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Heavy Metals Assessment of Water, Sediments, and Some commercial Fish species of Lavun Flood Plain, Niger State, Nigeria

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Abstract

Heavy metals are persistent pollutants that pose significant risks to aquatic ecosystems and human health due to their toxicity and ability to bioaccumulate. This study assessed the concentration of heavy metals (Lead, Cadmium, Cobalt, Nickel, Chromium, and Copper) in water, sediments, and commercially important fish species within the Lavun Flood Plain, Niger State, Nigeria. Samples were collected monthly over an eight-month period across four stations: Nku, Sa'achi, Nupeko, and Egagi. Analysis was performed using Atomic Absorption Spectrophotometer (AAS) following standard digestion procedures. Results show heavy metal concentrations varied across the environmental matrices. In water, Chromium recorded the highest mean value (0.40 ± 0.11 mg/L at Sa'achi), while Lead and Copper levels showed no significant differences across stations ($p>0.05$). Analysis revealed significantly higher metal loads compared to water, with Chromium reaching 7.29 ± 1.16 mg/L at Nku. Among the six fish species studied, Malapterurus electricus generally exhibited the highest bioaccumulation of metals including Lead (0.18 ± 0.24 mg/kg) and Nickel (2.48 ± 1.78 mg/L), while Oreochromis niloticus and Heterotis niloticus often recorded the lowest levels. The presence of these metals is largely attributed to anthropogenic activities such as agricultural runoff, domestic waste discharge, and the use of fertilizers and pesticides in the surrounding flood plain. These findings highlight the necessity of regular ecological monitoring to manage the risks posed to local consumers and the long-term health of the Lavun freshwater ecosystem.

Keywords: Heavy Metals, Lavun Flood Plain, Bioaccumulation, Sediments, Commercial Fish

Introduction

Heavy metals are persistent environmental pollutants that pose significant ecological and human health risks due to their toxicity, non-biodegradability, and ability to accumulate in aquatic ecosystems (El-Sharkawy et al., 2025). In freshwater environments, heavy metals originate from both natural sources such as weathering of geological materials, and anthropogenic activities including agricultural runoff, mining, industrial discharge, and wastewater effluents (Hama-Aziz et al., 2023). Once introduced into aquatic systems, these elements can be distributed among water, sediments, and aquatic organisms, thereby entering the food chain and potentially affecting ecosystem health and human consumers alike (Hossain et al., 2025). In Nigeria, heavy metal contamination of freshwater resources has been widely documented across diverse ecological contexts, including lagoons, rivers, and dams. For instance, assessments in Epe Lagoon reported detectable levels of zinc (Zn), manganese (Mn), cadmium (Cd), iron (Fe), copper (Cu), and lead (Pb) in water, sediments, and fish tissues, highlighting the potential health implications of metal accumulation in aquatic biota (Yunusa et al., 2023; Onyegbula & Olajide, 2025).

Similar studies in various Nigerian water bodies have consistently identified heavy metal presence across environmental matrices, often linked to anthropogenic pressures and seasonal fluctuations (Usman *et al*., 2022) Moreover, comprehensive reviews indicate that heavy metal levels in many Nigerian freshwaters and resident fish species frequently exceed national and international safety thresholds set by regulatory bodies such as the World Health Organization (WHO), Federal Environmental Protection Agency (FEPA), and United States Environmental Protection Agency (USEPA), thereby elevating public health concerns (Yunusa *et al*., 2023; Aborisade *et al*., 2024). Sediments serve as both sinks and secondary sources of heavy metals within aquatic systems (Aborisade *et al*., 2024). Over time, particulate metals settle into sediment layers where they can persist and later remobilize under changing physico-chemical conditions, influencing metal bioavailability and ecological risk (Yunusa *et al*., 2023; Aborisade *et al*., 2024). Fish, particularly those exploited in commercial fisheries, are vulnerable to bioaccumulation of these metals through direct uptake from water and dietary exposure from contaminated prey and sediments. The bioaccumulative nature of metals such as Cd, Pb, and Zn raises concerns due to their potential to exceed safe levels in edible fish tissues, leading to adverse effects in humans following consumption (Yunusa *et al*., 2023).

The Lavun Flood Plain in Niger State, Nigeria, represents a vital freshwater ecosystem supporting local livelihoods through fishing, agriculture, and domestic water use (Mohammed et al., 2021; Mohammed et al., 2023; Mohammed et al., 2024a; Mohammed et al., 2024b; Mohammed et al., 2026). However, limited research exists on the distribution and concentration of heavy metals across its water, sediments, and commercially important fish species. Characterizing heavy metal contamination in this flood plain is essential for understanding the degree of ecological exposure, the risks posed to consumers of local fish species, and for informing water resource management and environmental policy. Various human activities such as channeling of drainages and discharge of waste substances into water bodies, all season farming coupled with spraying of herbicide and pesticides by famers around Lavun floodplain which is surrounded by Kaduna River and Niger River can give rise to heavy metal bioaccumulation in fish species in the river. The aim of this research is to assess the accumulation of some heavy metals in water, sediment and some selected fish species in Lavun flood plain area of Niger State.

MATERIALS AND METHODS

Study Area

Lavun flood plain covers a vast area around the banks of River Kaduna and River Niger in Southern part of Niger state (Mohammed et al., 2021; Mohammed et al., 2023; Mohammed et al., 2024a; Mohammed et al., 2024b; Mohammed et al., 2026). The study water bodies are Nnako-Egagi, Ejegi-Saachi, Ebuko-Nku and Tonko-Nupeko in Lavun local government area of Niger state. The study area is located at latitude 8°.8846134 and longitude 5°.8657989 within Niger State, located in the North-central region of Nigeria. The areas are mainly floodplain area and are mostly flooded by Kaduna River except Tonko-Nupeko that's flooded by River Niger. The main occupation of residents close to these water bodies is farming cash crops such as rice and fishing. The study area is generally accessible through Bida Nupeko-Patigi Federal Road to Kwara State. The study area lies in savannah region of North-central Nigeria and is characterized by two distinct seasons (rainy and dry season). The rainy season is from April to October, while the dry season is from November to March

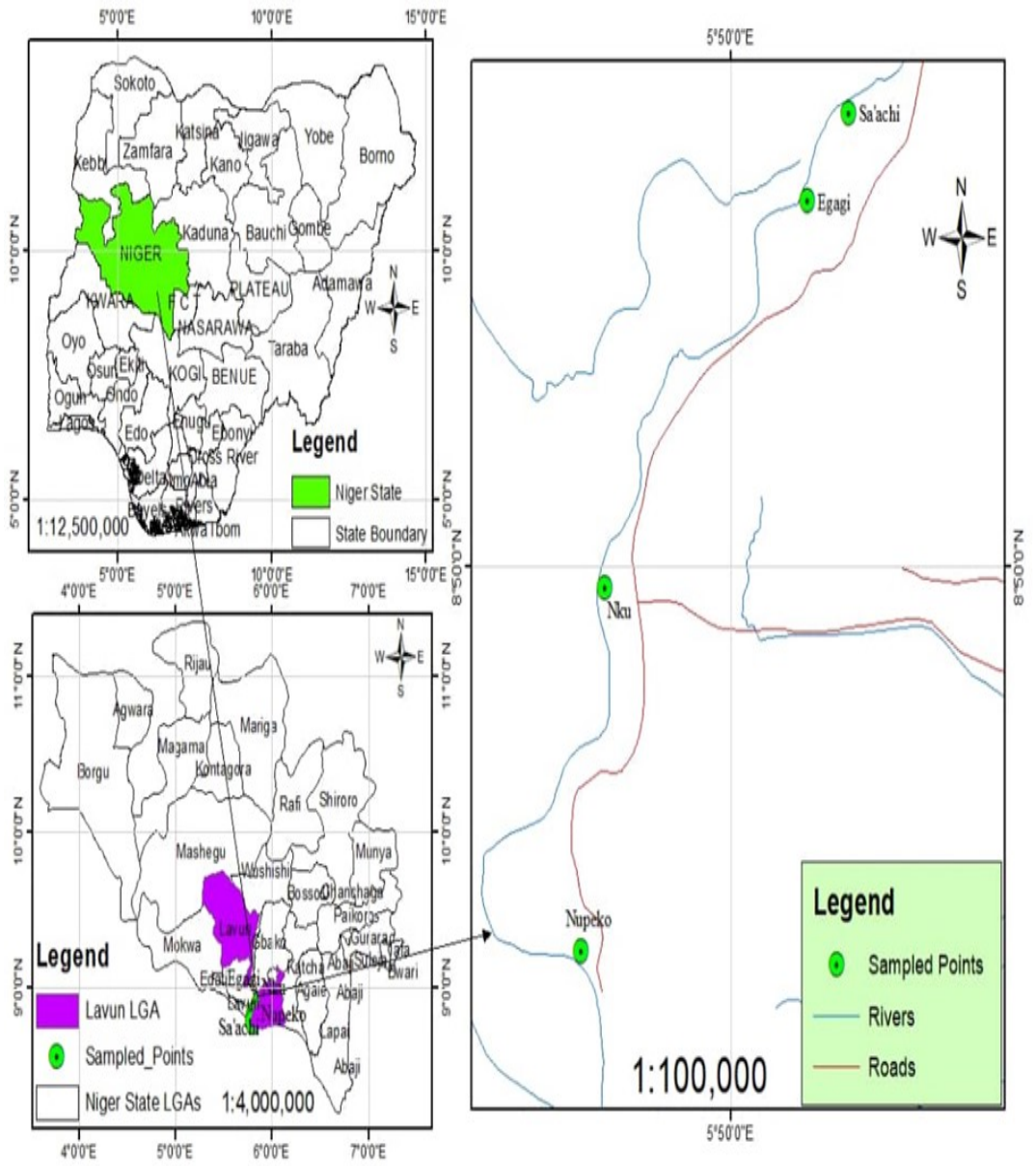

Figure 3.1: Map of Nigeria, showing Niger State and selected communities at Nupeko floodplain

Samples Collection

Water samples were collected from these water bodies monthly for a period of eight months covering both wet and dry season. Water samples for physicochemical parameters and heavy metal analysis were collected in triplicate and processed using standard methods and procedure as described by APHA (2017). Water samples were collected in sampling bottle (200 ml) properly clean and rinsed with distilled water prior to use. Sediment samples were collected from the sampling station.

The sediment samples were collected by scooping with a plastic spoon from the sampling point. 1kg of the sediment samples were obtained at a depth of 0-15cm in a clean and sterile polyethene bag at each sampling station of Lavun floodplain. The polythene bags were closed tightly and transported to the laboratory of Animal Biology Department Federal University of Technology Minna Niger state.

Fish samples were collected monthly from hired fishermen along the bodies between 07:00 and 10:00h. The available fish were identified to the lowest taxonomic rank using identification key (Olaosebikan and Raji (1998; Idodo-Umeh (2003). Each representative species of the selected fish species were collected and preserved in a cold storage box and transported to the laboratory of Animal Biology Department Federal University of Technology Minna Niger state.

Sample Preparation for Heavy Metals

In the laboratory, the sediment samples were dried for 48 hours, ground and sieved using 0.5 mm mesh size sieve to have uniform particle size. Each sample was labelled and stored in a dry plastic container that had been pre-cleaned with concentrated nitric acid prior to analysis.

The fish samples were washed with tap water and de-ionized water to remove air pollutants, followed by oven drying at 105°C for 48 hours to remove moisture. After oven drying the bones and scales were removed while the muscle, head, tail, eyes, gills were utilized for the analysis. The dried fish samples were pulverized, using agate pestle and mortar, followed by sieving through a 0.5 mm mesh size sieve to obtain a uniform particle size. Each sample was labelled and stored in a dry plastic container that had been pre-cleaned with concentrated nitric acid to prevent heavy metal contamination prior to analysis.

Samples Digestion

The sediment samples were digested using US-EPA method 3050 (USEPA, 1976); whereby 1.0g portion was weighed into a 100cm^3 beaker, followed by addition of 10.0 cm^3 of 1:1 HNO_3:H_2O. The mixture was heated on hot plate at 105^0C for 1hr and allowed to cool to room temperature. This was followed by sequential addition of 5.0cm^3 of concentrated HNO_3, 1.0cm^3 of Hydrogen peroxide (H_2O_2), and 5.0 cm^3 of HCl (Hydrochloric acid). The resulting solution was filtered and diluted with de-ionized water to a final volume of 100cm^3 in a volumetric flask. Wet method of digestion was used to carry out the analysis as described by (APHA, 2017). 1ml of collected water sample was added to 20ml of nitric acid and digested on hot plate at 150 °C till samples fully dissolved. Then 100ml of distilled water was added to the digested samples and it was then poured in a labeled sample bottles for further analysis. The fish samples were digested according to methods described Adewami *et al.,* (2017); whereby 0.50g of the powdered fished sample was weighed into a 100cm^3 beakers and 5cm^3 of concentrated HNO_3 and 2cm^3pychloric acid ($HClO_4$) was added. The mixture was then heated on hot plate at 95^0C until the digest became clear. The digest was diluted with de-ionized water, filtered into a 100cm^3 volumetric flask and then made up to the mark with more de-ionized water.

Determination of Heavy Metals Analysis of Water, Sediment and Fish Samples

The concentration of heavy metals in the digested samples were determined using Atomic Absorption Spectrophotometer (Shimadzu N100A model) equipped with a digital read-out system. Working standards was prepared, after serial dilution of 1000ppm metal stock solution in each case. Calibration curves were constructed by plotting absorbance values versus concentrations. By interpolation, the concentration of the metals in sample digests are determined (Brazova *et al*.,2012)

Data Analysis

Experimental data was presented as mean ± standard error of mean (SEM) Statistical analysis was implemented using PAST software version 4.3 All data were subjected to one way analysis of variance (ONE-WAY ANOVA) to test for significance between sampling station and sampling months.

RESULTS

Heavy metal concentration in water of some communities in Lavun flood plain of Niger State

The mean heavy metal in water samples from Lavun flood plains is presented in Table 1. The mean lead value ranged from 0.03 ± 0.02 mg/l in waters from Nku and Egagi to 0.05 ± 0.03 mg/L in Nupeko. The mean lead shows no significant ($p > 0.05$) difference between the water samples across the flood plain. The cadmium mean value ranged from 0.01 ± 0.01 mg/L in water sampled from Sa'achi, Nupeko and Egagi to 0.05 ± 0.01 mg/L in water sampled from Nku. The mean cadmium values shows significant difference ($p < 0.05$) between the water samples as water sample from Nku record high when compared to water from Sa'achi, Nupeko and Egagi. Cobalt mean value ranged from 0.01± 0.01 in water sampled from Nku, Sa'achi and Egagi to 0.02 ± 0.01 in Nupeko.

The mean Cobalt values shows no significant difference ($p < 0.05$) between the water samples from Nku, Nupeko, Sa'achi and Egagi. Nickel mean value ranged from 0.08 ± 0.05 mg/L in Water sampled from Nku to 0.14 ± 0.08 mg/L in water sampled from Nupeko. The mean nickel values shows significant difference ($p < 0.05$) between the water samples as water sample from Sa'achi and Nupeko record high nickel when compared to water from Nku and Egagi. Chromium means value ranged from 0.28 ± 0.10 mg/L in water sampled from Egagi to 0.40 ± 0.11 mg/L in water sampled from Sa'achi.

The mean chromium values show significant difference ($p<0.05$) between the water samples as water sample from Sa'achi record high chromium when compared to water from Nku, Nupeko and Egagi. The mean copper value ranged from 0.05 ± 0.03 mg/L in water sampled from Nupeko to 0.08 ± 0.03 mg/L in Sa'achi. The mean copper values show no significant difference ($p>0.05$) between the water samples from Nku, Sa'achi, Nupeko and Egagi.

Heavy metal concentration in sediments of some communities in Lavun floodplain of Niger State

The mean heavy metal in sediment samples from Lavun floodplain is presented in Table 2. The mean lead value ranged from 3.91 ± 0.29 mg/kg in sediment from Sa'achi to 4.40 ± 0.47 mg/L in sediment from Nupeko. The mean lead shows significant ($p<0.05$) difference between the sediment samples across the flood plain. The cadmium mean value ranged from 1.23 ± 0.42 mg/kg in sediment sample from Nupeko to 1.66 ± 0.26 mg/kg in sediment sampled from Sa'achi. The mean cadmium values show no significant difference ($p>0.05$) between the sediment samples from Nku, Sa'achi, Nupeko and Egagi. Cobalt mean value ranged from 1.06 ± 0.17 mg/kg in sediment sampled from Nku to 1.33 ± 0.29 mg/kg in Nupeko.

The mean cobalt values show significant difference ($p<0.05$) between the sediment samples as samples from Nku significantly

record low cobalt value when compared with sediment values from Nupeko, Sa'achi and Egagi. Nickel mean value ranged from 2.68 ± 0.54 mg/kg in sediment sampled from Nku to 3.85 ± 1.08 mg/kg in sediment sampled from Egagi. The mean nickel values show significant difference ($p<0.05$) between the sediment samples as sediment sample from Nupeko record high nickel when compared to water from other sampled areas. Chromium means value ranged from 5.93 ± 2.13 mg/kg in sediment sampled from Egagi to 7.29 ± 1.16 mg/kg in sediment sampled from Nku. The mean chromium values show significant difference ($p<0.05$) between the sediment samples as sample from Egagi record low chromium when compared to water from Nku, Nupeko and Egagi. The mean copper value ranged from 5.62 ± 1.60 mg/kg in sediment sampled from Egagi to 6.85 ± 2.02 mg/kg in Sa'achi. The mean copper values show significant difference ($p>0.05$) between the sediment samples from Nku, Sa'achi, Nupeko and Egagi.

Heavy metal concentration in sediments of some communities in Lavun floodplain of Niger State

The mean heavy metal in sediment samples from Lavun floodplain is presented in Table 2. The mean lead value ranged from 3.91 ± 0.29 mg/kg in sediment from Sa'achi to 4.40 ± 0.47 mg/L in sediment from Nupeko. The mean lead shows significant ($p<0.05$) difference between the sediment samples across the flood plain. The cadmium mean value ranged from 1.23 ± 0.42 mg/kg in sediment sample from Nupeko to 1.66 ± 0.26 mg/kg in sediment sampled from Sa'achi. The mean cadmium values show no significant difference ($p>0.05$) between the sediment samples from Nku, Sa'achi, Nupeko and Egagi. Cobalt mean value ranged from 1.06 ± 0.17 mg/kg in sediment sampled from Nku to 1.33 ± 0.29 mg/kg in Nupeko.

The mean cobalt values show significant difference ($p<0.05$) between the sediment samples as samples from Nku significantly record low cobalt value when compared with sediment values from Nupeko, Sa'achi and Egagi. Nickel mean value ranged from 2.68 ± 0.54 mg/kg in sediment sampled from Nku to 3.85 ± 1.08 mg/kg in sediment sampled from Egagi. The mean nickel values show significant difference ($p<0.05$) between the sediment samples as sediment sample from Nupeko record high nickel when compared to water from other sampled area. Chromium mean value ranged from 5.93 ± 2.13 mg/kg in sediment sampled from Egagi to 7.29 ± 1.16 mg/kg in sediment sampled from Nku. The mean chromium values show significant difference ($p<0.05$) between the sediment samples as sample from Egagi record low chromium when compared to water from Nku, Nupeko and Egagi. The mean copper value ranged from 5.62 ± 1.60 mg/kg in sediment sampled from Egagi to 6.85 ± 2.02 mg/kg in Sa'achi. The mean copper values shows significant difference ($p>0.05$) between the sediment samples from Nku, Sa'achi, Nupeko and Egagi.

Table 1: Mean Heavy Metal Concentration of Water Sampled of Some Communities in Nupe Flood Plain of Niger State.

	Sampling Stations			
Heavy Metals	Nku	Sa'achi	Nupeko	Egagi
Lead (mg/L)	0.03±0.02[a]	0.04±0.02[a]	0.05±0.03[a]	0.03±0.02[a]
Cadmium (mg/L)	0.05±0.01[b]	0.01±0.01[a]	0.01±0.01[a]	0.01±0.01[a]
Colbat (mg/L)	0.01±0.01[a]	0.01±0.01[a]	0.02±0.01[a]	0.01±0.05[a]
Nickel (mg/L)	0.08±0.05[a]	0.10±0.06[b]	0.14±0.08[b]	0.08±0.06[a]
Chromium (mg/L)	0.33±0.09a	0.40±0.11[b]	0.34±0.06[a]	0.28±0.10[a]
Copper (mg/L)	0.07±0.09[a]	0.08±0.03[a]	0.05±0.03[a]	0.07±0.05[a]

NB: value are presented in mean ± Standard deviation with minimum and maximum value of each parameter in parenthesis. Difference superscript in a row indicate significant while same superscript indicate no significant.

Table 2: Mean Heavy Metal Concentration of Sediments Sampled of Some Communities in Lavun Flood Plain of Niger State

	Sampling Stations			
Heavy Metals	Nku	Sa'achi	Nupeko	Egagi
Leads (mg/kg)	4.15±1.95[b]	3.91±0.29[a]	3.94±1.58[a]	4.40±0.47[b]
Cadmium (mg/kg)	1.51±0.20[a]	1.66±0.26[a]	1.23±0.42[a]	1.59±0.13[ab]
Cobalt (mg/kg)	1.06±0.17[a]	1.28±0.27[b]	1.33±0.29[b]	1.20±0.27[b]
Nickel (mg/kg)	2.68±0.54[a]	3.09±1.13[b]	3.15±1.04[b]	3.85±1.08[b]
Chromium (mg/kg)	7.29±1.16[b]	6.10±1.49[b]	6.95±2.20[b]	5.93±2.13[a]
Copper (mg/kg)	6.85±2.02[b]	6.31±1.35[b]	6.00±2.03[b]	5.62±1.60[a]

NB: value are presented in mean ± Standard deviation with minimum and maximum value of each parameter in parenthesis. Difference superscript in a row indicate significant while same superscript indicate no significant.

Discussion

Heavy metal concentration in water of some communities in Lavun flood plain of Niger State

Heavy metal concentration in water samples measured in communities in Lavun floodplain of Niger was slightly high for the four sampling stations. The concentration of Pb in this study ranged from 0.00, 0.01 to 0.13 mg/L. The lowest value of 0.00, 0.01 mg/L recorded from September, November 2023 and January 2024 in Egagi, Nupeko and Nku could be attributed to discharge of gasoline which is another mechanism of anthropogenic into the River (Meme *et al.*, 2014). The highest value 0.13 mg/L recorded in August 2023 could be due to increased fluctuation of particulates in the Communities, and it's in agreement with the report of Adewami *et al*., (2017). The mean value of Co ranged from 0.01±0.01 to 0.02 ±0.05 mg/L were not significantly different ($p > 0.05$) between the sampling station and the sampling months. The minimum level of Co may be due to seasonal changes within the water column resulting from anthropogenic and runoff from land-based sources (Akinsanyan *et al.,* 2012). The mean Cu value ranged from 0.07±0.09 mg/L. The highest of 0.15 mg/L in the month of September 2023 in Egagi, and lowest of 0.01 mg/L in Nupeko from the month of February 2024 were not within the recommended ranged of 1.3 mg/L (USEPA, 2010).

Cd was slightly detected in all the sampled stations in concentration that were not above the permissible limit of 0.01 mg/L (Izuchukwu *et al*., 2017), Nku, Nupeko and Egagi recorded the highest range value of 0.01 to 0.03 mg/L. Cd toxicity posed a very serious medical threat that could leads to fatality as it exposed increased overtime (Ojutiku *et al.,* 2015). The concentration of Nickel in this study ranged from 0.10±0.06 mg/L. The lowest concentration of 0.03 mg/L recorded in months of December, in Nku, Sa'achi in February and Egagi in December, 2023 had the highest distribution of heavy metals compared to the heavy metals analysed in the study by Amadi *et al.* (2012). This could be attributed to abundant released of fertilizer during farming and fossil fuel (Ugokwe *et al.,* 2007).

Heavy metal concentration in sediments of some communities in Lavun floodplain of Niger State

Heavy metals produced from variety of natural and anthropogenic sources (Bauvais *et al.,* 2015). According to many authors, heavy metals produced may either remain in the water for some periods of time or be taken up by some aquatic organism and even deposited in the sediments in the water body (Zaghloul, 2000). The mean concentrations of heavy Pb in the sediment ranged from 3.91±0.29 to4.40±0.47 mg/kg were recorded from Egagi and Sa'achi are significantly different ($p < 0.05$) when compared with other stations (Uzairu *et al.,* 2014).

Table 3 Heavy Metal Concentration in some Selected Fish Species

	Sampled fish species					
Heavy Metals	*Heterotis niloticus*	*Tilapia zilli*	*Oreochromis niloticus*	*Malapterurus electricus*	*Clarias Garipeinus*	*Auchenoglanis occidentalis*
Leads (mg/kg)	0.21±0.21[b]	0.14±0.11[b]	0.04±0.06[b]	0.61±1.05[b]	0.28±0.14[b]	0.41±0.42[b]
Cadmium (mg/kg)	0.02±0.03[a]	0.02±0.07[a]	0.04±0.06[a]	0.18±0.24[b]	0.06±0.07[a]	0.09±0.09[a]
Cobalt (mg/kg)	0.17±0.09[a]	0.21±0.08[a]	0.16±0.07[a]	0.35±0.17[b]	0.30±0.25[b]	0.23±0.09[b]
Nickel (mg/kg)	0.48±0.54[a]	0.46±0.37[a]	0.51±0.33[a]	1.27±0.89[b]	0.77±0.31[a]	0.82±0.28[a]
Chromium (mg/kg)	2.41±1.10[b]	1.59±0.98[a]	1.57±1.00[a]	2.48±1.78[b]	1.80±1.46[a]	1.98±1.76[a]
Copper (mg/kg)	0.43±0.18[a]	0.57±0.44[a]	0.45±0.33[a]	0.57±0.34[a]	0.42±0.47[a]	0.76±0.67[a]

.NB: value are presented in mean ± Standard deviation with minimum and maximum value of each parameter in parenthesis. Difference superscript in a row, indicate significant while same superscript indicates no signifant

This may be attributed to higher level of human activities across the sampling stations. Cd value ranged from 1.23±0.42 to 1.66±0.26 mg/kg recorded in Nupeko and Sa'achi had no significant different ($p > 0.05$). This could be attributed to effluent discharged from domestic and washing of clothes and dishes close to the bottom of the river (Kolo & Tukura, 2007). This result is in agreement with Amadi, (2012) who revealed that increased concentration of Cd in Aba River due to three sources of pollution arising from human activities along the river course. The concentration of Co recorded in this study ranged from 1.06±0.17 to 1.33±0.29 mg/kg showed higher distribution of heavy metal in Nku and Nupeko. This could be as a result of detergent used for washing of clothes and batting, similar to the finding of Keke *et al.,* (2015) who reported that Co, Mn and Fe had values higher than the recommended value of (2.03 0. 34 mg/kg). The lowest mean concentration of Ni 2.68± 0.55 mg/kg observed at Nku could be attributed to lack of mining industries and discharged of industrial waste. The highest mean value of 3.85± 1.08 mg/L recorded at Egagi may be due to lower amounts of water during dry season periods (Uzairu *et al.,* 2014). The mean concentration of Cr ranged from 5.93±2.13 to 7.29±1.16 mg/kg in Egagi and Nku showed a significantly different ($p > 0.05$) with the highest and the lowest mean value recorded across the four sampled stations. This is parallel to the finding of Adewami *et al.,* (2017) that recorded mean value of 0.40±0.02 and 0.70±0.04 mg/kg from Nile River, Egypt. The mean value of copper across the station showed significant difference ($p < 0.05$) though the lowest mean value of mg/kg in Egagi. The highest mean value of 6.85±2.02 mg/kg recorded may be due to the decreased sources of copper pollution during the period of sampling (Uzairu *et al.,* 2014). This finding corroborates with the results of Adekola and Eletha, (2007) who reported higher concentration of Zinc, Chromium and Copper from Asa River Ilorin, Nigeria.

Heavy metal concentration in some selected fish species of some sampled river from some communities in Nupe flood plain of Niger State

The species of fish encountered in this study *Orechromis niloticus* had the lowest concentration mean Pb of 0.04±0.06 mg/kg across all the stations where *Malapterurus electricus* had the highest mean value of 0.61±1.05 mg/kg had no significant different ($p < 0.05$) between the four sampled stations and the study periods. The result indicates that similar trend of heavy metal concentration can be represented Fe > Zn > Mn > Pb > Cu leads bioremediation of sediments level at the course of the river and the bottom (Eneji *et al.,* 2011). The *Clarias gariepinus* recorded the lowest mean concentration of 0.42±0.47 mg/kg, the lowest value recorded indicate lower concentration detected Cr (Eneji *et al.,* 2011) result from different species encountered where *Auchenoglaris occidentalis* captured had the highest concentration of 0.76±0.67 mg/kg were not significantly different ($p > 0.05$) across all the stations (Brazova *et al.,* 2012).

Cadmium (Cd), Cobalt (Co), Nickel (Ni) and Chromium (Cr) are the most common toxicants found in the communities among the six species of fish encountered (Sireli *et al.,* 2006). Cd recorded the lowest concentration of 0.02±0.03 mg/kg from *Heterotis niloticus* and *Tilapia zilli* across all the sampled stations where *Malapterurus electricus* had the highest value of 0.18±0.24 mg/L could be attributed to direct washing of cloth and bathing with detergent (Uzairu *et al*., 2014). This corroborate with the reports of Adewami *et al.,* (2017) who stated that heavy metals in some fish species were significantly higher at Efemi River, Nigeria. The concentration of Cobalt in fish species, the value of 0.16±0.07 mg/kg recorded from *Orechromis niloticus* were slightly low when compared with other values where the highest value of

0.35±0.17 mg/kg recorded from *Malapterurus electricus* could be attributed species had more heavy metal concentration than all the species captured in this study (Oyebamiji *et al*., 2018).

Conclusion

This study assessed the distribution and bioaccumulation of selected heavy metals (Pb, Cd, Co, Ni, Cr, and Cu) in water, sediments, and commercially important fish species from the Lavun Flood Plain, Niger State, Nigeria. The findings revealed that heavy metal concentrations varied across environmental matrices, with sediments consistently recording higher metal loads than water, confirming their role as major sinks and potential secondary sources of contamination within the floodplain ecosystem. In the water samples, Pb, Co, and Cu showed no significant spatial variation across sampling stations, while Cd, Ni, and Cr differed significantly, indicating localized anthropogenic influences such as agricultural runoff, domestic waste discharge, and the use of agrochemicals within surrounding communities. Sediment samples exhibited significantly elevated concentrations of most metals, reflecting long-term accumulation and highlighting the vulnerability of the floodplain to persistent pollution inputs. Among the fish species analysed, *Malapterurus electricus* demonstrated the highest bioaccumulation potential for several metals, whereas *Oreochromis niloticus* and *Heterotis niloticus* generally recorded lower concentrations. The detection of toxic metals in edible fish tissues raises concern over possible ecological risks and human health implications for local populations that depend on these fish resources for food and livelihood. Overall, the study underscores the need for continuous ecological monitoring, enforcement of pollution control measures, and public awareness strategies to reduce heavy metal inputs into the Lavun Flood Plain.

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