the maximum limit approved by WHO/FEPA (2 mg/L) (Joint, 1993). Pb content in Water and Sediment was also found higher than the maximum limit approved by WHO/FPEA that is 0.010 mg/L for water and 0.04 mg/kg for sediment (Joint, 1993).High content of Pb in Buriganga River may be due to tannery effluents discharged in it which contains not only Cr but also significant amount of Pb along with other heavy metals (Imamul, 1998). Tannery sludge can also be a significant source of Pb (Keswick, 1998). Pb pollution may also be caused by the activities of car wash operators and automobile repair workshop and from sources like leaded gasoline located in the area (Mukai, 1994), chemical manufacturing and storage facilities and steel work in Dhaka. High content Pb may cause metallic poisoning and result in possible human carcinogenic (Bakare-Odunola, 2005). High Pb concentration may also result in birth defects, mental retardation, autism, psychosis, abdominal pain, head ache, irritability, fatigue, anemia and paralysis. It is carcinogenic as well as poisonous, affecting the principal nervous system, the liver, kidneys, skin, bones and teeth (Hogan, 2010).

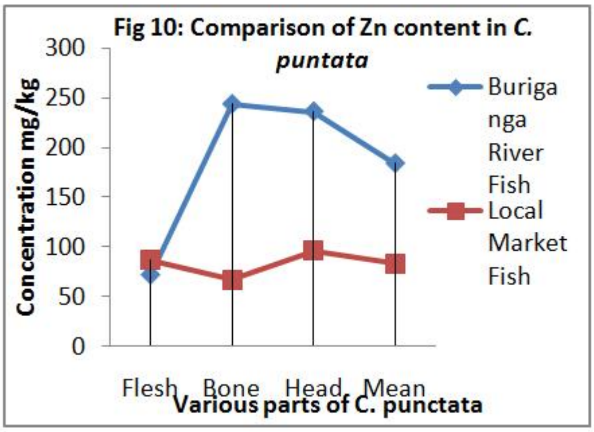


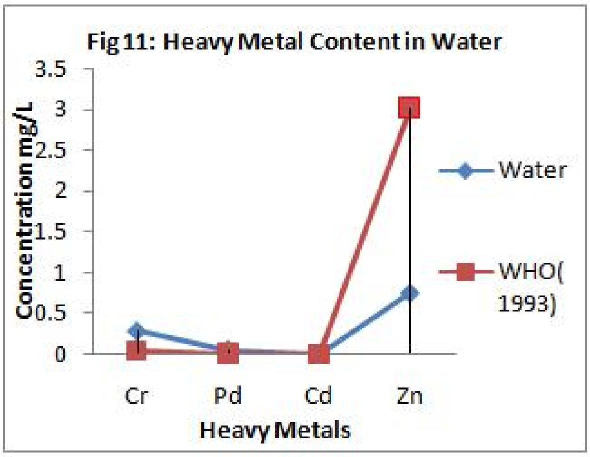


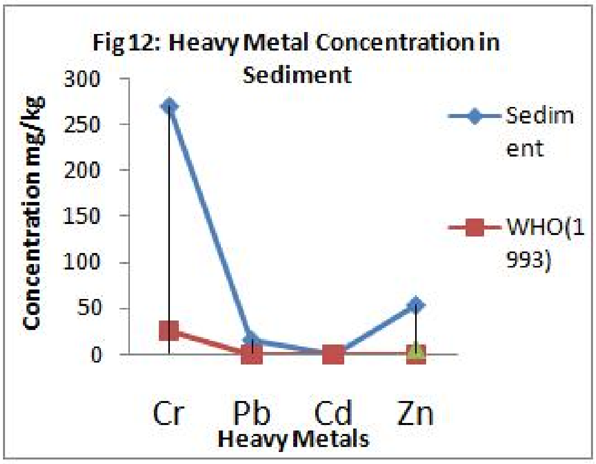
The effects of lead are most severe in children, and at high concentrations, Pb toxicity can cause death (Bari, 2015). Figure 7 and figure 8 show the comparison of Cd content in *Heteropneustes fossilis* and *Channa punctata* respectively of Buriganga River and Local Market. The level of Cd content in *H. fossilis* fish of Buriganga was 1.4 mg/kg in flesh, 2.5 mg/kg in bone and 2.2 in head while the concentration was 2.75 mg/kg in flesh, 1.35 mg/kg in bone and 0.05 mg/kg in the head of *H.fossilis* collected from Local Market. On the other hand in *C. punctata of Buriganga* Cd content was found 0.4 mg/kg in flesh, 0.5 mg/kg in bone and 1.25 mg/kg in head while it was 0.5 mg/kg in flesh, 1.05 mg/kg in bone and 2.9 mg/kg in the head of *C. punctata fish from* Local Market. In sediment and water the contamination level of Cd was 0.43 mg/kg and 0.002 mg/L respectively as represented in figure 11 and 12. In case of *Heteropneustes fossilis* of Buriganga, Cd content in Bone and Head was higher than that of Local Market but in the Flesh result was opposite. On the other hand when *Channa punctate* was considered, Cd content in Flesh, Bone and Head of Local Market fishes was higher than that of Buriganga River. In this case it followed the order Head> Bone> Flesh. But in *Heteropneustes fossilis* no such order was followed. Cd content was found most abundant (2.9 mg/kg) in the Head of *C. punctate* of Local Market and least abundant (0.05 mg/kg) in the Head of *H. fossilis* of same source.



Mean values of Cd in both species of fishes of both sources are higher than the WHO approved maximum limit (0.5 mg/kg) (Joint, 1993). The limit also exceeded in Water and Sediment of Buriganga River that was 0.003 mg/L for Water and 0.006 mg/kg for sediment (Joint, 1993). High concentration of Cd in Buriganga River may be attributed to untreated tannery effluents discharged in it which contains not only Cr but also considerable amount of Cd along with other heavy metals (Imamul, 1998).







Excessive Cd content may also be due to industrial activity, atmospheric emission and deposition organic and fine grain sediments, leachates from defused Ni-Cd batteries and Cd plate items (Mohiuddin, 2011). Cd is a toxic element which has no significant biological functions and shows its carcinogenic effects on aquatic biota and humans even at low exposures (Toxicological Profile for Lead, 1999). Cd poisoning responsible for anaemia, renal damage, bone disorder as well as cancer of the lungs (Ademoroti, 1996). Again Figure 9 and figure 10 show the comparison of Zn content in *Heteropneustes fossilis* and *Channa punctata* respectively of Buriganga River and Local Market. The bioaccumulation of Zn in *H. fossilis* of Buriganga was 29.7 mg/kg in flesh, 184.0 mg/kg in bone and 338.5 in head while it was 180.5 mg/kg in flesh, 135.5 mg/kg in bone and 49.35 mg/kg in the head of *H.fossilis* from Local market.

Table 5. Health Risk Index of Heavy Metals via intake of Fish from Buriganga

Species	Heavy Metals	Mean concentration (mg/kg)	DIM (mg/kg^{-1} day^{-1})	HRI
Heteropneustes fossilis	Cr	164.73	5.41x10^{-2}	36.08
	Pd	11.05	3.6x10^{-3}	1.03
	Cd	2.03	6.67x10^{-4}	0.667
	Zn	184.06	6.05x10^{-2}	0.20
Channa punctata	Cr	49.36	1.62x10^{-2}	10.81
	Pb	18.16	5.97x10^{-3}	1.70
	Cd	0.717	2.36x10^{-4}	0.236
	Zn	184.46	6.06x10^{-2}	0.202

On the other hand in *C. punctata* of Buriganga Zn content was found 72.9 mg/kg in flesh, 244 mg/kg in bone and 236.5 mg/kg in head while the concentration was 87.0 mg/kg in flesh, 67.0 mg/kg in bone and 96.45 mg/kg in the head of *C. punctata of* Local Market.

In water and sediment accumulation level was 0.757 mg/L and 54 mg/kg respectively as shown in figure 11 and 12.In both *Heteropneustesfossilis* and *Channa punctata* species, in case of Bone and Head Zn content was higher in the Buriganga River fish than that of Local Market. But the result was opposite for Flesh. In *H.fossilis* of Buriganga River the order was Head>Bone> Flesh. But in *H.fossilis of* Local Market the order was exactly opposite Flesh>Bone> Head. Zn content was most abundant (338.5 mg/g) in the Head of Buriganga River *H. fossilis* it is least abundant (29.7 mg/kg) in the Flesh of the same fish. The mean value of Zn in all Fish, Water and Sediments were much higher than the WHO/FAO approved maximum limit that is 30 mg/kg (FAO, 1983) for Fish, 3.00 mg/L for Water and 0.0123 mg/kg for sediment (Joint, 1993). Higher Zinc content in this study could be associated with human activities and vehicle movement such as the use of chemicals and Zinc-based fertilizers by farmers and spent engine oil wastes and petrochemicals from the nearby welder and automobile mechanic workshops (Edward, 2013). Domestic construction and car associated source as well as untreated waste water are also the key sources of Zn (Sörme, 2002). Zinc is an essential trace metal for both plants and animals. Its deficiency may be responsible for retarded growth, loss of taste and hypogonadism, leading to decreased fertility (56). It is necessary for embryo development and is important to reproductive organs (Carpene, 1994). Figure 11 shows heavy metal contents in Buriganga river water and their corresponding maximum permissible limit approved by WHO (1993). Figure 12 shows heavy metal contents in Buriganga river sediments and their corresponding maximum permissible limit approved by WHO (1993).

Risk assessment

In Table 5, Daily Intake of Metals and Health Risk Index were calculated to assess the Health risk associated with heavy metals (Cr, Pb, Cd, and Zn). Health Risk Index for Cr and Pb was found greater than 1 which indicates that they can pose serious negative impact on human health who consumes those fishes as both Cr and Pd are toxic and carcinogenic. Specially it more critical for Cr in this study as HRI value is very greater than 1. On the other hand, HRI value for Cd and Zn was found lower than 1 and hence it can be considered acceptable and it is may be due to taking lower amounts in diet, which ultimately decrease the HRI value.

Conclusion

Heavy metal contamination has become a great concern all around the world. The matter is also same for a developing country like Bangladesh especially it is more critical for the river Buriganga which is encircled by Dhaka city. It has been the disposal point for wastes of various kinds of industries located along its bank. It has also been the dumping point of municipal wastes for a long. Amongst the industrial wastes, untreated tannery effluents and sludge from nearby tannery industries of Hazaribag is the main culprit for the destruction of aquatic ecosystem and water quality of the Buriganga River. Heavy metals from these untreated wastes get mixed with water and sink in sediments and eventually bio accumulated in aquatic life like fishes. Ultimately these highly toxic metals get passed into human body through food chain and cause a severe threat to human health. So, necessary steps should be taken in this regard unless it is too late.

REFERENCES

Ademoroti, C. 1996. Standard methods for water and effluents analysis. Ibadan: Foludex Press Ltd, 1996. 178: p. 182.

Adeniyi, A. and K. Yusuf, 2007. Determination of heavy metals in fish tissues, water and bottom sediments from Epe and Badagry Lagoons, Lagos, Nigeria. Environ. Monitor. Assess. 37: p. 451-458.

Agency for Toxic Substances and Disease Registry. Environmental Health and medicine Education. Chromium Toxicity: What Are the Physiologic Effects of Chromium Exposure, 2013 Dec (cited 2015 Oct 16).

Ahmed, M.K. *et al.* 2009. Heavy metals concentration in water, sediments and their bioaccumulations in some freshwater fishes and mussel in Dhaleshwari river, Bangladesh. *Terres. Aquat. Environ. Toxicol.*, 2009. 3(1): p. 33-41.

Akan, J. *et al*. 2009. Impact of tannery and textile effluent on the chemical characteristics of Challawa River, Kano State, Nigeria. *Australian Journal of Basic and Applied Sciences*, 3(3): p. 1933-1947.

Asuquo, F.E. *et al*. 2004. Fish species used as biomarker for heavy metal and hydrocarbon contamination for Cross River, Nigeria. Environmentalist, 2004. 24(1): p. 29-37.

ATSDR (Toxicological Profile for Lead) (1999). US Department of Health and Human Services, Public Health Services 205-93-0606.

Azom, M. *et al*. 2012. Environmental impact assessment of tanneries: a case study of Hazaribag in Bangladesh. *International Journal of Environmental Science and Development*, 3 (2): p. 152.

Babatunde, A. *et al*. 2008. Constructed wetlands for environmental pollution control: a review of developments, research and practice in Ireland. *Environment International*, 34(1): p. 116-126.

Bakare-Odunola, M.2005. Determination of some metallic impurities present in soft drinks marketed in Nigeria. *The Nigerian Journal of Pharmaceutical Research*, 4(1): p. 51-54.

Bari, M.L., *et al*., Potential Human Health Risks of Tannery Waste-contaminated Poultry Feed. *Journal of Health and Pollution*, 2015. 5(9): p. 68-77.

Bhuiyan, M.A.H. *et al*. 2011. Investigation of the possible sources of heavy metal contamination in lagoon and canal water in the tannery industrial area in Dhaka, *Bangladesh.*

Environmental monitoring and assessment. 175(1-4): p. 633-649.

Blacksmith Institute's World´s Worst Pollution Problems Report 2010, Top Six Toxic Threats: Six pollutants that jeopardize the health of tens of millions of people, p. 39

Camusso, M., L. Vigano, and R. Balestrini, Bioconcentration of trace metals in rainbow trout: a field study. *Ecotoxicology and Environmental Safety*, 1995. 31(2): p. 133-141.

Canli, M. and Atli, G. 2003.The relationships between heavy metal (Cd, Cr, Cu, Fe, Pb, Zn) levels and the size of six Mediterranean fish species. *Environmental pollution*. 121(1): p. 129-136.

Carpene, E., *et al*.1994. Trace elements (Zn, Cu, Cd) in fish from rearing ponds of Emilia-Romagna region (Italy). Science of the total environment, 141(1): p. 139-146.

Censi, P. *et al*.2006. Heavy metals in coastal water systems. A case study from the northwestern Gulf of Thailand. Chemosphere,. 64(7): p. 1167-1176.

Chari, K. and S. Abbasi, A study on the fish fauna of Oussudu–a rare freshwater lake of South India. *International journal of environmental studies*, 2005. 62(2): p. 137-145.

Cross, F.A., T.W. Duke, and J.N. Willis, 1970. Biogeochemistry of trace elements in a coastal plain estuary: distribution of manganese, iron, and zinc in sediments, water, and polychaetous worms. *Chesapeake Science*, 11(4): p. 221-234.

Demirak, A., *et al*. 2006. Heavy metals in water, sediment and tissues of Leuciscus cephalus from a stream in southwestern Turkey. Chemosphere, 63(9): p. 1451-1458.

Dixit, S. and S. Tiwari, 2007. Impact assessment of heavy metal pollution of Shahpura Lake, Bhopal, India. 2(1): p. 37-42.

Ebrahimpour, M. and Mushrifah, I. 2010. Seasonal variation of cadmium, copper, and lead concentrations in fish from a freshwater lake. *Biological trace element research*, 138(1-3): p. 190-201.

Edward, J. *et al*. 2013. Determination of heavy metal concentration in fish samples, sediment and water from Odo-Ayo River in Ado-Ekiti, Ekiti-State, Nigeria. *International Journal of Environmental Monitoring and Analysis*, 2013. 1(1): p. 27-33.

Environmental Concerns regarding Hazaribagh Tannery area and Present Relocation Scenario (2011).

Gerberding, J.L. 2005. Toxicological profile for zinc. Atlanta Georgia., p. 22-23.

Hogan, C. 2010. Heavy metal. Encyclopedia of Earth. National Council for Science and the Environment. Eds E. Monosson & C. Cleveland, Washington DC.

HumanRightsWatch_Taneries_Bangladesh2012.

Imamul, S. 1998. Critical Environmental Issues Relating to Tanning Industries in Bangladesh In: Naidu *et al*.(eds), Towards Better Management of Soils Contaminated with Tannery Waste. in Proceedings of a Workshop Held at the Tamil Nadu Agricultural University, Coimbatore, India, 31st January to 4th February.

Islam, M.M. *et al*. 2014. Biochemical Characteristics and Accumulation of Heavy Metals in Fishes, Water and Sediments of the River Buriganga and Shitalakhya of Bangladesh. *Journal of Asian Scientific Research*, 2014. 4(6): p. 270.

Joint, F., W.E.C.o.F. Additives, and W.H. Organization, Toxicological evaluation of certain food additives and contaminants. 1993.

Kebede, A. and Wondimu, T. 2004. Distribution of trace elements in muscle and organs of Tilapia, Oreochromis niloticus, from lakes Awassa and Ziway, Ethiopia. *Bulletin of the Chemical Society of Ethiopia*. 18(2).

Keswick, B., Sources of groundwater pollution. 1984 ; Ogbonna, J., *et al*. Chemical characteristics and fertilizing value of primary sludge from tannery effluent treatment plant. in 16th annual national conference of the Nigerian institute of science and technology at University of Ibadan. 1998.

Khan, S., *et al*. 2009. Health risk assessment of heavy metals for population via consumption of vegetables. *World Appl Sci J.*, 2009. 6(12): p. 1602-1606.

Lenntech. Heavy-metals, 2010.

Llopis, C.M. *et al*. 2006. Heavy metal content of agricultural soils in a Mediterranean semiarid area: the Segura River Valley (Alicante, Spain). *Spanish Journal of Agricultural Research*, 4(4): p. 363-372.

MacFarlane, G. and M. Burchett, 2000. Cellular distribution of copper, lead and zinc in the grey mangrove, Avicennia marina (Forsk.) Vierh. Aquatic botany, 68(1): p. 45-59.

Mandal, S. and A.T.A. Ahmed, Copper, Cadmium, Chromium and lead bioaccumulation in Stinging Catfish, Heteropneustes fossilis (Bloch) and freshwater mussel, Lamellidens corrianus Lia and to compare their concentration in sediments and water of Turag river. *Journal of the Asiatic Society of Bangladesh, Science*, 2014. 39(2): p. 231-238.

Martin, D. *et al*. 2006. Association of blood lead and tibia lead with blood pressure and hypertension in a community sample of older adults. *American Journal of Epidemiology*, 163(5): p. 467-478.

Mertz, W. 1981. The essential trace elements. Science. 213(4514): p. 1332-1338.

Mohiuddin, K. *et al*. 2011. Heavy metals contamination in water and sediments of an urban river in a developing country. *International Journal of Environmental Science & Technology*, 2011. 8(4): p. 723-736.

Mukai, H. *et al*. 1994. Lead isotope ratios of airborne particulate matter as tracers of long- range transport of air pollutants around Japan. Journal of Geophysical Research: Atmospheres, 1994. 99(D2): p. 3717-3726.

Namminga, H.E. 1976. Effects of high discharge and an oil refinery cleanup operation on heavy metals in water and sediments in Skeleton Creek. in Proceedings of the *Oklahoma Academy of Science*, 56: p. 133-138.

Ogbonna, J. *et al*. 1998. Chemical characteristics and fertilizing value of primary sludge from tannery effluent treatment plant. in 16th annual national conference of the *Nigerian institute of science and technology at University of Ibadan*.

Okunola, O., *et al*. 2011. Risk assessment of using coated mobile recharge cards in Nigeria. *Journal of environmental chemistry and ecotoxicology*, 3(4): p. 80-85.

Öztürk, M., *et al*. 2009. Determination of heavy metals in fish, water and sediments of Avsar Dam Lake in Turkey. *Journal of Environmental Health Science & Engineering*, 6(2): p. 73-80.

Papagiannis, I. *et al*. 2004. Copper and zinc in four freshwater fish species from Lake Pamvotis (Greece). Environment International, 30(3): p. 357-362.

Rasul, M.G., I. Faisal, and M.M.K. Khan, Environmental pollution generated from process industries in Bangladesh. *International journal of environment and pollution*, 2006. 28(1-2): p. 144-161.

Saranraj, P. and D. Sujitha, 2013. Microbial bioremediation of chromium in tannery effluent: A Review. *International Journal of Microbiological Research,* 4(3): p. 305-320.

Sivaperumal, P., T. Sankar, and P.V. Nair, 2007. Heavy metal concentrations in fish, shellfish and fish products from internal markets of India vis-a-vis international standards. Food chemistry, 102(3): p. 612-620.

Sörme, L. and R. Lagerkvist, 2002. Sources of heavy metals in urban wastewater in Stockholm. Science of the Total Environment, 298 (1): p. 131-145.

Szentmihalyi, K. and Then, M. 2007. Examination of microelements in medicinal plants of the carpathian basin. Acta Alimentaria, 36(2): p. 231-236.

Tariq, S.R. *et al*. 2006. Multivariate analysis of trace metal levels in tannery effluents in relation to soil and water: A case study from Peshawar, *Pakistan. Journal of Environmental Management*, 79(1): p. 20-29.

Thompson, P. *et al*. 2002. Changing significance of inland fisheries for livelihoods and nutrition in Bangladesh. *Journal of crop production*, 6(1-2): p. 249-317.

Tüzen, M.2003. Determination of heavy metals in fish samples of the middle Black Sea (Turkey) by graphite furnace atomic absorption spectrometry. *Food chemistry*. 80(1): p. 119-123.

USEPA, 2009. United States Environmental Protection Agency, Risk-based concentration table. Philadelphia: United States Environmental Protection Agency, Washington, DC.

Waalkes, M.P. 2000. Cadmium carcinogenesis in review, *J. Inorganic Biochemistry*, 2000. 79(1-4): p. 241-4.

Yousafzai, A.M. *et al*.2010. Comparison of heavy metals burden in two freshwater fishes Wallago attu and Labeo dyocheilus with regard to their feeding habits in natural ecosystem. *Pak. J. Zool.,* 42(5): p. 537-544.

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