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Physicochemical Properties of Water and Heavy Metals Concentration of Sediments, Feeds and Various Farmed Tilapia (*Oreochoromis niloticus*) In Bangladesh

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Abstract

Heavy metals to man through aquatic life occur with the consumption of affected fish which is detrimental to the human body, having toxic and carcinogenic effects. In Bangladesh, the practice of Tilapia (*Oreochromis niloticus*) culture has become popular due to its great demand to people. This study aimed at determining levels of Cd, Cr, Cu, Pb, Ni in feed used for tilapia culture (N=18), in sediment (N=9) and water (N=9) of three culture pond of three different farms of Noakhali region in Bangladesh. Heavy metal concentration was detected by Atomic absorption spectroscopy. The average metal concentration in fishes of farm 1, farm 2 and farm 3 following trend Pb>Cr>Cu>Ni>Cd, Pb>Ni>Cr>Cu>Cd, and Pb>Ni>Cu>Cr>Cd, respectively. The level of selected heavy metals was below detection limit in a water sample. The order of heavy metal concentration in feed samples of each farm was decreased in the similar sequence of Cu>Cr>Ni>Pb>Cd. Heavy metal concentrations in the sediment of farm 1 was decreased in the order of Cu>Ni>Pb>Cr>Cd but metal concentrations in the sediment of farm 2 and farm 3 were decreased in the similar manner of Ni>Cu>Cr>Pb>Cd. The results show evidence of bioaccumulation of heavy metals in the fish with alarming levels that are higher than IAEA-407 limits, therefore, posing a potential risk for the consumer.

Keywords Heavy metals concentration; Commercially farmed tilapia; Bioaccumulation; Toxicity; Bangladesh

Introduction

For economic development of Bangladesh by ensuring food security and increasing the growth of a number of sister industries aquaculture and fisheries sector is one of the major component of agricultural activities [1,2]. Fisheries and aquaculture sector contributing to the national economy 3.69% to the gross domestic product (GDP) and 23.12% to the agricultural GDP in Bangladesh [3]. The harvested culture fish production was fairly steady over the last ten years and increasing at an average of 5.38% per year which was shown in Table 1 and also in Figure 1 [2]. Very interestingly this agricultural sector was fairly consistent growth rate within 7.32% growth in 2009-2010 to 4.04% growth in 2013-2014 [4]. It is the second largest export next to ready-made garments near about 2.01% in Figure 2.

Species Name	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Rui (*Labeorohita*)	22.13	22.02	18.71	15.7	13.34	12.96
Catla (*Catlacatla*)	17.09	17.15	14.41	11.4	9.23	8.88
Mrigal (*Cirrhinuscirrhosus*)	12.99	12.45	9.46	9.86	8.76	9.12
Pangas (*Pangasiuspangasius*)	10.94	12.82	18.99	19.27	23.66	24.58
Tilapia (*Oreochromis niloticus*)	2.16	8.1	8.43	14.09	18.12	18.64
Silver Carp (*Hypophthalmichthysmolitrix*)	16.57	10.48	11.14	12.54	10.74	9.22
Grass Carp (*Ctenopharyngodonidella*)	2.35	1.72	1.19	2.41	2.24	1.69

Kalibaus (*Labeocalbasu*)	3.89	2.98	0.93	0.93	1.07	0.99

Table 1: Pond aquaculture production (MT) in Bangladesh between 2010 and 2015 [3].

For sustainable development goal (SDG) our target to become a reached middle income country by 2021.This is our present government vision and mission 2021. With this aim of this target and SDG indicator the fisheries sector play vital role for overall gross national economic development in Bangladesh. From the Bangladesh bureau of statistics (BBS) about 17.80 million peoples (11% of the total population) directly or indirectly depends on fisheries sector for their livelihood, among them significant portion means1.40 million were women (about 8.5 % of fisheries sector). Interestingly, however, despite the great effort Bangladesh has established a milestone in aquaculture sector development and in the year 2014, was ranked 5th in the world farmed fish production and in detailed scenario shown in Table 2 and also Figure 2 [5].

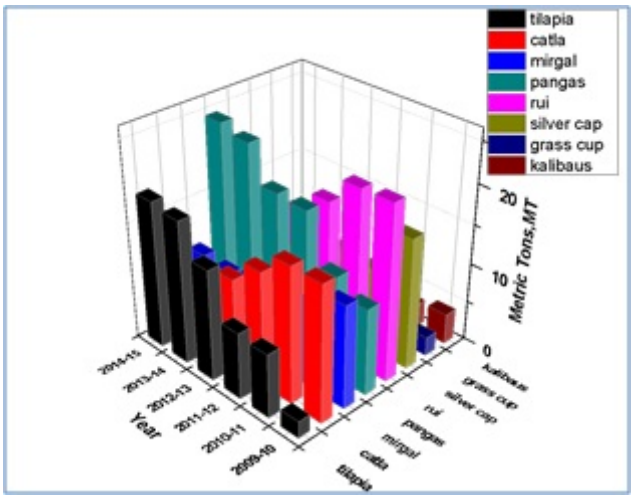

Figure 1: Pond aquaculture production (MT) in Bangladesh between 2010 and 2015 [3].

Sr. No	Country	Fishes
1	China	41108306
2	India	4209415
3	Vietnam	3085500
4	Indonesia	3067660
5	Bangladesh	1726066
6	Norway	1321119
7	Thailand	1233877
8	Chile	1071421
9	Egypt	1017738

Table 2: Country wise farmed fish production 2012.

Metabolite activities of all biological system metal and metal oxide are highly important and for contaminated water (pesticides, heavy metals, industrial effluents treatments) purification using various semiconducting metal oxide for photo decomposition of pollutants [6]. As trace elements, some heavy metals (e.g. copper, selenium, zinc) are essential to maintaining the metabolism of the human body [7]. Recently anthropogenic activities affect the natural geological and biological distribution of heavy metals through pollution of air, water, and soil and are also responsible for altering the chemical forms of heavy metals released into the soil and environments [8,9]. As we know 4chlorophenol (4-CP) and methylene blue (MB) that effects the target organs of human body like kidney and lunch [9]. Metal's toxicity by allowing it to bioaccumulation in plants and animals, bio-concentrate in the food chain through agricultural activities, or attack some specific organs of the human body [10].

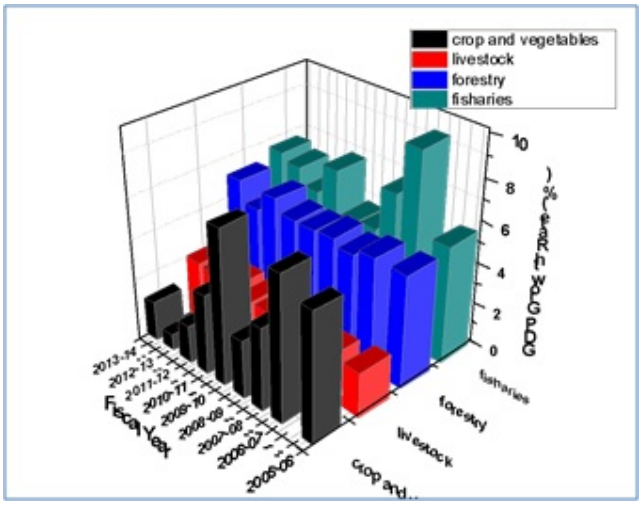

Figure 2: Contribution of various agricultural components in GDP growth rate of Bangladesh between 2010 and 2015 [3].

Optimum level of water quality such as dissolved oxygen, alkalinity, hardness and pH are also the prerequisite for fish production [11]. Like terrestrial animal's fish and other aquatic organisms also require oxygen for respiration. Dissolved Oxygen level plays a vital role in water quality in aquaculture [12]. To oxygenate the water nowadays is general in intensive aquaculture to increase biomass and production [13]. Fish stop eating when oxygen supply does not satisfy oxygen demand [14]. pH of water has an important role for enhancement of fish yield. Temperature determines the amount of dissolved gases (oxygen, carbon dioxide, nitrogen, etc.) in the water. The cooler the water the more soluble the dissolved oxygen. Turbidity limits light penetration and photosynthesis in the bottom layer. Higher turbidity can cause temperature and DO stratification.

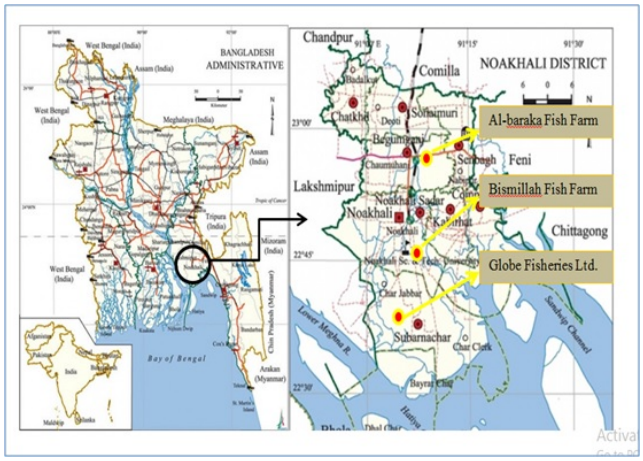

Figure 3: Location of the different investigated farms in the study area (red circle).

Current fish intake 53 g/person/day and desirable fish intake 60 g/person/day in Bangladesh, consumable 60% animal protein of our daily meal comes from fisheries sector. In Bangladesh fisheries resources composed of freshwater native species 260, exotic fishes 12 species, freshwater prawn 24 species, marine fish species 486 and marine shrimp 36 species [15,16]. Among the various farmed fish *Oreochoromis niloticus* is an extensively cultured because this species grow and reproduce very faster even in very harsh environmental conditions [17]. According to the statistical data in 200-2002, 8,221 MT of Nile tilapia production from ponds and closed system of Bangladesh which was only 1.52% of total culture fish production and the production rate has massively increased to 98,758 MT in the year 2010 which is 8.10% of total artificial fish production [2-6] and fairly increase to 136,000 metric tons in 2012 [18] and an average yearly production of some commonly culture fishes production demonstrate in Table 1.

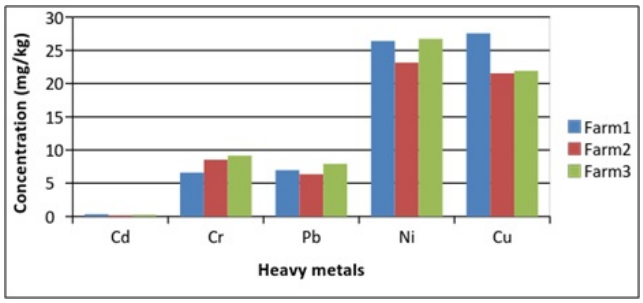

Figure 4: Comparison of heavy metals concentration in mg/kg of various farmed sediments.

Contamination of significant metals within the aquatic surroundings has attracted world attention thanks to its abundance, persistence and environmental toxicity and physiochemical properties of water. The increasing pollution by significant metals encompasses a vital adverse health effects for invertebrates, fish and humans. Farmed fishes additionally as aquacultures heavily think about developed feed and few of the business feed producers didn't converge with standards for the need of fish and also the supply of staple for the assembly of the feeds tends to be contaminated with significant metals et al [19,20]. The metal pollution of aquatic ecosystems is increasing thanks to the results of urbanization and manufacture [21]. Toxicant significant metals area unit unrelenting environmental contaminants as a result of they cannot be ravaged or destroyed [22] and comprise a major portion of the matter as these metals illustrious for his or her bioaccumulation and bio-magnification that cause numerous health hazards to human [23]. Generally, culture fish bio-accumulate chemicals additionally as significant metals directly from contaminated water by diffusion through gill and skin or they ingest with food [24]. In depth analysis was happening significant metal concentration in preferred culture fish in Bangladesh. Antecedent we have a tendency to according the metal concentration of most popular| farmed fishes in market however lacking of that report we might establish the precise supply of pollutants, whether or not it had been native culture or exported fishes from neighbouring country [25]. Continuation of our work this report we have a tendency to might establish the chemistry properties of farmed water, metal concentration in sediment, feed, numerous fishes and specific location wherever it had been culture. Food and Agriculture Organization (FAO) of the world organization state additionally because the World Health Organization (WHO) watching eight parts investigated in fish Copper (Cu), Zinc (Zn), Iron (Fe), Tin (Sn),Mercury (Hg), metallic element (Cd), Lead (Pb), Arsenic (As),) is necessary watching et al metals simply dissuasive and sets a standard [24-31].

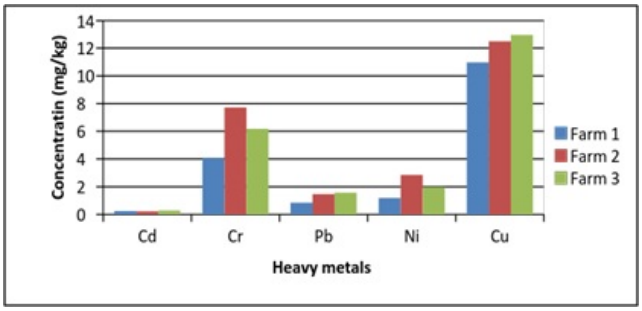

Figure 5: Graphical representation of heavy metals concentration in mg/kg of feed samples which are used for farmed feeds in Bangladesh.

So our current study aim to judge the physicochemical properties of water and presence of serious metals (Cd, Cr, Cu, Pb and Ni) in farmed fishes and pool surroundings reaching to measure this surroundings standing of board section in Bangladesh and metals' content in numerous tissues were compared against the counselled most permissible limit (MPL) planned by Food and Agriculture Organization and World Health Organization to assess the standard of fish for human consumption.

Materials and Methods

The study was conducted in Noakhali region from January 2016 to January 2017. It included three different farms of three different areas in the same district (Figure 3 and Table 3).

Studies samples were collected from August 23, 2015 to August 28, 2016 to determine the presence of heavy metal in fish, water, and sediment and feed sample and to examine the physicochemical

properties (temperature, dissolved oxygen (DO), pH, Turbidity) of water.

Sl. No	Name	Location
Farm 1	Bismillah Agro Farm and Fisheries	Subornochar, Sonapur, Noakhali.
Farm 2	Globe Fisheries Limited	Subornochar, Sonapur, Noakhali.
Farm 3	Al-Baraka Fish Farm	Hazipara,Begumgonj,Chowmuhani, Noakhali.

Table 3: Different cultured farms and its location were from the samples were collected for experimental studies of water quality parameters and respective heavy metals of sediments and fishes.

Fishes were collected by using cast net (plate 8) with the help of local farm worker. Immediately after collection, the fish samples were kept into the ice box and then kept in the laboratory deep freezer (-20°C) to prevent deterioration till further analysis. Water samples were collected with water sampler for the detection of water quality parameters. 250 ml water sample was collected from each pond and preserved in separate plastic bottles for further analysis.

The sediment samples were collected by vertical corer (0 cm-15 cm depth). The samples were brought to the laboratory and dried immediately at room temperature in a well- aerated room. After drying, the sample grinded and screened to pass throws a 2.00 mm sieve and kept into the plastic bags. Feed samples were collected from every farm and then kept into a plastic vial for analysis.

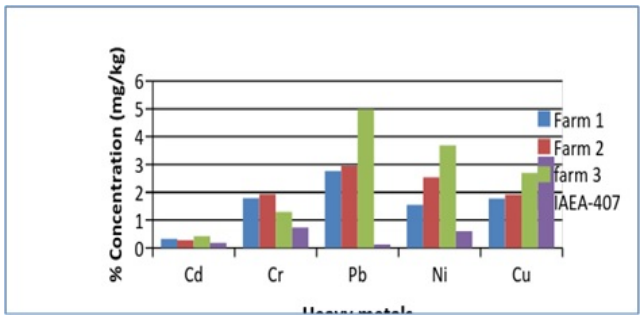

Figure 6: Concentration of metals in mg/kg for fish samples (*Oreochromis niloticus*) compared with international guideline (IAEA-407).

Fishes were kept into an oven at 70°C for 24 hours and grinned to a fine powder using the pastel; prepared samples were preserved in an individual vial for analysis of heavy metals.

For digestion 0.2 g-0.5 g of each dry sample was taken into a separate glass beaker and digested with a mixture of nitric acid $(HNO_3)^-$ per chloric acid $(HClO_4)$ at 3:1 ratio and temperature at 150°C for 3 h and then filter and finally marked with 50 ml volume with laboratory distilled water.

In this study, heavy metals were evaluated by using atomic absorption spectrophotometer (Shimadzu AA 7000, Japan) that was equipped with flame. For our experiment we select Air acetylene flame mode condition fastened like acetylene 1.8 L/min and air 15 L/min, argon gas flow for inert atmosphere and also the instrumental default temperature parameters were automatically fixed for each and every element analysis. For quantitative mensuration of every part with its linear working vary and its individual wavelength and applied math standardization graph of the correlation coefficient is listed in Table 4 and knowledge recorded of individual components in triplicate measurements [20]. Metal concentration calculation using this formula. The concentration of heavy metals=(Reading–blank reading) ×final volume of sample in ml/weight fish taken in gm. Statistical software namely SPSS (version 15) were used for statistical data analysis.

Element	Wavelength (nm)	Lamp intensity (mA)	Slit width (nm)
Cr	357.9	7	0.2
Cu	324.8	4	0.5
Pb	217.3	10	1
Cd	228.8	4	0.5
Ni	232	4	0.2

Table 4: Operating parameter (metals) for working element in AAS (Shimadzu, AA-7000).

Results and Discussions

Nowadays heavy metal pollution in the aquatic environment is a burning issue in Bangladesh. It is one of the most alarming reasons of human health risk and also for decreasing fisheries resources. Our research exclusively dealing with the outcomes of analysis of water quality parameters and the detection of different heavy metals in fish, feed and sediment. All data generated were analysed statistically by calculating the mean and standard deviation of the measured parameters.

Different water quality parameters like temperature, pH and turbidity, were analyzed by using a thermometer, pH meter and turbidity meter respectively. The results of these parameters collected from different ponds of a selected fish farm are presented in Table 5.The mean value of temperature was 29.67°C ± 1.15°C, 30.67°C ± 0.58°C and 29.67°C ± 0.58°C at Farm 1, Farm 2 and Farm 3 respectively. The values of temperature under three farms were ranged from 29°C-31°C.The average pH values were found 7.16 ± 0.05, 7.87 ± 0.25 and 7.17 ± 0.06 at farm 1, farm 2 and farm 3 respectively. The pH values of water from three sampling farms were found to fluctuate from 7.1 to 8.1. The highest value of pH was found 8.1 at the pond of Farm 2 namely Globe fisheries Ltd. The lowest value of pH was found 7.1 at one of the ponds of Farm 1 and Farm 2.The mean values of turbidity were 212.67 ppm ± 164.75 ppm, 147.67 ppm ± 53.12 ppm and 85.67 ppm ± 6.03 ppm at farm 1, farm 2 and farm 3 respectively.

The turbidity values of different ponds of three sampling farms were ranged from 80 ppm to 402 ppm. The highest value of turbidity was found 402 ppm at farm 1 namely Bismillah Agro Farm and Fisheries. The lowest value of turbidity was found 80 ppm at farm 3 namely Al-Baraka Fish Farm. The average dissolved oxygen (DO) concentrations were at about optimum range in all selected ponds of each farm. The mean DO concentration in farm 1 was 4.77 mg/L ± 0.31 mg/L. In farm 2 then mean DO concentration level was 4.87 mg/L ± 0.29 mg/L. In farm 3 the mean DO concentration was 4.66 mg/L ± 0.15 mg/L. The level of selected heavy metals was below detection limit (BDL) in a water sample.

		Temperature (°C)	pH	Turbidity (NTU)	Dissolve Oxygen (mg/L)
Farm1 (Bismillah Agro Farm and Fisheries)	Pond 1	29	7.2	102	4.5
	Pond 2	31	7.2	402	4.7
	Pond 3	29	7.1	134	5.1
	Mean ± SD	29.67 ± 1.15	7.16 ± 0.05	212.67 ± 164.75	4.77 ± 0.31
Farm 2	Pond 1	31	7.6	209	4.7
(Globe Fisheries Ltd.)	Pond 2	31	8.1	117	5.2
	Pond 3	30	7.9	117	4.7
	Mean ± SD	30.67 ± 0.58	7.87 ± 0.25	147.67 ± 53.12	4.87 ± 0.29
Farm 3	Pond 1	30	7.2	85	4.7
(Al-Baraka Fish Farm)	Pond 2	30	7.1	92	4.6
	Pond 3	29	7.2	80	4.4
	Mean ± SD	29.67 ± 0.58	7.17 ± 0.06	85.67 ± 6.03	4.66 ± 0.15

Table 5: Physicochemical properties of various cultured ponds water quality parameters.

The estimated heavy metals (Cd, Cr, Pb, Ni and Cu) concentrations in sediments of ponds and standard guideline values shown in Table 6. In soil samples, according to analysis results, the highest mean concentration of Cadmium (Cd) was 0.36 mg/kg ± 0.10 mg/kg found in farm 1 and the lowest concentration of Cd was 0.28 mg/kg ± 0.06 mg/kg found in farm 3. The highest mean concentration of Chromium (Cr) wkas 9.16 mg/kg ± 4.87 mg/kg found in farm 3 and lowest concentration of Cr was 6.60 mg/kg ± 1.77 mg/kg found in farm 1. The highest mean concentration of lead (Pb) was 7.92 mg/kg ± 2.34 mg/kg found in farm 3 and the lowest concentration was 6.34 mg/kg ± 1.47 mg/kg in farm 2. The highest concentration of Nickel (Ni) was 26.73 mg/kg ± 5.27 mg/kg found in farm 3 and the lowest concentration was 23.15 mg/kg ± 0.99 mg/kg. Again the highest concentration of Copper (Cu) was 27.57 mg/kg ± 3.47 mg/kg found in farm 1 and the lowest concentration was 21.53 mg/kg ± 5.78 mg/kg found in 21.53 mg/kg ± 5.78 mg/kg. Heavy metal concentrations in the farm 1 was decreased in the sequence of Cu>Ni>Pb>Cr>Cd. On the other hand, heavy metal concentrations in the farm 2 and farm 3 were decreased in the similar sequence of Ni>Cu>Cr>Pb>Cd. To represent the heavy metal concentration in the sediment of ponds of three different farms, the final values were fitted to the graphical representation of Figure 4.

		Cd	Cr	Pb	Ni	Cu
Farm 1	Mean ± SD	0.36 ± 0.10	6.60 ± 1.77	6.96 ± 0.47	26.41 ± 1.07	27.57 ± 3.47
Farm 2	Mean ± SD	0.20 ± 0.07	8.52 ± 3.17	6.34 ± 1.47	23.15 ± 0.99	21.53 ± 5.78
Farm 3	Mean ± SD	0.28 ± 0.06	9.16 ± 4.87	7.92 ± 2.34	26.73 ± 5.27	21.91 ± 3.42
LEL* (Lowest Effect Level)	Mean	0.6	26	31	16	16
TEC*(Threshold Effect Concentration)	Mean	0.99	43.4	35.8	22.7	31.6
PEC* (ProbableEffect Concentration)	Mean	4.9	111	128	48.6	149
SEL* (Severe Effect Level)	Mean	10	110	250	75	110

Table 6: Concentration of metals in mg/kg for sediment samples and comparison with Sediment Quality Guideline.

From the Table 7 in feed samples, the highest mean concentration of cadmium (Cd) was 0.28 mg/kg ± 0.13 mg/kg found in mega feed used by farm 3 and the lowest concentration was found 0.22 mg/kg ± 0.17 mg/kg in Globe fish feed used by farm 2. The highest mean

concentration of Chromium (Cr) was 7.72 mg/kg ± 1.93 mg/kg in feed used by farm 2 and the lowest concentration was found 4.07 mg/kg ± 0.51 mg/kg in Kazi feed used by farm 1. the highest mean concentration of lead (Pb) was 1.56 mg/kg ± 1.20 mg/kg in Mega feed used by Farm 3 and the lowest concentration was found 0.85 mg/kg ± 0.61 mg/kg in Kazi feed used by farm 1.The highest mean concentration of Nickel (Ni) was 2.86 mg/kg ± 1.50 mg/kg in Globe fish feed used by farm 2 and the lowest concentration was found 1.19 mg/kg ± 1.30 mg/kg in feed used by farm 2. The highest mean concentration of Copper (Cu) was found 12.95 mg/kg ± 2.21 mg/kg in Mega feed used by farm 3 and the lowest concentration was found 10.97 mg/kg ± 1.60 mg/kg in Kazi feed used by farm 1 for fish culture. After analysis it is found that order of heavy metal concentration in feed samples of each farm was decreased in the similar sequence of Cu>Cr>Ni>Pb>Cd (Figure 5).

		Cd	Cr	Pb	Ni	Cu
Feed of farm1	Mean ± SD	0.25 ± 0.16	4.07 ± 0.51	0.85 ± 0.61	1.19 ± 1.30	10.97 ± 1.60
Feed of farm 2	Mean ± SD	0.22 ± 0.17	7.72 ± 1.93	1.47 ± 1.31	2.86 ± 1.50	12.49 ± 2.20
Feed of farm 3	Mean ± SD	0.28 ± 0.13	6.17 ± 3.97	1.56 ± 1.20	1.96 ± 0.85	12.95 ± 2.21

Table 7: Comparison of heavy metals concentration in mg/kg for feed samples.

The bio-accumulation of heavy metals (Cd, Cr, Pb, Ni and Cu) in *Oreochromis niloticus*, collected from three different fish farms compared with IAEA-407 are presented in Table 8. The average concentration of heavy metals in fishes' different farmed. The highest mean value of cadmium (Cd) was 0.42 ± 0.22 in fishes of the farm 3 and the lowest mean value was found 0.28 ± 0.16 in fishes of the farm 2. The highest mean concentration of chromium was found 1.78 mg/kg ± 0.48 mg/kg in fishes of farm 1 and the lowest concentration was found 1.29 mg/kg ± 0.54 mg/kg in fishes of farm 3 [32,33]. The highest mean value of lead (Pb) was 4.98 mg/kg ± 1.27 mg/kg in fishes of farm 3 whereas the lowest mean value was found 2.76 mg/kg ± 0.42 mg/kg in fishes of the farm-1. The highest mean concentration of Nickel (Ni) was found 3.69 mg/kg ± 2.35 mg/kg in fishes of the farm 3 and lowest concentration was found 1.54 mg/kg ± 0.52 mg/kg in fishes of the farm 1. The highest mean concentration of Copper (Cu) was found 2.70 mg/kg ± 0.38 mg/kg in fishes of farm 3 and lowest concentration was found 1.77 mg/kg ± 0.74 mg/kg in fishes of farm1. The heavy metal concentrations in fishes of the farm 1 decreased in the sequence of Pb>Cr>Cu>Ni>Cd. In farm 2 the order of metal concentration was Pb>Ni>Cr>Cu>Cd. In farm 3 the order of metal concentration was Pb>Ni>Cu>Cr>Cd shown in Figure 6.

Fishes are exposed to contaminants through the contact with ambient water, sediment and through consuming contaminated feed. Increases use of fertilizers, which contain metals, in agricultural revolution could result in the continued rises in the concentration of metal pollutants in fresh water due to the water run-off [28]. Results from the analysis indicate that heavy metals of Cd, Cr, Pb, Ni and Cu were all present in all samples. Mean concentrations and standard deviation of heavy metals in sediment of ponds of selected three different fish farms are presented in Table 6. This table indicates that all of those farms' sediment is more or less contaminated by heavy metals. It is found that concentration of Nickel (Ni) and Copper (Cu) is comparatively higher in all of three farms whereas Cadmium (Cd) concentration is lower. The metal concentrations obtained from the sediment samples of three different farms were compared with sediment quality guideline [29]. which showed that, concentration of Cd, Cr, Pb were below lowest effect level (LEL) while Cu and Ni concentration much higher than the lowest effect level (LEL) and the threshold effect concentration (TEC).

The heavy metal concentration of water was below detection limit (BDL); it might be because of using rain water in all of the selected ponds of each farm at sampling time as the sampling time was immediate post monsoon period.

Results from analysis have shown that these heavy metals: Cd, Cr, Pb, Ni and Cu were all present in all the three samples analysed. Mean concentrations and standard deviation of heavy metals in sediment of ponds of selected three different fish farms are presented in Table 6. This table indicates that all of those farms' sediment is more or less contaminated by heavy metals. It is found that concentration of Nickel (Ni) and Copper (Cu) is comparatively higher in all of three farms whereas Cadmium (Cd) concentration is lower. The metal concentrations obtained from the sediment samples of three different farms were compared with Sediment Quality Guideline which showed that, concentration of Cd, Cr, Pb were below lowest effect level (LEL) while Cu concentration exceeds the lowest effect level (LEL) and Ni concentration exceeded the lowest effect level and the threshold effect concentration (TEC) shown in Table 6.

When the values obtained in the *Oreochromis niloticus* samples were compared with the tolerable values set by IAEA -407 (International Atomic Energy Agency), it has been determined that the pollution has reached hazardous levels for the health of human (Table 8). Cd, Cr, Pb, Ni and Cu values were higher than tolerable values. Pb showed the highest value of accumulation among those five metals.

		Cd	Cr	Pb	Ni	Cu
Fishes of farm 1	Mean ± SD	0.32 ± 0.29	1.78 ± 0.48	2.76 ± 0.42	1.54 ± 0.52	1.77 ± 0.74
Fishes of farm 2	Mean ± SD	0.28 ± 0.16	1.93 ± 1.50	2.95 ± 0.96	2.54 ± 1.10	1.92 ± 0.62
Fishes of farm 3	Mean ± SD	0.42 ± 0.22	1.29 ± 0.54	4.98 ± 1.27	3.69 ± 2.35	2.70 ± 0.38

IAEA-407		0.18	0.73	0.12	0.6	3.28

Table 8: Estimated heavy metal concentration in mg/kg of *Oreochromis niloticus*, in the examined compared to recommended values.

It is additionally value to say that, the contribution of fish consumption to serious metal exposure in while an outsized variety of literature is accessible on serious metal concentrations in fish, the bulk of them were involved either in several fish species collected from a similar water body or in the same fish species collected from totally different localities. Therefore, comparison our results with other studies are troublesome and may be taken in precaution. However, there was some limitation in our study as a result of we've got not nonetheless conducted systematic studies to estimate the impact of the phenomenon; elaborate surveys on accumulation of those pollutants in aquatic ecosystems and evaluations of the impact of heavy metals on the setting and public health is additionally lacking.

Conclusion

Fish features a widespread name as an alimentary and healthy food. The consumption of fish is recommended as a result of it's a decent supply of polyunsaturated fatty acid fatty acids that has been related to health edges because of cardio-protective effects. Fish conjointly contains vitamins, mineral and proteins which play an important role in human health. However, the degree of contaminants in fish and poor management of fisheries area unit of explicit interest due to the potential risk to humans who consume them.

The present study concludes that the samples of the studied species (*Oreochromis niloticus*) collected from different three fish farms of Noakhali region contain all the analysed heavy metals (Cd, Cr, Pb, Ni and Cu) at different levels which are more than the maximum permissible limit. Analysis of presence of different heavy metals in cultured tilapia fish indicates that there is a high possibility of bioaccumulation of different heavy metals in fish body by using commercial fish feed in fish farms. All the tested metals were found enough to be thought of as a possible
human hazard. People that unceasingly consume fish contaminated with metals as found
in the gift study area unit underneath the target of many severe diseases risk within the long haul. So, popular fish shoppers ought to be educated to alternate their dependency on completely different safer and available sources of fish macromolecule to avoid potential health risks of intense contaminated fish.

The data and findings of this analysis will serve as a suggestion for researchers and environmental managers to spot future evolution impacts at the study area and might even be helpful for the management and sustainable development of the studied localities as so much as significant metal pollution is involved.

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Author Contribution

First and Second author are equally contributed.

Conflict of Interest

There is no conflict of interest.

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