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Research Paper

Seasonal Assessment of Heavy Metals Concentration in Water and Commercially Important Fishes of Upper River Niger, Lokoja, Kogi State

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Abstract
This study assessed the level of bio-accumulated heavy metal in the water and fish during raining and dry season. The study was carried out within River Niger at Lokoja, Nigeria. Water samples were collected bimonthly for the dry season from month of November to January and for the wet season from month of August to October from each site. The sample were collected at 400cm depth below the water surface using pretreated poly propylene of 500ml capacity 50 meters distance from river bank in a boat. The fish samples were collected using cast nets by the hired fishermen who throw the cast net many times at each site so as to catch the target fishes. This fish were collected in this manner bimonthly for six month (August to January). The fish caught by the net were washed, weighed and preserved in the refrigerators for a day before taking for heavy metal analysis. The physio-chemical parameters of the water were measured in-situ using Hannah instrument (model-Hi 98129, Hi 98130). The study revealed that the mean concentrations of the heavy metal in the water among the site are the same. Apart from Cr which concentration in water samples from Okumi, Adankolo and Kwata were within the permissible limits of 0.100 mg/l set EPA but within the permissible limits of WHO. Pb, Cu, As and Ag concentration in all the water samples from Okumi, Adankolo and Kwata were all above the permissible limits sets by WHO and EPA. The concentration of heavy metals in fish samples during the wet season showed significant difference ($P<0.05$) among the species of fish samples August, September and October. The study therefore, recommend the need for proper waste disposal and enforcement of laws on proper agricultural, industrial and domestic waste disposal.

Keywords: Heavy Metals, Concentration, Water, Fishes, Upper River Niger, Lokoja

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I. Introduction

In recent years, life in all its form is threatened by water pollution. The quality of life is a quality of water being one of the most important natural resources. Despites the importance accorded to water, human activities over the years have jeopardize water quality in all its form making it harmful for life in water and on land.Globally, water pollution is problem seriously affecting aquatic life. One of the most important pollutants is heavy metals.This issue is of paramount concern to the United Nation as captured in Goal number three (good health and well-being), Goal number six (clean water and sanitation) and Goal number fourteen (life below water) of the SeventeenSustainable Development Goals (SDGs) that centered around sustainable surface water management (United Nation 2014).

According to United Nation (2016), fish account for17% of the global population intake of animal protein and up to 57 million people are engage in the primary fish harvesting and production sector. Fisheries and aquaculture offers ample opportunities to reduce hunger and improve nutrition, alleviate poverty, generate economic growth and ensure better use of natural resources. FAO blue initiative aims at harmonizing the environment, social and economic aspects of using aquatic resources to ensure equitable benefits for communities (FAO 2015).

One of the threats to aquatic life is environmental contaminants as well as pollutants that are increasing observed in surface water (Masindi and Muedi 2018). During the last hundred years, industrialization has grown

at a fast rate. It has thus increased the demand for exploitation of the earth's natural resources at a careless rate, which has exacerbated the world's problem of environmental pollution (Guatam*et.al.,*2016). Surface water pollution of heavy metals is increasingly becoming a problem and has become a great concern due to the adverse effects it is causing around the aquatic life (Renal *et. al.,* 2020).

Heavy metals according to Tchounwon (2012), Gautam *et. al.,* (2016) and Azeh*et. al.,* (2019) are those metals that have a higher density and a small quantity of it is toxic. The heavy metals include Titanium (Ti), Vanadium (Va), Chromium (Cr), Manganese (Mn), Iron (Fe) ,Cobalt (C0), Nickel (Ni), Copper (Cu), Zinc (Z) ,Arsenic (AS), Molybdenum (Mo), Silver (Ag), Cadnum (Cd), Tin (Tn), Platinum (P), Gold (pb), Mercury (Hg), Lead (pb). These heavy metals are found naturally on the earth crust since the earth's formation due to the astonishing increase of the use of heavy metals, it has resulted in an imminent surge of metallic substances in both the terrestrial environment and aquatic environment (Guatam*et. al.,* 2016). These heavy metals ifwithin permissible limits in water are important for healthy metabolism but when their concentration is high these elementscan also be toxic. The present of heavy metals in water can transfer and stockpile in fiches and cause threat to their health status. High concentration of heavy metals in rivers can cause a disability of ecosystem, as these metals accumulate inthe aquatic animals and enter the food chain causing health problems and even death of someorganisms including humans.

Heavy metal pollution has emerged due to anthropogenic activities primarily due to mining the metal, smelting, foundries as a result of urbanization and other industries that are metal based, leaching of metals from different sources such as land fillers, waste dumps, excretion, livestock and chicken manure, dungs, automobiles and road works. (Renald*et. al.,*2020). Heavy metals use in the agricultural field has been the secondary source of heavy metal pollution such as the use of pesticide, insecticide, fertilizers and more. Natural causes can also increase heavy metals pollution such as volcanic activity metal corrosion, metal evaporation from soil and water and sediment re-suspension, soil erosion, geological weathering (Masindi and Muedi 2018andYusuf*et. al.,* 2020).

Toxicity of heavy metals depends on a lot of factors such as which metal is present, the nature of the metal, the biological role of the metal, the organism exposed and the period of the organism's life when it is exposed (Renal *et. al.,*2020). If one organism is affected, this will affect all the food chain. Since humans are usually the last of the food chain, this will affect us more as we would have accumulated more heavy metals as the concentration increases along the food chain.

Gupta *et. al.,* 2012 and Yusuf *et. al.,* 2020 analysis of the sedimentation of some pollution indicates peaks during period of extreme weather events. There is an increased trend of the present of certain heavy metals and other organic pollutants in major rivers with consequences impacts on aquatic lives. This represents potential dangers to public health from the consumption of the aquatic organism (Li *et. al.,*2017).

This situation is further exacerbated by the high rate of erosion in the riverine area and in uncontrolled disposal of urban waste which have contributed to increased sedimentation in most rivers (Wangboje, 2017). Chemical contamination of aquatic ecosystem due to increasing human influence and climatic change is unquestionably a global environmental problem. With the increasing anthropogenic activities in Lokoja Metropolis and several settlements upstream, toxic residue of heavy metals are continuously mobilized and carried in the river from different channels to river Niger. In addition to this existing toxic residue on the upper land, the floodplain of river Niger have been engaged with agricultural activities mainly rice production with massive use of agrochemical with most of them non-biodegradable.

It is clear that pollution of fresh water ecosystem is a global problem. This problem is alarmingly becoming high in Nigeria, Lokoja especially being one of the largest fish commercial centers in Nigeria with attendant public health effect on the dependent population. Fish, a source of protein with pronounced placement on local food menu is now considered an important dietary threat of heavy metal and agrochemical toxicity through consumption. Heavy metals are toxic as they are persistent non-biodegradable in living organism (Wangboje, 2017). During raining season, river Niger watershed brings run-off water from hinterland into the river carrying deposits of heavy metals from anthropogenic activities. However, some dissolved heavy metals carried along the runoff into the river can be bio concentrated in the fish dozy. Also the accumulation of heavy metals in fish food organism such as planktons and some water plants can be transferred to fishes and if the level is too high, it will affect the final consumers of fishes. Study has shown that the concentration of heavy metals is a function of a season and fish species and accumulate more in water at certain season (wet and dry) and more in some fish tissues than others.

This study assessed the level of bio-accumulated heavy metal in the water and fish during raining and dry season and compared the level of heavy metals accumulation in water and some important commercial fish species with FEPA, WHO, FAO standard to ascertain human health implication. The international agency for research on cancer (IARC) has classified heavy metals into four (4) groups as shown in table 1.

Table 1:Classification of Heavy Metal Carcinogenicity

Groups	Carcinogenicity level in human	Evidence	Heavy metal Classification
Group 1	Carcinogenic	Sufficient evidence in human	Al production, Arsenic and inorganic Cd and Cd compound Cr Vi compound, Ni compound Ni refining
Group 2a	Probably Carcinogenic	Limited evidence in humans, enough evidence in animals	Lead compound inorganic
Group 2b	Possibly carcinogenic	Limited evidence in humans , not enough evidence in animal	Tanatiumpentoxic, molybdenumpen,methyl mercury, nickel metallic alloys –pb, -Co
Group 3	Carcinogenicity not classifiable	Insufficient evidence in human, insufficient evidence in animal	Cr II compound, Cr metallic compound Cu, Hg, Se and Se compound
Group 4	Probably not carcinogenic	Evidence suggests no carcinogenic	Mn, Ag, Zn

Source: Corant and Middleton (1990).

II. Materials and Methods

Study Area

The study was carried out within River Niger at Lokoja, Kogi State, Nigeria. The study between Latitude 70°451 north of the equator and Longitude 60°451 east of the Greenwich Meridian..The climate of Lokoja is tropical in nature and with the dry season running from November to March while the wet season runs from April to October. The mean temperature reading in lokoja in the month of January (Dry season) is 27^{o}C - 30^{o}C and 25^{o}C-27^{o}C in July (Rainy season) respectively. The month of March and April records the highest temperature with high evaporation from both the metropolis and the River Niger surfaces. The humidity is between 55% to 75% in January and increases to between 75% to 95% in July.The vegetation is of the guinea savannah with the mixture of different variety of trees, shrubs and grasses. The substratum of river Niger consists mainly of fine sand mixed with mud and pebble. Decaying macrophytes and debris also form part of the substratum. The major inhabitants of the study area areKakanda, Nupe, Igala and Ebira who are actively engaged in farming, fishing, commerce, mining, artisan industrial activities, transportation (road and water transport). The major crops produced are groundnuts, rice, cassava, yam, maize, tomato, melon amongst others.

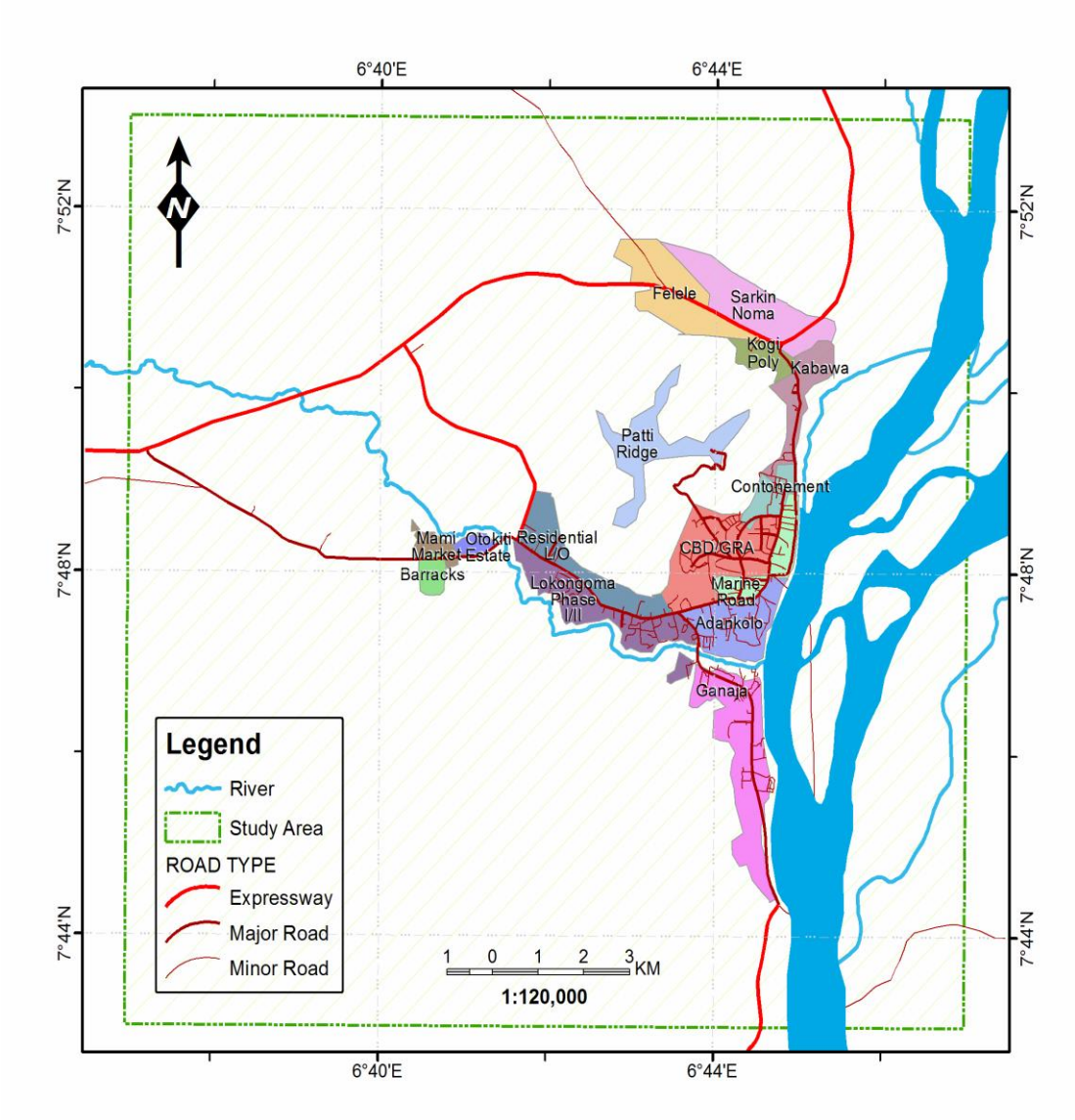

Fig. 1.1: Study Area Map

Sample Collection

Samples were collected from three sampling sites. The first site designated as site A, was located at Adankolo (latitude 7 ^{0} 49'25.20N and longitude 6 ^{0} 35'04.15E).The second site designated as site B was located at Kwata market fish land beside marine police station Lokoja lies within (latitude 7 ^{0} 55'15.80N and longitude 6 ^{0} 45'18.10E). The third site designated as site C was located at Okumi up Natako on Lokoja Abuja express road Lokoja lies within (latitude 7 ^{0} 59'40.30N and longitude 6 ^{0} 35'40.05E) (See figure 2).

Water samples were collected bimonthly for the dry season from month of November to January and for the wet season from month of August to October from each site. The sample were collected at 400cm depth below the water surface using pretreated poly propylene of 500ml capacity 50 meters distance from river bank in a boat. The fish samples were collected using cast nets by the hired fishermen who throw the cast net many times at each site so as to catch the target fishes. This fish were collected in this manner bimonthly for six month (August to January). The fish caught by the net were washed, weighed and preserved in the refrigerators for a day before taking for heavy metal analysis.

The physio-chemical parameters of the water were measured in-situ using Hannah instrument (model-Hi 98129, Hi 98130). In measuring the pH and temperature measurement, the pH mode on the instrument was selected with the set/hold button. The electrode was submerged in the sample water for 60 seconds. The measurement thus then taken when the stability when the stability symbol on the top left of the liquid crystal display (LCD) disappears. The pH value automatically compensated for temperature as it was shown on the primary (LCD) while the secondary (LCD) showed the temperature of the sample.

The same procedures were applied for dissolved oxygen measurement. The electrical conductivity and total dissolved solid were measured by using EC or TDS mode selected with set/hold button and the probe was submerged in the water sample. The measurement was taken when the stability symbol on the top left of the liquid crystal display (LCD) disappears. The EC or TDS value automatically compensated for EC which was shown on the primary LCD while the secondary LCD showed the TDS of the sample. The turbidity was measure using secchi disc.

Laboratory Procedures

Water sample was pretreated with 5ml of diluted nitric acid prior to digestion process and the digested and store for atomic absorption spectrophotometer (AAS) analysis as described by (Galyean 2010) for the heavy metals.

The fish samples were identified with taxonome keys as published by Obasebikan and Raji (1998) and absolute and syndnhan (2007). Seven commercially important fish species were identified and used for the study among the fishes caught. They were identified as chrysichthysnigrocligitatus, CitharinusCitarus, Clariasgariepirus, Heterotosniloticus, Oreochromis niloticus, Parachanna Obscura, Protoptarusannected. Each of those fish sample was weighed while and the total length taken and recorded. The fish samples were the over dried for digestion process prior to AAS analysis for heavy metal as described by (Galyean 2010). The heavy metals analysed includes lead (pb), Chronium (Cr), Copper (Cu), Arsenic (As), Silver (Ag). These heavy metals were analysed for the concentration in water sample and fish sample.

III. Result

Heavy metals concentration in water samples from River Niger at Lokoja during wet season

The concentration of heavy metals in the water sample during wet season is presented in Table 1. There was no significant different ($p<0.05$) among the heavy metals between the three sites except in Ag, which has 0.181 mg/l, 0.336mg/l, 0.488 mg/l for Okumi, Adankoloand Kwata.Results shows that Pb, Cr, Cu, As and Ag were above the permissible limits sets by WHO and EPA for aquatic animals.

Table 1: Heavy metals concentration in water samples from River Niger at Lokoja during wet season

Sites	**Heavy metals (mg/l)**				
	Pb	**Cr**	**Cu**	**As**	**Ag**
Adankolo	1.02b[a]	1.167[a]	2.860[a]	1.057	0.336[ab]
Kwata	1.234[a]	1.036[a]	2.790[a]	1.124[a]	0.488[a]
Okumi	1.264[a]	1.254[a]	2.960[a]	0.934[a]	0.181[b]
WHO	0.010	0.050	____	0.010	____
EPA	0.015	0.100	1.300	0.050	0.050
LSD	0.302NS	0.397NS	0.513NS	0.236NS	0.249NS
P. Value	0.221	0.515	0.817	0.254	0.058
SEM	0.101	0.131	0.191	0.111	0.083

Means value with the same letter superscript along the column are not significantly different ($p<0.05$), (WHO 2017), (EPA 2005).

Source: Researcher Analysis, 2021.

Concentration of heavy metal in fish during wet season from River Niger

The concentration of heavy metals in fish samples during the wet season showed significant difference ($P<0.05$) among the species of fish samples August, September and October (See table 2, 3 and 4).

Chrysichthysnigrogligitatus, Heterotisniliticus and Pararchanna obscura had more concentration lead 0.126 mg/l, 0.140mg/l, and 0.126 mg/l than clariasgariepirus 0.023, protoptorusamriectan 0.041 and Oreochromisniloticus 0.019 mg/l. There were significant differences ($P<0.05$) in the concentration of all the heavy metal in the fish species samples during wet season. There was also variation in the mean concentration of heavy metals in the fish samples among the month in the wet season (See table 2, 3 and 4).Pb and Ag concentration are all above the permissible limit (0.015 mg/l and 0.050 mg/l) in all the fishes during the wet season (August, September and October). Cr concentration in Heterotisniliticus and Oreochromisniloticus is higher than the EPA permissible limit of 0.100mg/l during the wet season (August, September and October). The Cu concentration in all the fishes is within the permissible limit of EPA (See table 2, 3 and 4).

Table 2: Concentration of heavy metal in fish from River Niger in August

August/Heavy Metals (Mg/L)					
Fish	**Pb**	**Cr**	**Cu**	**As**	**Ag**
Chrysichthys sp.	0.126[a]	0.094[b]	0.034[abc]	0.060[c]	0.049[cd]
Citharinus sp.	0.072[b]	0.041[b]	0.035[abc]	0.078[a]	0.070[a]

Clarias sp.	0.023[c]	0.041[b]	0.038[ab]	0.067[a]	0.055[bc]
Heterotis sp.	0.140[a]	0.115[a]	0.029[c]	0.072[ab]	0.052[cd]
Oreochromis sp.	0.019[b]	0.102[b]	0.039[a]	0.069[b]	0.055[b]
Parachanna sp.	0.126[a]	0.097[b]	0.035[ab]	0.073[ab]	0.046[d]
Protopterus sp.	0.041[b]	0.093[b]	0.033[bc]	0.060[c]	0.051[cd]
EPA Limit	0.015	0.100	1.300	0.050	0.050
LSD	0.021	0.011	0.005	0.006	0.006
p. value	<0.001	<0.001	0.017	<0.001	<0.001
SEM	0.007	0.004	0.002	0.002	0.002

Mean value with the same letter superscript along the column are not significantly different (p<0.005).
Source: Researcher Analysis, 2021.

Table 3:Concentration of heavy metals in fish from River Niger in September

September/Heavy Metals (Mg/L)					
Fish	**Pb**	**Cr**	**Cu**	**As**	**Ag**
Chrysichthys sp.	0.153[a]	0.092[b]	0.031[b]	0.056[c]	0.054[bc]
Citharinus sp.	0.070[c]	0.041[b]	0.036[ab]	0.061[bc]	0.064[a]
Clarias sp.	0.965[b]	0.103[a]	0.031[b]	0.065[ab]	0.058[abc]
Heterotis sp.	0.115[b]	0.105[a]	0.031[b]	0.070[a]	0.064[a]
Oreochromis sp.	0.022[d]	0.103[a]	0.041[a]	0.071[a]	0.059[abc]
Parachanna sp.	0.105[b]	0.100[a]	0.033[b]	0.061[bc]	0.061[ab]
Protopterus sp.	0.049[c]	0.100[a]	0.031[b]	0.061[bc]	0.061[ab]
EPA Limit	0.015	0.100	1.300	0.050	0.050
LSD	0.023	0.006	0.006	0.006	0.008
p. value	<0.001	<0.001	0.038	<0.001	0.004
SEM	0.008	0.002	0.002	0.002	0.003

Mean value with the same letter superscript along the column are not significantly different (p<0.005).
Source: Researcher Analysis, 2021.

Table 4:Concentration of heavy metals in fish from River Niger in October

October/Heavy Metals (Mg/L)					
Fish	**Pb**	**Cr**	**Cu**	**As**	**Ag**
Chrysichthys sp.	0.132[a]	0.100[ab]	0.024[c]	0.056[c]	0.058[b]
Citharinus sp.	0.128[a]	0.020[c]	0.039[a]	0.061[bc]	0.057[b]
Clarias sp.	0.132[a]	0.104[ab]	0.033[ab]	0.065[ab]	0.060[b]
Heterotis sp.	0.096[b]	0.103[ab]	0.037[a]	0.070[a]	0.058[b]
Oreochromis sp.	0.017[c]	0.106[a]	0.039[a]	0.071[a]	0.056[b]
Parachanna sp.	0.091[b]	0.100[ab]	0.030[bc]	0.061[bc]	0.067[a]
Protopterus sp.	0.049[c]	0.097[b]	0.029[bc]	0.061[bc]	0.057b
EPA Limit	0.015	0.100	1.300	0.050	0.050
LSD	0.014	0.007	0.007	0.006	0.006
p. value	<0.001	<0.001	0.002	0.001	0.017
SEM	0.005	0.002	0.002	0.002	0.002

Mean value along the column with same letter superscript are not significantly different (P<0.005)
Source: Researcher Analysis, 2021.

Heavy metals concentration in water samples from River Niger at Lokoja during the dry season

The concentration of heavy metals in the water samples during dry season is presented in table 5. There was no significant different in the concentration of heavy metals between the site water during the dry season. The mean concentrations of the heavy metal in the water among the site are the same. Apart from Cr which concentration in water samples from Okumi, Adankolo and Kwata were within the permissible limits of 0.100 mg/l set EPA but within the permissible limits of WHO. Pb, Cu, As and Ag concentration in all the water samples from Okumi, Adankolo and Kwata were all above the permissible limits sets by WHO and EPA (See table 5).

Table 5: Heavy metals concentration in water samples from River Niger at Lokoja during dry season

Heavy Metals (Mg/L)					
Site	**Pb**	**Cr**	**Cu**	**As**	**Ag**
Adankolo	0.747[a]	0.759[a]	2.361[a]	0.639[a]	0.086[a]
Kwata	0.899[a]	0.690[a]	2.321[a]	0.579[a]	0.071[a]
Okumi	0.884[a]	0.904[a]	2.397[a]	0.436[a]	0.109[a]

WHO (limit)	0.010	0.050	____	0.010	____
EPA (limit)	0.015	0.100	1.300	0.050	0.050
LSD	0.352	0.386	0.387	0.235	0.046
P-value	0.619	0.500	0.918	0.201	0.226
SEM	0.120	0.129	0.129	0.078	0.015

Mean value with the same letter superscript along the column are not significantly different (P<0.005).
Source: Researcher Analysis, 2021.

Concentration of heavy metal in fish during dry season from River Niger

Concentration of heavy metals in fish samples during dry season showed significantly different (P<0.005) among the fish species and months.These are shown in table 6, 7 and 8 below. From the result, there was a significant different in Pb between heterotis spp. And orechromissp but there is no significant different in Cr between clariassp and heterotis, chrysichhys and parachanna in as between clarias, heterotis and oreochromis. Pb concentrations of all the months were above the permissible limits of EPA except in oreochromis which is within limit in November and December. Cr concentrations of all the fish samples of the dry season months were within the permissible limits of EPA except inCitharinussp which is above limit in January. Cu concentrations of all the fish samples in all the months in the dry season are within the permissible limits of EPA. As concentrations of all the fish samples of the dry season months were not within the permissible limits of EPA except inChrysichthysspwhich is above limit in December. The concentrations of Ag are not uniform among fishes in the dry season months with the concentrations slightly above or below the EPA limit set limit of 0.050 mg/l (See table 6, 7 and 8).

Table 6: concentration of heavy metals in fish spp during dry season in November

November/Heavy Metals (Mg/L)					
Fish	**Pb**	**Cr**	**Cu**	**As**	**Ag**
Chrysichthys sp.	0.020^{bc}	0.089^{b}	0.029^{abc}	0.057^{c}	0.045^{b}
Citharinus sp.	0.052^{abc}	0.017^{d}	0.030^{a}	0.072^{a}	0.061^{a}
Clarias sp.	0.020^{bc}	0.092^{b}	0.030^{a}	0.061^{bc}	0.043^{b}
Heterotis sp.	0.068^{ab}	0.097^{a}	0.028^{bc}	0.066^{ab}	0.047^{b}
Oreochromis sp.	0.014^{c}	0.090^{b}	0.027^{c}	0.060^{bc}	0.051^{b}
Parachanna sp.	0.099^{a}	0.098^{a}	0.029^{abc}	0.071^{a}	0.043^{b}
Protopterus sp.	0.024^{bc}	0.083^{c}	0.030^{ab}	0.056^{c}	0.049^{b}
EPA Limit	0.015	0.100	1.300	0.050	0.050
LSD	0.047	0.005	0.002	0.008	0.008
p. value	0.015	<0.001	0.018	0.002	0.005
SEM	0.015	0.002	0.001	0.002	0.003

Mean value with the same letter superscript along the column are not significantly different (P<0.005).
Source: Researcher Analysis, 2021.

Table 7: concentration of heavy metals in fish spp during dry season in December

December/Heavy Metals (Mg/L)					
Fish	**Pb**	**Cr**	**Cu**	**As**	**Ag**
Chrysichthys sp.	0.085^{a}	0.087^{b}	0.018^{e}	0.042^{d}	0.047^{bc}
Citharinus sp.	0.018^{b}	0.014^{d}	0.032^{a}	0.056^{c}	0.050^{abc}
Clarias sp.	0.106^{a}	0.079^{c}	0.024^{cd}	0.064^{a}	0.058^{a}
Heterotis sp.	0.020^{b}	0.080^{c}	0.027^{bc}	0.066^{a}	0.057^{a}
Oreochromis sp.	0.014^{c}	0.087^{b}	0.030^{ab}	0.067^{a}	0.053^{abc}
Parachanna sp.	0.094^{ab}	0.086^{b}	0.029^{ab}	0.059^{bc}	0.045^{c}
Protopterus sp.	0.017^{b}	0.099^{a}	0.021^{de}	0.056^{c}	0.055^{ab}
EPA Limit	0.015	0.100	1.300	0.050	0.050
LSD	0.020	0.005	0.004	0.005	0.009
p. value	<0.001	<0.001	<0.001	<0.001	0.040
SEM	0.006	0.002	0.001	0.002	0.003

Mean value with the same letter superscript the column are not significantly different (P<0.005).
Source: Researcher Analysis, 2021.

Table 8: concentration of heavy metal in fish during dry season in January

January/Heavy Metals (Mg/L)					
Fish	**Pb**	**Cr**	**Cu**	**As**	**Ag**
Chrysichthys sp.	0.019^{bc}	0.089^{b}	0.022^{c}	0.065^{bc}	0.052^{b}
Citharinus sp.	0.022^{b}	0.120^{b}	0.038^{a}	0.068^{b}	0.049^{bc}
Clarias sp.	0.047^{a}	0.094^{b}	0.029^{b}	0.061^{cd}	0.044^{c}
Heterotis sp.	0.021^{bc}	0.530^{a}	0.029^{b}	0.073^{a}	0.052^{bc}
Oreochromis sp.	0.016^{c}	0.076^{b}	0.030^{b}	0.068^{b}	0.049^{bc}
Parachanna sp.	0.095^{a}	0.098^{b}	0.024^{c}	0.057^{d}	0.061^{a}
Protopterus sp.	0.017^{bc}	0.082^{b}	0.029^{b}	0.058^{d}	0.049^{bc}
EPA Limit	0.015	0.100	1.300	0.050	0.050
LSD	0.005	0.288	0.003	0.005	0.005
p. value	<0.001	0.044	<0.001	<0.001	<0.001
SEM	0.002	0.093	0.001	0.002	0.002

Mean value along the column with the same letter superscript are not significantly different ($p<0.05$).
Source: Researcher Analysis, 2021.

IV. Discussion

The concentration levels of heavy metals in water was observed to be higher in the dry season than in wet season in all the sampling sites which could result from high level of pollutants from home, cottage industries and mechanized activities washed into the river and reduced water volume in dry season leading to high concentration level of these metals.

Flooding and high-water velocity in wet season may be responsible for dilution of water bodies and taken away in flood leading to lower concentration level in wet season. Many compound of these metal are also soluble in water and they may washed away the action of water. This report agreed with the report of Bello and Ojutiku (2018) who had similar report. The water at the three sampling site had concentration of chromium and copper lower than the permissible limit Y (EPA, 2003) but have high level for lead. The wet and dry season observed displayed the same Arsenic and silver.

The above observation was different from the observation recorded with different fish samples, as the was higher concentration level of heavy metals in the fishes during wet season than in the dry season. These could as a result of high concentration of heavy metals washed into the river during wet season and because of the metabolic activities of the fish talk more heavy metals. This study has also shown that seven commercially important fish species chrysichthysnigrodigitatus, citharinuscitharus, clariasgarfiepinus, oreochromisnilotocus, heterotisniloticus, parachannaobasura and protopterusanmecten accumulated heavy metals at different concentration in their bodies. This observations agreed with Oluwa et al (2010) and Oseji et al (2018) who observed and stated that fishes accumulated metals differently as some usually have higher concentration than others. Though there was no significant difference ($P<0.005$) in the concentration of lead between chrysizhthys, heterotis and parachanna, between citharinusorechromis and propterus but clarias had different concentration.

The differences in the total concentration of heavy metal in these fishes could be as a result of their different micro-habits, metabolic rate and food habit (Oseji*et. al.,* 2018). The mean concentration of all the heavy metals observed (pb, Cr, Cu, As and Ag) were below the permissible limit (EPA, 2005) in all the fishes observed. The mean value of heavy metals concentration in all the fishes were generally low in the dry season than in the wet season as observed in this study. This observation could as a result of most heavy metals enters in to the water during wet season via runoff from the anthropogenic activities which would be bio-concentrated and biomagnified in the fishes because of metabolic activities which is usually higher during the wet season. The also agreed with observation of Oseji*et. al.,* (2018) who observed higher metals concentration in fishes during wet seasons.

V. Conclusion and Recommendation

This study proved that water content of River Niger at Lokoja contains some heavy metals (pb, Cr, Cu,) whose concentration level are below permissible level through the wet season and dry season but heavy metals (As and Ag) are above the permissible level which could endanger public health through consumption of these water. However, the study has observed that chrysichths sp. Citharinussp, clariassp, oreochromissp, had various level of heavy metals contamination. But the concentration of these metals falls below the permissible limit therefore pose no threat to human health when consuming these fishes.

Therefore, there is need for proper waste disposal and enforcement of laws on proper agricultural, industrial and domestic waste disposal should be carried out regularly by the state government environmental protection agency.

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