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# Status of heavy metal pollution of water and fishes in Balu and Brahmaputra rivers

**MM Rahman, MA Islam*, MB Khan**

Department of Environmental Science, Bangladesh Agricultural University,
Mymensingh 2202, Bangladesh

## Abstract

The study was conducted to investigate the surface water quality and concentration of heavy metals in water and fish of the Balu and Brahmaputra rivers near to Demra in Dhaka city and BAU campus in Mymensingh respectively. Water samples were collected in distinct three sampling sites which were denoted as Station 1, Station 2 and Station 3. In Balu and Brahmaputra river, analysis of physicochemical parameters like temperature, transparency, pH, electrical conductivity (EC), total dissolved solid (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD) and alkalinity and the concentration of heavy metals (Pb, Cr, Cd, Cu, Ni, Zn) both water and three fish (*Mastacembelus armatus, Channa punctatus* and *Mystus vittatus*) species were analyzed. The comparative study reported that some physicochemical parameters like TDS (704±8.54 mg/l); EC (1043±39.15 mg/l), BOD (22±3 mg/l), and alkalinity (311±6.56 mg/l) of Balu river water were found much higher than Brahmaputra river where as transparency (10±0.25 cm), and DO (1.7±0.36 mg/l) lower than Brahmaputra river water. Temperature and $P^H$ were close to standard. The comparative study also revealed that the concentrations of heavy metals like Pb (0.032±0.003 mg/l), Cr (0.02±0.003 mg/l), Cd (0.02±0.005 mg/l), Ni (0.04±0.004 mg/l), Zn (0.08±0.005 mg/l) and Cu (0.01±0.002 mg/l) of Balu river water were higher than Brahmaputra River. In *M. armatus, C. punctatus* and *M. vittatus,* the concentration of heavy metals like Pb (0.85, 0.92 and 0.89 mg/kg), Cd (0.45, 0.48 and 0.51 mg/kg), Cr (0.72, 0.76 and 0.51 mg/kg), Cu (0.39, 0.38 and 0.35 mg/kg), Ni (0.95, 0.86 and 0.81 mg/kg) and Zn (1.17, 1.21 and 1.25 mg/kg) were noted in Balu river which were much higher than those of Brahmaputra river. Bioaccumulation of heavy metals in fish can increase with the increase of heavy metals in water if pollutants discharge simultaneously. The results suggested that the water in the Balu river was polluted and not suitable for human consumption and aquaculture. On the other hand water in the Brahmaputra river was usable for aquaculture and irrigation but gradually degrade its quality by growing industries and untreated waste from municipalities.

**Key words:** Heavy metals, *Mastacembelus armatus*, *Channa punctatus, Mystus vittatus* .

 ***Corresponding Author:** maislam@bau.edu.bd

## 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. 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 (JICA, 1999). 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 responsibility of pollutants, especially in the developing worlds. Water pollution caused by chemical substances such as heavy metals effects river ecology (Shikder *et al*., 2012).

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 (Tilzer and Khondker, 1993). 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 aquatic ecosystem from different natural and anthropogenic sources, including industrial or domestic sewage, storm runoff, leaching from landfills/dumpsites and atmospheric deposits. Metals like iron and manganese are required for metabolic activities in organisms, but some other elements like chromium, copper, mercury, nickel, lead and 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 (Kumar *et al*., 2011).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 bio-magnification in the food chain (Eisler, 1988). Keeping these points in mind the study was conducted to assess the physicochemical parameters of water of the Balu river and Brahmaputra river and to identify and quantify the presence of heavy metals accumulation in water and fishes.

## Materials and Methods

***Site selection*:** The study was conducted at Balu River and Brahmaputra River of Dhaka and Mymensingh district respectively. In case of Balu River study area was conducted near the Demra and in case of Brahmaputra River study area was conducted near the BAU Campus in Mymensingh Municipal area. Each study area divided into three sampling location and they were denoted as Station 1, Station 2, Station 3respectively. The sampling stations of Balu river: Demra (Station 1): located at latitude 23°43'57.92"N and longitude 90°29'46.37"E; Poschimgoan (Station 2): located at latitude 23°44'38.76"N and longitude 90°29'34.17"E; Dokkhin Para (Station 3): located at latitude 23°45'21.39"N and longitude 90°29'16.36"E. The sampling stations of Brahmaputra river: BAU (Station 1): located at latitude 24°43'41.84"N and longitude 90°26'19.86"E; Somvugonj (Station 2): located at latitude 24°44'51.08"N and longitude 90˚25' 41.29" E; Town Hall (Station 3): located at latitude 24°45'57.75"N and longitude 90°24'26.10"E.

***Sample collection*:** Water samples were collected from the three stations (total 6 samples with 3 replications) of the Balu River and Brahmaputra River. Samples were collected in 250 ml plastic bottles at a distance of about 500 meters from each other. 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. 500 ml of water sample from each sampling point. Samples contained 5ml 1M Nitric acid solution for the analysis of heavy metals. $HNO_3$ solution was used to protect water samples from any fungal and other pathogenic attack. After collection the samples were sealed immediately to avoid exposure to air. To provide necessary information for each sample such as date of collection, location, time, etc. were recorded in the note book and each sample collected in a bottle was labeled separately with a unique identification number and then samples were placed in ice box. The water samples were then carefully carried

to the laboratory of Environmental Science, BAU, Mymensingh. In the laboratory the water samples were filtered using fine filter paper. In the laboratory, the bottles were kept in a clean, cool and dry place. The samples for the analysis of heavy metals were carefully transported to the Laboratory of Soil Science Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, Bangladesh. In this study three fish species were (*Mastacembelus armatus*, *Channa punctatus* and *Mystus vittatus*) collected from the Balu River and Brahmaputra River. The fish species was collected directly from fisherman. The samples were brought to the laboratory with ice box. Fish samples were kept in freeze for preservation until further analysis.

***Analysis of heavy metals in water sample*:** At first 100ml water sample was taken in a beaker and then 4 ml $HNO_3$ was added. After mixing, the solution was kept into hot plate for evaporation until the volume become 50ml. Then the 50 ml volume sample was kept in 100ml volumetric flask and it was made 100ml volume by adding distilled water. Then this concentrated sample was filtered and standard solution made for analyzing heavy metals (Pb, Cr, Cd, Cu, Ni and Zn) with the help of Atomic Absorption Spectrophotometer (AAS).

***Heavy metal analysis in fish sample*:** Before analysis fish samples were cleaned. Then a small portion of fish muscle was collected and weighted and dried. In drying procedure portion of muscle was kept in $100^0$C oven overnight or in microwave oven. When dry, heat on hot plate until smoking ceases, and then placed dish in $525^0$Cfurnace for minimum time necessary to obtain ash that was white and free from Carbon, normally 3-5h, but ≤8h. Remove dish from furnace and let cool. Ash should be white and free Carbon. But ash may be contained with Carbon particles. To remove Carbon particles ash from sample was wetted with water and added with 0.5-3 ml $HNO_3$. Then dried on hot plate and returned dish to $525^0$C furnace 1-2h (Sultana *et al.,* 2014). The sample was digested in open beakers on a hot plate. 10g of weighted sample was kept on in an open beaker and 10ml of freshly prepared nitric acid was added the beaker was covered with a watch glass till initial reaction subsided in about 1 hour. The beaker was placed on a hot plate and temperature gradually allowed to rise $160^0$C and the content boiled gently for about 2 hours to reduce the volume to between 2-5ml. The digest was allowed to cool and transferred to 50 ml volumetric flasks and made up to mark with water. The water used was distilled or deionized. The digested fish sample was kept in plastic bottles and preserved for laboratory analysis. Digested samples were analyzed by atomic absorption spectrophotometer (Model- PG-990, Made in England) method described by Association of Official Analytical Chemist (AOAC), $18^{th}$ edition. Atomic Absorption Spectroscopy was used for determination of heavy metals. The standard solutions of elements were prepared before every analysis. Samples were diluted in three different concentrations to obtain calibration curve for quantitative analysis.

***Statistical analysis*:** The collected data were compiled and tabulated in proper form and were subjected to statistical analysis. The Microsoft Office Excel software was used to present and interpret the collected data. The results of the study were presented in charts and tabular forms.

## Results and Discussion

The observed temperature of three sampling points in Balu river were 27.5, 28, 27.7ºC respectively. From this study, minimum temperature was observed at station 1 and maximum temperature observed at station 2. On the other hand temperature values of three sampling points of Brahmaputra river were 25.5, 24.7, 25.5 ºC respectively. From this investigation, the lowest Temperature was observed at station 2 and the highest value observed at station 3. In case of river water temperature, the DoE standard for sustaining aquatic life is within 20 to 30°C both in dry and wet season (Bhaumic *et al.,* 2006). Temperatures of both the river water were within the standard level.

The investigated transparency level of three sampling points in Balu river was10, 9 and 11cm, respectively. From this study the lowest transparency value was observed at station 2 and the highest transparency value observed at station 3. On the other hand transparency level of three sampling points of Brahmaputra river were 32, 31, and 34 cm, respectively. From this study, the lowest transparency value was observed at station 2 and the highest value observed at station 3. According to WHO the standard value of transparency is 40 cm. Balu river water transparency is very lower than standard level. This occurs because of more suspended solids, effluent from industries found in Balu river which prohibit light penetration into the water and reduce the DO production and make the water hot which is not suitable for aquatic organisms. On the other hand Brahmaputra river water transparency was slightly below and within the standard level which is not so much harmful. The transparency of the fresh water is ranging from 35-45 cm is suitable for aquatic environment (Swingle, 1967).

**Table 1.** Different physicochemical parameters of water samples of both rivers

| **Parameter** | **Balu river** | | | | **Brahmaputra river** | | | |
|---|---|---|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | Mean± SD | $S_1$ | $S_2$ | $S_3$ | Mean± SD |
| Temperature | 27.50 | 28 | 27.7 | 27.73±0.25 | 25.50 | 24.70 | 25.70 | 25.23±0.46 |
| Transparency | 10 | 9 | 11 | 10±1 | 32 | 31 | 34 | 32.33±1.53 |
| PH | 7.17 | 7.35 | 7.10 | 7.21±0.13 | 7.6 | 7.45 | 7.65 | 7.57±0.10 |
| TDS | 715 | 722 | 705 | 714±8.54 | 205 | 217 | 220 | 214±7.94 |
| EC | 1012 | 1130 | 1087 | 1043±39.15 | 355 | 352 | 348 | 351.67±3.51 |
| DO | 2.10 | 1.60 | 1.40 | 1.7±0.36 | 3.50 | 3.70 | 3.20 | 3.47±0.25 |
| BOD | 18 | 21 | 24 | 21±3 | 4 | 3.6 | 4.2 | 3.9±0.31 |
| Alkalinity | 310 | 318 | 305 | 311.0±6.56 | 97 | 105 | 108 | 103.3±5.69 |

The observed pH values of three sampling points of Balu River were 7.17, 7.35 and 7.1 respectively. From this study the lowest pH value was observed at station 3 and the highest value observed at station 2. On the other hand pH values of three sampling points of Brahmaputra river were 7.6, 7.45, and 7.65 respectively. From this study, the lowest pH value was observed at station 2 and the highest value observed at station 3. The acceptable range of $p^H$ for irrigation water is 6.5-8.5 according to Bangladesh standards, FAO standards and Bangladesh EQS (1997) standard. In the study pH in all sampling sites of both Rivers were within the standard range.

The observed TDS level of three sampling points of Balu river were 715, 722, 705 mg/L respectively. From this study the lowest TDS value was observed at station 3 and the highest TDS value observed at station 2. On the other hand TDS values of three sampling points of Brahmaputra river were 205, 217, 220 mg/L respectively. From this study, the lowest TDS content was observed at station 1 and the highest value observed at station 3. The standard of TDS for Irrigation and fishing are 400 ppm. From the study it has been cleared that TDS concentration in Balu exceeds the acceptable level because of high level of wastes mixing with water. Brahmaputra River comparatively contains low concentration of TDS because of lower amount of wastes mixing but it increasing day by day in alarming rates.

The observed EC values of three sampling points of Balu river were 1012, 1030 and 1087 µS/cm, respectively. From this study the lowest EC value was observed at station 1 and the highest EC value observed at station 3. On the other hand EC values of three sampling points of Brahmaputra river were 355, 352 and348µS/cm, respectively. From this study, the

lowest EC value was observed at station 3 and the highest EC value observed at station 1. The standard value of EC is 750 µS/cm for irrigation purpose and 800 to 1000µS/cm for fishing (ADB, 1994). In present study the EC values of all points in Balu River exceed the standard level. The Balu river not only receives the waste water (Industrial effluent, household and sewage effluent) but also contains high ionic concentration, which is ultimately harmful for the aquatic life and responsible for high EC value. On the other hand EC values of the Brahmaputra river water are lower than standard level. It happens because of water of the Brahmaputra river is moving and contain less amount of ionic concentration.

The observed DO values of three sampling points of Balu river were 2.1, 1.60 and 1.40 mg/L, respectively. From this study the lowest DO value was observed at station 3 and the highest DO value observed at station 1. On the other hand DO values of three sampling points of Brahmaputra river were 3.50, 3.70 and 3.20 mg/L, respectively. From this study, the lowest DO value was observed at station 3 and the highest DO value observed at station 2 of the Brahmaputra river. The optimum DO in a water body is 4-6 mg/L for drinking and 5 mg/L for aquaculture. But the DO level of water in the present study in Balu River was very low.This reduction in value may be due to high discharge of organic material, e.g. from sewage treatment works, storm overflows, agricultural slurry, silage liquor. Such low value do not supports the survival of aquatic life. It indicates the water quality is not suitable for aquaculture or any other aquatic organisms. On the other hand DO of the Brahmaputra river water was also under the standard level but higher than Balu river water. Lower value occurred in Brahmaputra river water mainly due to discharge of municipal sewage, besides this hospital wastes, industrial effluents and agricultural activities also responsible for lower DO values in the Brahmaputra river water.

The observed BOD values showing of three sampling points of Balu river were 18, 21 and 24mg/L, respectively. From this study the lowest BOD value was observed at station 2 and the highest BOD value observed at station 3. On the other hand BOD values of three sampling points of Brahmaputra river were 4, 3.6 and 4.2 mg/L. From this study, the lowest BOD value was observed at station 2 and the highest BOD value observed at station 3.According to the EQS (1997), the tolerable limit of BOD is 0.2 mg/l for drinking, 3 mg/l for recreation, 6 mg/l for fish and 10 mg/l for irrigation. In this study higher BOD values found in all sampling point in Balu River. These values exceed all standard level because of discharge of huge load of untreated toxic liquid chemical waste, agricultural runoff and solid waste dumping in the study area.It also indicate the presence of comparatively high organic waste in the river water. When BOD levels are high, dissolved oxygen (DO) levels decrease because the oxygen that is available in the water is being consumed by the bacteria (Sawyer *et al.,* 2003).On the other hand BOD values of all sampling points in Brahmaputra River near the standard level and suitable for fish culture.

The observed alkalinity values of three sampling points of Balu river were 310, 318, and 305 mg/L respectively. From this study the lowest alkalinity value was observed at station 3 and the highest alkalinity value observed at station 2. On the other hand alkalinity values of three sampling points of Brahmaputra river were 97, 105, and 108 mg/L. From this study, the lowest alkalinity value was observed at station 1 and the highest alkalinity value observed at station 3.According to WHO (1993) acceptable level of river alkalinity is 100 mg/L. The suitable value of alkalinity for aquaculture ranges from 50 to 300 mg/L (James, 2000). The alkalinity of Balu river water in all sampling point exceeded the standard level in terms of aquaculture. On the other hand alkalinity of the Brahmaputra river water was within the standard level.

**Table 2.** Measurement of heavy metal concentrations of river water

| Parameter | Balu river (mg/L) | | | | Brahmaputra river(mg/L) | | | |
|---|---|---|---|---|---|---|---|---|
| | $S_1$ | $S_2$ | $S_3$ | Mean± SD | $S_1$ | $S_2$ | $S_3$ | Mean± SD |
| Pb | 0.029 | 0.031 | 0.035 | 0.032±0.003 | 0.019 | 0.024 | 0.017 | 0.02±0.004 |
| Cr | 0.015 | 0.017 | 0.021 | 0.02±0.003 | 0.010 | 0.012 | 0.009 | 0.01±0.002 |
| Cd | 0.015 | 0.021 | 0.025 | 0.020±0.005 | 0.008 | 0.012 | 0.011 | 0.01±0.002 |
| Ni | 0.040 | 0.045 | 0.047 | 0.04±0.004 | 0.034 | 0.036 | 0.032 | 0.034±0.002 |
| Zn | 0.075 | 0.081 | 0.085 | 0.08±0.005 | 0.018 | 0.023 | 0.032 | 0.02±0.007 |
| Cu | 0.010 | 0.008 | 0.011 | 0.010±0.002 | 0 | 0 | 0 | 0±0 |

The observed lead values of three sampling points of Balu river were 0.029, 0.031, 0.035 mg/L, respectively. From this study the lowest lead value was observed at station 1 and highest concentration observed at station 3. On the other hand lead values of three sampling points of Brahmaputra River were 0.019, 0.024, 0.017 mg/L, respectively. From this study, the lowest lead value was observed at station 3 and the highest lead value observed at station 2. According to WHO (1993), the standard value of lead is 0.02 ppm. At present study, value of lead of both rivers exceeds standard level. It happened because of high amount discharge of industrial effluents into the river. Balu river is one of the major river around the Dhaka city. Many industrial wastes and municipal wastes discharge into this river and its peripheral rivers which is the major source of lead. On the other hand study area of the Brahmaputra river besides the Mymensingh city, where hospital and municipal wastes discharge into this river.

In the investigation, chromium (Cr) concentration in water of Balu river were 0.015, 0.017, 0.021 mg/L in three sampling stations respectively. From this study the lowest chromium concentration was observed at station 1 and the highest Chromium concentration observed at station 3. On the other hand chromium concentration of three sampling points of Brahmaputra river were 0.01, 0.012, 0.009 mg/L respectively. From this study, the lowest Chromium concentration was observed at station 3 and the highest concentration observed at station 2.

In the present investigation, cadmium concentrations of three sampling points of Balu river were 0.015, 0.021, 0.025mg/L respectively. From this study the lowest cadmium value was observed at station 1 and the highest cadmium value observed at station 3. On the other hand cadmium values of three sampling points of Brahmaputra river were 0.008, 0.012, 0.011 mg/L respectively. From this study, the lowest cadmium value was observed at station 1 and the highest cadmium value observed at station 2. Standard value of cadmium is 0.003 mg/L for drinking and <1mg/l for aquaculture. Present findings in both river exceeds the standard value in case of drinking but within acceptable for aquaculture.

The observed nickel values of three sampling points of Balu river were 0.040, 0.045, 0.047 mg/L respectively. From this study the lowest nickel value was observed at station 1 and the highest nickel value observed at station 3. On the other hand nickel values of three sampling points of Brahmaputra river were 0.034, 0.036, 0.032mg/L. From this study, the lowest nickel value was observed at station 3 and the highest nickel value observed at station 2. According to WHO (1993) standard value of nickel is 0.02 for drinking and <0.02 for aquaculture. Present study shows that both river water nickel concentrations exceed the standard level.

The observed zinc concentrations of three sampling points of Balu river were 0.075, 0.081, 0.085mg/L respectively. From this study the lowest zinc value was observed at station 1 and the highest zinc value

observed at station 3. On the other hand zinc values of three sampling points of Brahmaputra river were 0.018, 0.023, 0.032mg/L respectively. From this study, the lowest zinc concentration was observed at station 1 and the highest Concentrations observed at station 3.According to WHO (1993), Standard value of zinc in water is 3 mg/ L. Present findings of both rivers are within the standard level.

In the present study, copper (Cu) concentrations in three sampling stations of water in Balu river were 0.01, 0.008 and 0.011 mg/L, respectively. From this study the lowest copper concentration was observed at station 2 and the highest concentration observed at station 1.On the other hand copper concentration of Brahmaputra River was nil. According to WHO (1993), standard value of copper is 0.1. Present findings are lower than standard.

From this study, lead concentration of Taki, Baim and Tengra fish in Balu river were 0.92, 0.85, 0.89 mg/kg. From this study the lowest lead value found in Baim fish and the highest lead value found in Taki fish. On the other hand lead values of Taki, Baim and Tengra fish in Brahmaputra river were 0.25, 0.22and 0.27 mg/kg. Here the lowest lead concentration found in Baim fish and highest lead value found in Tengra fish. Standard value of lead in fish is 0.3 mg/kg (WHO, 1993). From this study lead value are much higher than standard level. Which indicate high concentration of lead in water and accumulated in fish through bioaccumulation.

**Table 3.** Heavy metal concentration of fish species collect from Balu river and Brahmaputra river.

| Fish Species | Parameter | Balu river Average value (mg/kg) | Brahmaputra river Average value (mg/kg) |
|---|---|---|---|
| Baim (*Mastacembelusarmatus*) | Lead (Pb) | 0.85 | 0.22 |
| | Cadmium (Cd) | 0.45 | 0.17 |
| | Chromium (Cr) | 0.72 | 0.19 |
| | Copper (Cu) | 0.39 | 0 |
| | Nickel (Ni) | 0.95 | 0.31 |
| | Zinc (Zn) | 1.17 | 0.49 |
| Taki (*Channapunctatus*) | Lead (Pb) | 0.92 | 0.25 |
| | Cadmium (Cd) | 0.48 | 0.21 |
| | Chromium (Cr) | 0.76 | 0.17 |
| | Copper (Cu) | 0.38 | 0 |
| | Nickel (Ni) | 0.86 | 0.25 |
| | Zinc (Zn) | 1.21 | 0.58 |
| Tengra (*Mystusvittatus*) | Lead (Pb) | 0.89 | 0.27 |
| | Cadmium (Cd) | 0.51 | 0.23 |
| | Chromium (Cr) | 0.75 | 0.22 |
| | Copper (Cu) | 0.35 | 0 |
| | Nickel (Ni) | 0.81 | 0.29 |
| | Zinc (Zn) | 1.25 | 0.48 |

The observed cadmium values of Taki, Baim and Tengra fish in Baluriver were 0.48, 0.45, and 0.51 mg/kg. From this study the lowest cadmium value found in Baim fish and the highest cadmium value found in Tengra fish. On the other hand cadmium values of Taki, Baim and Tengra fish in Brahmaputra river were 0.21, 0.17, and 0.23 mg/kg. Here the lowest cadmium value found in Baim fish and highest

cadmium value found in Tengra fish. These variations in concentrations are mainly due to feeding habits, chemical form of freshwater environment, and season of the year and detoxification process. Standard value of Cadmium in fish is 0.5 mg/kg (WHO, 1993). From this study cadmium value of two rivers does not exceeds the standard level but Balu river's cadmium in fishes were near the standard level which indicate the high concentration cadmium in the Balu river water.

The observed chromium values of Taki, Baim and Tengra fish in Balu river were 0.76, 0.72 and 0.75 mg/kg. From this study the lowest chromium value found in Baim fish and the highest value found in Taki fish. On the other hand chromium values of Taki, Baim and Tengra fish in Brahmaputra river were 0.17, 0.19 and 0.22 mg/kg. Here the lowest chromium value found in Taki fish and the highest chromium value found in Tengra fish. Standard value of chromium in fish is 1 mg/kg (WHO, 1993). In this study chromium value of two rivers were within the standard level.

The observed copper values of Taki, Baim and Tengra fish in Baluriver were 0.38, 0.39 and 0.35mg/kg. From this study the lowest copper value found in Taki fish and the highest copper value found in Baim fish. On the other hand copper values of Taki, Baim and Tengra fish in Brahmaputra river were Nil. Standard value of Cu is 10 mg/kg. Present findings in both rivers are much lower than standard.

In this present investigation, nickel values of Taki, Baim and Tengra fish in Balu river were 0.86, 0.95, 0.81 mg/kg. From this study the lowest nickel value found in Takifish and the highest nickel value found in Baim fish. On the other hand Nickel values of Taki, Baim and Tengra fish in Brahmaputra river were 0.25, 0.31 and 0.29 mg/kg. Here the lowest nickel value found in Taki fish and the highest value found in Baim fish. Standard value of Ni in fish is 10 mg/kg (WHO, 1993). Present findings in both river are lower than standard.

The observed zinc values of Taki, Baim and Tengra fish in Balu River were 1.21, 1.17 and 1.25mg/kg. From this study the lowest zinc value found in Baim fish and the highest concentration found in Tengra fish. On the other hand nickel values of Taki, Baim and Tengra fish in Brahmaputra river were 0.58, 0.49 and 0.48 mg/kg. Here the lowest zinc value found in Tengra fish and highest value found in Taki fish. Standard value of Zn in fish is 30 mg/kg (WHO, 1993). Present findings in both rivers are lower than standard.

## Conclusion

From the results of the present study, it is concluded that the water quality of the Balu river is unfavorable for all aquatic lives and human beings due to discharging untreated industrial effluents into the Balu river water without considering aquatic lives existing in the Balu river water bodies. On the other hand water quality of the Brahmaputra river is acceptable for aquaculture and irrigation but due continuous discharge of effluents it can be unfavorable for those purposes in near future. According to the findings the water quality of the Balu river and Brahmaputra river are not in acceptable form and heavy metal concentration in river water is increasing gradually and aquatic organisms like fishes are being contaminated. Proper management of water quality and fish species of the Balu river and Brahmaputra river is necessary for conserving their ecosystem.

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