Environmental Assessment of Heavy Metals Levels in Sediment and Fish of Lake Geriyo

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Abstract

Monitoring of contamination level in Lake Geriyo was coordinated by evaluating the concentrations of metals (Zn, Cu, Pb, & Cd) in sediment and fish samples of the lake in two seasons. The order of the concentrations of the metals in the sediment were Zn > Cu > Pb > Cd. The results showed that the metals exhibited lower values than sediment quality guideline (SQG). Thus, Lake Geriyo sediment can be categorized as unpolluted. Metal levels were within the set limit of TEL, PEL, ERL, and ERM which indicated that the sediment did not pose any danger to local fauna and flora. Zn and Cd were below the background values (Hakanson, 1980) nevertheless Pb and Cu exceeded. Metal Bioaccumulation were determined in the liver, gills and flesh from benthic and pelagic fish species obtained from the lake. The levels of the heavy metals differ remarkably amid fish species and organs. Flesh have the lowest concentration of all the metals. Liver was the choose organ for Zn, Cu and Pb accumulations. Cd nevertheless exhibited higher concentration in the gills. The metals bio concentration in fish flesh were acceptable by the international legislation limits for Cu, Zn, and Cd but however Pb go beyond in Clarias and Tilapia for wet season and Heterotis both seasons , consequently risky for human consumption and a danger to public health. These levels might be likely due to anthropogenic inputs as there is no industrial activity around the lake.

Keywords; *Heavy metals, Lake Geriyo, Fish, Sediment, Bioaccumulation.*

1. INTRODUCTION

The environmental issues with heavy metals include among others they are non-degradable, and can be assimilated or incorporated in to soil, water, sediment, and aquatic biota such as fish or at different trophic levels of food chain (Malik *et al*., 2020). Thus, heavy metals may be bio accumulated and biomagnified in the food cycle and in due course assimilated by people through the consumption of contaminated food resulting in health risk.

Recent concern in anthropogenic pollution of the hydrosphere by heavy metals result in a lot of studies (Voegborlo *et al*., 2020; Pote *et al*., 2019; Begum *et al*., 2015; Voegborlo *et al*., 2019; Milan 2020) Their outcome revealed that sediments are essential depository of numerous contaminants particularly heavy metals. The stuffs of anthropogenic distraction are most powerfully apparent by lakes and rivers domain near cities (Nouri *et al* 2019). Heavy metals following the fluctuating water and new water sources are ceaselessly taken out from water body and discarded into sediments (Tam and Wong, 2018; Samarghandi *et al*., 2019).

In the last decade researches on sediment origin have yielded remarkable results for the resolution of the effects of human and natural phenomenon on depositional contaminants. (Vinodhini and Narayanan, 2019; Nadia *et al*., 2020). Most pollutants lived behind symbolic prints in sediments. Studies have also indicated that polluted sediments have unfavorable effect on creatures in the benthic environment, subjecting them to dangerous concentrations of the toxic metals. Majority of the polluted sediments cause death to benthic organisms resulting in decrease of food accessible to higher animals such as fish (Abida *et al*, 2019).

The eating of fish world over has increase speedily in the contemporary years especially with the perception of its nutritional and therapeutic values. Despite to its significant source of protein, fish are enhance with important minerals, vitamins and unsaturated fatty acids. (El-Moselhy, 2020).The American Heart Association endorses eating of fish at minimal twice per week in order to make up the daily intake of omega -3 fatty acids (Kris-Etherten *et al.*, 2019). However, fish usually absorbs heavy metals from food, water and sediments (Yilmez *et al.*, 2020; Zhao, *et al.*, 2019) and are good indicator of heavy metal pollution in water (Voegborlor *et al.*, 2020).

The existing of toxic heavy metals in fish can annul their advantageous effects. Many unfavorable consequences of heavy metals to human health have been known for long time (Castro –Gonzalez and Mendez –Aimenta, 2020). This involve grave risk like renal failure, liver damage, cardiovascular diseases and sometime death (Al-Busaidi *et al.*, 2018; Rahman *et al.*, 2019). Thus, a lot of several local and international monitoring schemes have been set up in order to evaluate the standard of fish for human consumption and to observe the health of the aquatic ecosystem (Meche *et al.*, 2020).

According to the literatures, metal bio concentration by fish and successive dispersal in organs is considerably very much variants. Additionally, many factors can effect metal uptake like sex, age, size, reproductive cycle, swimming pattern, feeding pattern and geographical location (Zhao *et al.*, 2019; Mustafa and Guluzar, 2020)

Lake Geriyo (Figure 1) is a superficial Lake with a mean deepness of about 3 meters overlaying an area of about 250 hectares in measurement with in-depth irrigation farming on all sides. The area lies within the hot climatic Northern Guinea Savannah region of Nigeria with recognizable dry and wet seasons. The lake Geriyo pool collect abundant amounts of unwanted water as run offs from agricultural pursuit and refuse dumpsite. Urban wastes management and refuse disposal system practices in the state is substandard by which to a certain extent the lake environment is used as widespread dump site. The lake supply abundant level of local economic activities which comprises fish production and irrigation farming. It has a potential irrigable land mass of about 1500 hectares with 1200 hectares already developed for the growing of rice and vegetables for food security. The lake Geriyo irrigation project plan provides indispensable employment changes for the teaming youth within Yola and Jimeta metropolitan. The study is essential considering the health risks of pollution load on the plants, animals and even humans within the environment.

2. MATERIALS AND METHODS

2.1 The study area

Lake Geriyo (Figure 1) is situated in Yola, Adamawa State capital and located on latitude $09^0$10'N and longitude $12^0$20'E. The state is in the Sahel region of Northern Nigeria generally semi- arid with low rainfall, low humidity and high temperature. The Geology of the area is entirely underlain by the cretaceous and quaternary sedimentary deposits. The Bima Sandstone is Albian in age while the river alluvium belongs to the quaternary geologic period. The Bima Sandstone is made up of clay lenses, calcareous sandstones, Limestone, Siltstones and iron stones. The river alluvium consists of poorly sorted sandstone, clays siltstone (Ishaku and Ezeigbo 2000).

The area undergo two definite wet and dry seasons. The wet season begin from April to October while the dry season set up from November to March. Mean daily temperature vary with seasons from 25^0C to 45^0C and mean annual rainfall received is in the range of (150-1000m). The climate is characterized by high evapotranspiration particularly during dry season (Adebayo, 2019). Yola the state capital the population is estimated at 325,925 people (NPC, 2006). Lake Geriyo Occupies natural depression close to river Benue in the North eastern part of Nigeria. The lake is flooded during wet season such that it experience inflow of waters which comprise pollution load coming from river Benue and from the urban waste dumpsite of the Lake environment (plate 1). Aquatic vegetation of the lake consist of stock of floating weeds that is water spinach, water hyacinth, water Lilly and water lettuce which moves around the lake surface depending on the prevailing wind (Ekunday *et al*, 2019).

The lake water is chiefly used for the thorough irrigation farming scheme, fishing and water sources for cattle farmers in the area. The water is conveyed to the farmlands through direct pumping and the map of the study area indicating irrigation site is as shown in (figure 2).

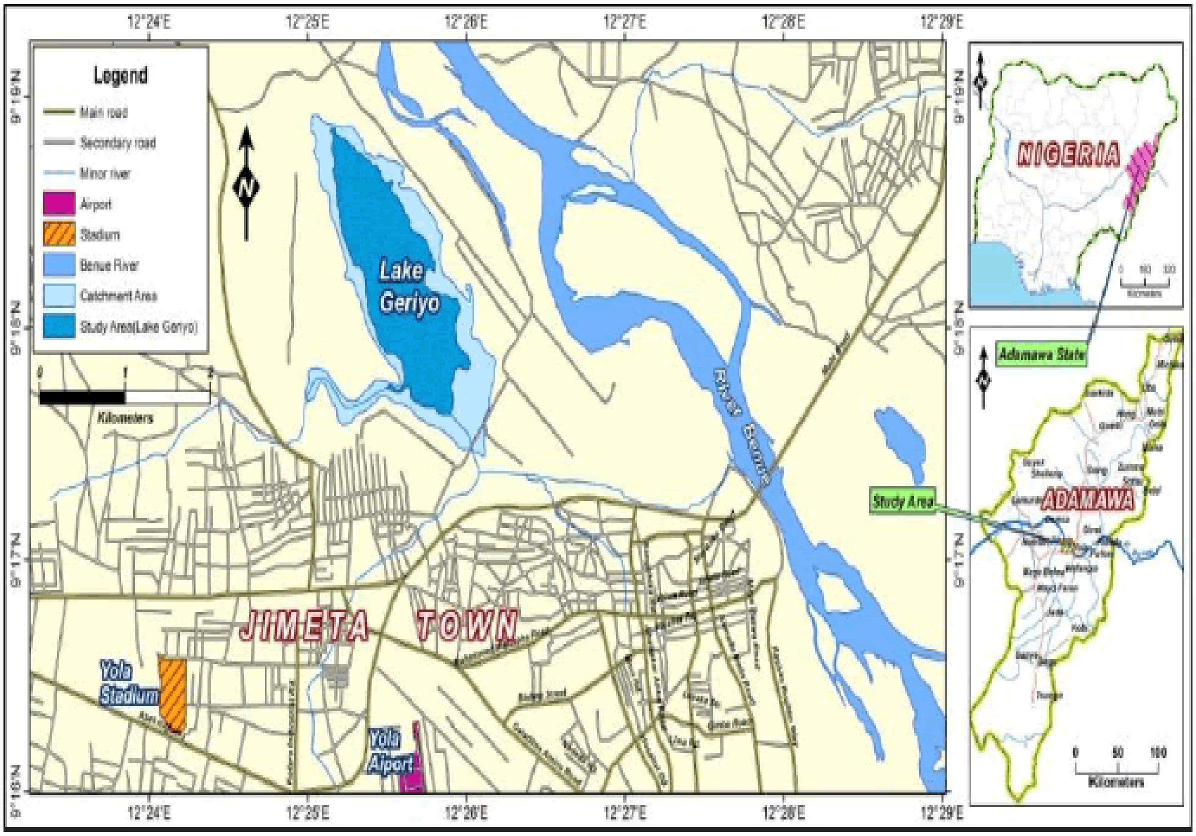

Figure 1: Map of lake Geriyo.

Plate:1 Map of the study area showing the waste dumpsite

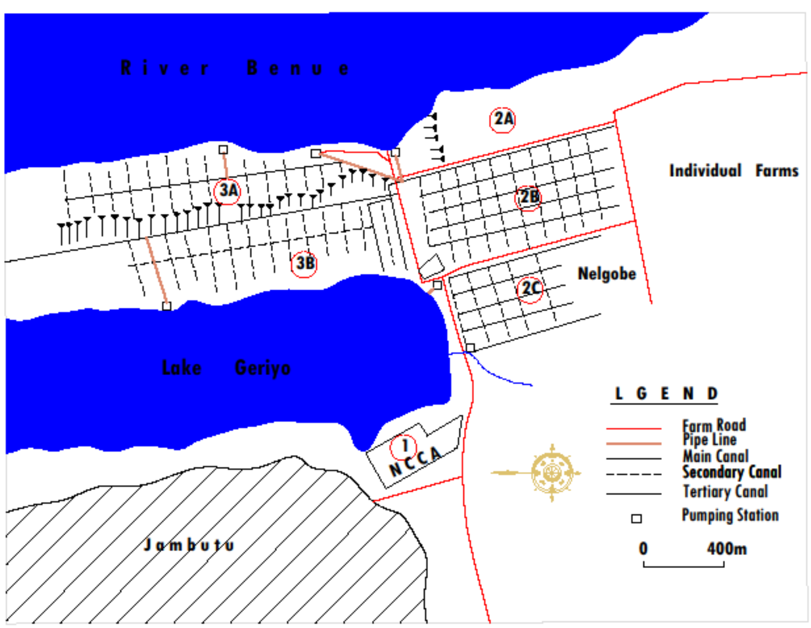

Fig. 3.2: Map of the study area showing irrigation site

Figure: 2 map of the study area showing irrigation site

3.0 SAMPLE COLLECTION, PREPARATION AND ANALYSIS

3.1 Sediment Sampling.

Sediment samples were obtained as reported by Radujevic and Bechlin, (1999) in triplicate at an interval of three meters in a zigzag manner at four locations that is North, East, West and South in the two seasons. They were obtained through the use of a scooper sediment sampler control from a boat and could scoop sediment samples with water from about four meters below the water surface. These samples were air dried, homogenized and sieved through a 2 mm nylon mesh after which they were disaggregated with the help of an agate mortar and pestle. (Bining and Baired, 2017; Voegborlo *et al*, 2019). The powdered sediment samples were then kept in a clean sample bottle at room temperature for analysis.

A quantity of 1.00g of the homogenized sediment samples was weight into a 50ml digestion tube and digested by the procedure described by Voegborlo *et al* (2019). In the method the samples were digested with Perchloric acid and Nitric acid ratio (1:1) $HN0_3$ – $HCl0_4$ then followed by Sulphuric acid and the mixture was heated at 200^0C for 30mins. The complete digest was then cooled down to room temperature and made up to 50ml scale with distilled water and analyzed for Cu, Zn Pb and Cd using a Flame Atomic Absorption Spectrophotometer (AAS Model Agilent AA55).An analytical blank was prepared in a similar manner. The obtained results were expressed in mg/kg weight.

3.2 Fish Sampling

Fifteen commercial fish species were captured using Malian nets set overnight with the assistance of the local fishermen at the lake basin during the two seasons. The obtained fish species were *Claries anguillaris, Heterotus niloticus* and *Tilapia zilli.* The collected fish species constitute different biotops (Table 1) and were subsequently preserved on ice in an ice chest and taken to the laboratory to which they were classified, weighed, total length recorded and kept frozen at -20^0C until further analysis. Identification of fish to species was carried out by a specialist from Department of Fisheries, Modibbo Adama University (MAU) Yola. Nigeria.

Table 1: Ecological Features of the fish breed

Scientific Name	English Name	Feeding Habit	Biotype Complex	No of Samples	Length (cm)		Weight (g)	
					D	W	D	W
Claries Anguillaris	Cat fish	Carnivore (fish & invertebrate)	Benthnic	5	27.80-41.00	30.5-49.2	150-458	186.5-712.8

Heterotis Niloticus	African bony tongue	Omnivorous/ Herbivore	Pelagic	5	17.40-20.20	36.5-58.5	53.6-86.1	403.6-1370
Tilapia Zilli	Mango fish	Omnivorous/ herbivore	Pelagic	5	14.50-17.90	19.3-23.5	36.8-101.5	125.2-180.4

D = Dry Season, W = Wet Season

The fish samples were cleanse with distilled water and scales of *Heterotis Niloticus* and *Tilapia zilli* were removed. The fishes were dissected into separate organs namely, flesh, liver and gills using stainless steel instruments (Bernhard, 1976; Veogborlo *et al.,* 2019) and digested by the procedure described by Veogborlo *et al*. (2019).

In the procedure 1 g of the samples were digested with Perchloric acid and Nitric acid ratio (1:1) HNO_3- $HClO_4$, Followed by Sulphuric acid and the mixture was heated at 200^0C for 30mins. The complete digest was then cool down to room temperature and made up to 50ml scale with distilled water and analyzed for Cu, Zn, Pb and Cd using Flame Atomic Absorption Spectrophotometer (model AgilentAA55) after selecting the various wavelength at which the heavy metals were determined. An analytical blank was prepared in a similar manner. The obtained results were expressed as mg/kg weight.

4.0 Quality assurance

All the reagents used were of analytical grade. Glass wares were soaked in 10% Nitric acid for 24Hrs and cleanse with distilled water followed by 0.5% (w/v) $KMN0_4$ solution and finally with distilled water. Accuracy and precision were authenticated by using reference material (CRM IAEA-SL-I, CRM IAEA 401) provided by the International Atomic Agency (IAEA). Analytical results of the quality control samples indicated a satisfactory performance of heavy metal determination within the range of certified values 95-111% recovery for the metals studied.

5.0 STATISTICAL ANALYSIS

All analyses were performed in triplicates. Statistical data analyses of the results were performed using GRAPH PAD INSTAT AND PAST WINDOWS 2020 (computer package). The means of the replicates and evaluation of significant differences between different samples were determined using descriptive statistics and analysis of variance (ANOVA) respectively. A two- way analysis of variable (ANOVA) was used to test for significant differences in the concentrations of heavy metals in the samples along the seasons and the sites. Results of the test were considered significant if the calculated P – Values were ≤ 0.05. Pearson correlation was used to examine the relationship between the elements in fish. T-test was used to show the variation of data between the two seasons.

5.0 RESULTS AND DISCUSSIONS

5.1 Heavy metal concentration in sediment

The concentrations of heavy metals analyzed in forty eight sediment samples collected during the two seasons are given in Table 2. The results of analysis of variance indicated significant different at (P<0.05). They metals concentration trend follow the decreasing order of Zn>Cu >Pb >Cd. Wet season exhibited higher metal concentration than the dry season. This is likely due to effluent run-off from the urban dumpsite (plate.1) and the application of agrochemicals from the farm land of the irrigation site as the lake is not near to an industrial area. From table 2 the concentrations of Zn and Cd were lower than the background values (Hakanson 1980) excluding at (82.32mg/kg and 0.8mg/kg) West locations, Wet and Dry seasons respectively. Likewise Pb and Cu exhibited concentrations higher than the background values excluding at (2.67mg/kg West location) and (13.58mg/kg North location), during wet season. This indicate anthropogenic input.

Contrast of the mean concentration values of the studied heavy metals in Lake with the corresponding Global base sediment quality guideline (SQG Perin *et al;* 1997). The concentrations of Zn, Pb, Cd and Cu in the Lake sediment was classified as unpolluted with regard to these metals since the recorded values cut down below 90, 40, 5, and 25mg/kg respectively. A comparison of Zn, Pb , Cd, and Cu concentrations in sediment of lake Geriyo with values in Threshold effect level (TEL), Probable effect level (PEL)(Smith *et al*, 1996) Effect range median (ERM), and Effect range low (ERL) (Adami *et al* 2000, Macdonald *et al* 2000) showed that the levels were below the permissible limit. Which indicate that the sediment of Lake Geriyo did not constitute any significant danger to the local fauna and flora in the Lake basin.

Table 2 Mean concentration of heavy metals in sediment vis-a-vis background value and sediment quality guidelines (SQG).

Mean concentrations of Heavy Metals (mg/Kg)					
Location	Season	Zn	Pb	Cd	Cu
North	Dry	57.77 ±860	14.87 ±6.71	0.1±0.017	18.08±1.23
	Wet	66.60 ±5.10	16.63±11.66	0.58 ±0.42	13.58 ±24
South	Dry	49.12 ±1.24	11.18 ±0.96	0.1 ±0.017	19.63 ±0.21
	Wet	62.92 ±5.0	13.28 ±4.83	0.57 ±0.81	15.20 ±2.90
East	Dry	49.12 ±1.24	11.18 ±0.96	0.1 ±0.017	17.08 ±0.43

	Wet	60.98 ±8.64	16.38 ±3.68a	0.22 ±0.16	18.85 ±5.60
West	Dry	59.10 ±4.71	13.62 ±2.14	0.8 ±0.52	19.97 ±10.67
	Wet	82.32 ±3.71	2.67 ±0.28	0.23 ±0.23	16.17 ±1.67
Background value		67	8	0.6	14
SQG Non polluted		< 90	< 40	< 5	< 25
SQG Moderately Polluted		90-200	40-60	< 10	25-50
SQG Heavy Polluted		> 200	> 60	> 20	> 50
TEL/PEL		123/315	35/91.3	0.60/3.53	35.7/97
ERL/ERM		120/220	35/110	5/9	70/390

Source: Background value data from Hakanson (1980), SQG values from Perin *et- al* (1997)

TEL/PEL Threshold effect Level, probably effect, values taken from Smith *et- al* (1996)

ERL/ERM values taken from (Adams *et- al* 2000, Macdonald *et- al* 2000)

5.2 Heavy metal concentration in fish.

The distinction of the fish species studied disclosed that *Clarias* was carnivorous, while *Heterotis* and *Tilapia* were the omnivorous or herbivorous (Table 1). There was noticeable variations in the concentrations of heavy metals (Cu, Zn, Pb and Cd) in flesh, liver and gills of the fishes (Table 3). Results indicated that all fish species hold higher concentration of metals in liver and lower in flesh with little exceptions. The results of analysis of variance indicated notable differences in metal concentrations in the distinct internal organs at ($P<0.05$) in the two seasons. The metal bioaccumulation pattern obtained in this study were in the decreasing order of Zn > Cu > Pb > Cd.

5.2 Variations in ability of organs metal bioaccumulation

Results indicated that the metal concentration in the organs were in the sequence of liver > gills > flesh. The essential metals Zn and Cu and non-essential metal Pb show higher bio concentration in the liver. Cd recorded bioaccumulation in gills.

Table 3: Seasonal variations in Heavy metals mean concentrations (mg/kg) within the Flesh, Liver and Gills of *Clarias*, *Tilapia* and *Heterotis* from Lake Geriyo

Heavy metals	Season	*Clarias* Fish Specie			*Tilapia* Fish Specie			*Heterotis* Fish Specie		
		Flesh	Liver	Gills	Flesh	Liver	Gills	Flesh	Liver	Gills
Zn	Dry	5.35 ± 1.19^{d}	22.4 ± 1.19^{c}	16.63 ± 3.41^{c}	4.48 ± 0.46^{d}	97.28 ± 35.72^{ab}	10.13 ± 2.76	10.18 ± 2.41^{c}	148.08 ± 19.47^{a}	10.17 ± 3.88^{c}
	Wet	4.17 ± 0.39^{c}	65.04 ± 19.39^{a}	10.45 ± 0.60^{e}	5.06 ± 0.38^{c}	52.87 ± 14.40^{c}	13.34 ± 1.4^{e}	6.61 ± 0.89^{c}	125 ± 10.68^{a}	25.94 ± 5.56^{d}
Pb	Dry	0.23 ± 0.22^{b}	3.5 ± 0.00^{ab}	3.42 ± 1.97^{a}	0.01 ± 0.00^{b}	0.5 ± 0.0^{b}	5.39 ± 3.15^{a}	3.51 ± 1.30^{a}	4.5 ± 0.00^{b}	3.30 ± 2.01^{a}
	Wet	8.44 ± 2.54^{a}	1.22 ± 0.76^{b}	4.00 ± 2.10^{ab}	3.78 ± 1.36^{b}	5.55 ± 1.77^{a}	4.79 ± 2.58^{ab}	7.12 ± 2.62^{a}	8.99 ± 3.78^{a}	2.17 ± 0.90^{b}
Cd	Dry	0.54 ± 0.14^{b}	0.11 ± 0.01^{d}	0.53 ± 0.19^{b}	0.30 ± 0.15^{c}	0.17 ± 0.07^{d}	0.42 ± 0.20^{b}	0.35 ± 0.09^{bc}	0.30 ± 0.00^{d}	0.79 ± 0.25^{a}
	Wet	0.37 ± 0.25^{b}	0.29 ± 0.10^{b}	0.26 ± 0.07^{b}	0.33 ± 0.16^{b}	0.44 ± 0.16^{ab}	0.61 ± 0.14^{a}	0.39 ± 0.11^{b}	0.51 ± 0.20^{a}	0.48 ± 0.23^{ab}
Cu	Dry	0.5 ± 0.00^{e}	29.87 ± 9.28^{a}	0.15 ± 0.00^{c}	0.15 ± 0.00^{c}	31.15 ± 3.40^{a}	0.15 ± 0.00^{c}	0.15 ± 0.00^{c}	20.4 ± 4.19^{b}	0.15 ± 0.00^{c}
	Wet	2.02 ± 1.87^{bc}	22.6 ± 7.85^{a}	0.31 ± 0.16^{c}	1.27 ± 1.12^{c}	18.08 ± 6.54^{a}	2.62 ± 1.65^{bc}	4.42 ± 1.89^{b}	4.69 ± 2.05^{b}	1.41 ± 0.78^{c}

Data on the same row with different superscripts are significantly difference ($p<0.05$).

The metal bio concentration in liver may be connected to its function of metabolism (Zhao *et al.*, 2019), excess levels of Zn and Cu in hepatic tissues are associated to natural protein binding such as Metallothioneius (Gorar *et al.*, 2019). Liver also function as store for metals, redistribution and detoxification (Amiard *et al.*, 2016). This is the Bern mark for which liver organs are serves as an indicator of water contamination than any organ in fishes (El-moselhy, 2020). Similarly results of excess Zn and Cu in liver were reported by other researchers (Zhao *et al.*, 2019; Eisler, 2020; Duralul *et al.*, 2017).

Some species of the fish recorded metal bioconcentratio of Cd in gills. Gills are route of metal ion exchange from water (Qadir and Malik, 2019), since they have very wide surface area that secure diffusion of metals quickly (Dhaneesh *et al.*, 2018). Hence, it is advocated that metals bio accumulated in gills are fundamentally concentrate from water. This is in agreement with the results of Moore and Ramamoorthy, (2000). Similarly results of excess Cd concentration in gills were recorded by kargin, (2000), Avenan –Oldewage and max(2018), Abu –Hilal and ismail, (2019) ,Qadir and malik (2019).

In this research, fish were obtained showing different feeding habitat as shown in Table 1. The results indicated that fish displayed wide range of dissimilarities in inter-specific metal bio concentration in all organs. Many studies show excess metal bioaccumulation to feeding habitat of the fish. Khaled, (2014) contend that *Sirivutas* being an herbivore, thus bio concentrate higher metal accumulation in their flesh than the carnivore *Sargus.* This assertion is in an agreement with the current study as *Heterotis* (Herbivore) show higher metal bio concentration in flesh than *Clarias*(Carnivore). Abdallah, (2018) indicated high concentration of Pb and Zn in the flesh of *sardinella aurita* collected from EL-Mex Bay.

These results are connected to feeding of the fish on phytoplankton since it is the likely biota compartment for Cu and Zn accumulation (Abdallah, 2018; Nweze and Mahmood, 2020; EPA (1972).

However, a large size of fish of *Heterotis Niloticas* recorded higher bio metal concentrations of Cd in liver compared to the other studied fish. This result can be connected to the age of the fish because according to Khaled, (2014) Cd is not easy to be excreted once it is bio accumulated in the liver. This large fish (length 36.5 - 58.5cm, weight 403.6 - 1370g) probably bio accumulated high Cd throughout its long life. This is in agreement with the report of Eisler, (2020) that Cd in liver is connected to the age of the fish. Similarly, Ploet *et al.*, (2017) reported that Cd bioaccumulations in the liver of King mackere, (*Scomberomiums cavalla*) increased with increasing fork length. Kojadinovic *et al.*, (2017) indicated Cd bio concentration in liver of swordfish (*Xiphias gladius)* up to 46.9 mg/kg wet wt.

Results of this study are in consistent with report of Abdallah,(2018) and Nweeze and Mahmood,(2020) in which pelagic fish (Omnivorous/Herbivore) indicated higher metals bio concentrations than the Benthic fish (Carnivore) (Table 2). In spite of the fact that fish are mostly migratory and rarely settle in one location, metal bioaccumulation in fish organs gives proof of exposure to contaminated aquatic environment (Qadir and Mallik, 2019) and could be used to assess the health status of the environment from which they were collected. In this research study, fragmentary distribution of metals in the organs of the fish species studied from Lake Geriyo basin is mainly due to anthropogenic input as it is not near any industrial area.

5.3 Health risk assessment for fish consumption.

To evaluate public health risk of Lake Geriyo fish consumption, metal bio concentrations in flesh of the fish were compared with the Maximum Permissible Limits (MPL) for human consumption as set by numerous organizations (Table 4).

The concentrations of metals in the studied fish species from lake Geriyo fell below the MPL for human consumption recommended by FAO,(1983); FAO/WHO,(1989); WHO, (1995) and England, (2000) with little deviation (Table 3). The essential metals Zn, and Cu were clearly below the permissible limit (PML), for human consumption. Similarly the non-essential metal Pb was below PML recommended by FAO,(1983); FAO/WHO (1989); WHO (1995) and England, (2000) only for fish species of *Clarias* and *Tilapia* in the dry season while *Clarias* and *Tilapia* wet season and *Heterotis* both seasons were above the set standard. Cd non-essential metal was below the recommended limit of PML. The fish species namely *Clarias* and *Tilapia* wet season and *Heterotis* both seasons of Lake Geriyo were found to be risky for consumption. They were polluted by Pb and hazardous to public health. This could be probably due to anthropogenic input as the lake is not near to an industrial location.

Table 4: Heavy metals in flesh (mg/kg, ww) of fish from Lake Geriyo and Maximum Permissible Limits (MPL) International Standard

	Concentrations of metals (mg/kg ,ww) in different species						**MPL**			
Heavy metals	***Claris*** **D**	**W**	***Tilapia*** **D**	**W**	***Heterotis*** **D**	**W**	**FAO (1983)**	**FAO/WHO (1989)**	**WHO (1995)**	**ENGLAND (2000)**
Zn	5.35	4.17	4.48	5.06	10.18	6.61	30	40	100	50
Pb	0.23	8.44	0.01	3.78	3.51	7.12	0.5	0.5	2	2
Cd	0.54	0.37	0.30	0.33	0.35	0.39	0.05	0.5	1	2
Cu	0.15	2.02	0.15	1.27	0.15	4.42	30	30	30	20

D= Dry season, W= Wet season

6.0 CONCLUSION.

Wet season recorded higher metal concentration than the dry season when the metal mean concentrations were set side by side with global base Sediment Quality Guidelines (SQG Perin *et-al,* 1997). The lake sediment can be categorized as unpolluted. Levels of the heavy metals were within the set standard limit of TEL, PEL, ERM, and ERL. These indicated that the sediment did not pose any significant danger to the local fauna and flora.

The result indicated that metal bioaccumulation differs depending on species – specific factors, others are feeding behavior, fish size and age. Metal bioconcentration was higher in omnivorous/herbivore fish such as *Heterotis niloticus* and lower in carnivore fish such as *Clarias anguillaries.* Dissimilarities in metal bioconcentrations were exhibited in the internal organs of the fish species studied. Metal bioaccumulations were higher in the liver then gills and flesh. Health hazard analysis of heavy metals in the eatable parts of the fish indicated invulnerable levels for human consumption and concentrations in the flesh generally agreed with the international legislation limit [MPL] for essential metals (Zn and Cu) and non-essential metal (Cd). Nevertheless, Pb in *Clarias* and *Tilapia* fish species during the wet season, and *Heterotis* at both seasons surpass MPL hence, risky for consumption therefore pose a danger to public health.

7.0 CONFLICT OF INTEREST

The authors wish to declare that there is no conflict of interest associated with this studies.

8.0 **ACKNOWLEDMENT**

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