Biometric indices of Heavy Metals in the Sediments of Ethiope River

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Abstract
This present study evaluates the sediment characteristics of Ethiope River, Niger Delta, Nigeria. The investigation was carried out between January 2016 and December 2017 to ascertain the impact of anthropogenic activities on Ethiope River. Five locations were selected from Umuaja to Eku for this study. Sediment samples were analysed using standard methods. Different biometric indices were used. The Enrichment factor revealed high content for nickel, lead, and vanadium. The Geoaccumulation index (Igeo) showed a moderately to heavily polluted sediments with nickel, chromium, cadmium and vanadium. The results from pollution load index (PLI) values ranged from 1.44 to 3.10 for (2016) and varied from between 1.38 to 5.10 for (2017) indicated contaminated sediments. The potential ecological risk revealed high cadmium concentration and a very strong risk level at locations 3 and 4 of the river. Concentrations of Heavy metals obtained will act as a mitigation plan for monitoring anthropogenic activities along the stretch of Ethiope River.

Keywords: Biometric indices, Ethiope River, Particle Size and Sediment

INTRODUCTION

Data on the quality of sediment is important for evaluating the morphometry, hydrodynamic pressure and geological substrates of an aquatic ecosystem. It is a significant tool in assessing sediment-water interaction in water ecosystems (USEPA 2002). Sediment acts as a carrier, Indicator of harmful and radioactive materials in a water environment via bioaccumulation. Resuspension release contaminants into the water bodies by a process of. (Marchand, *et al*., 2006; Davies and Abowei 2009). (EcoRA) Ecological risk assessment of heavy metals has attracted more public attentions in the aquatic ecosystems ,that can show sediment contamination and its impacts on ecological function of the identify heavy metals in questioned (Lim *et al.* (2013); Venkatramanan *et al.* (2013) and Ogbeibu *et al* .(2014)|. Earlier research on the determination of sediment of some water bodies in Nigeria include the studies of Iwegbue et *al.* (2007), Fagbote and Olanipekun (2010), Ezekiel *et al*. (2011), Adepoju and Adekoya (2012) and Osakwe and Peretiemo-Clarke (2013). However, no information is available on the (EcoRA) potential ecological risk in Ethiope River, that is a comprehensive. The index reveals the toxicity of these metals in the aquatic ecosystem. Such an investigation is necessary for the quantitative and qualitative information on the toxicity level and its effects on the river bed. Therefore, this present study investigates the seasonal changes of heavy metals along the stretch of the various locations with the aim of assessing pollution level in Ethiope River, using different biometrics to evaluate sediment quality.

Study Area

The studied area which is located within the humid sub-equatorial region runs through the North central zone of Delta State, Nigeria. It lies across latitude. (05° 56' 31.4″ N and longitude. 06°13'58.7″ E and lat. 05°45'19.2″ N and long. 05°58'57.3″ E). It has a tropical wet and dry seasons, climate change regulated primarily by rainfall. The wet season falls between March and October while the dry season begins in October and ends in February. The average annual rainfall ranges from 0.7- 98.8 mm for (2016) and 6.2-103.1 mm for (2017). The recorded data from the Nigerian Meteorological Agency (NIMET), Warri, Delta State, its Temperature ranged from 32.6°C - 34.5°C for (2016) and 32.1°C – 35.3°C for (2017) Five locations were sampled (Umuaja, Umutu, Obiaruku, Abraka and Eku).

Materials and Methods

Sediments were collected between January (2016) and December (2017) from the aforementioned locations.

Sample Collection for Sediment

Composite sample were Composed from each location Five (5) hauls were made at each sampling location by sending the grab into the bottom and using the messenger to close and grab some quantity sediment that was wrapped in a foil paper.

The particle size and physicochemical parameters were analysed using Ekman Grab of 10 cm diameter and 12 cm long.

Heavy Metal Determination in Sediment

Air dried sediment was weighed (5g) into a conical flask. Then 50ml of HCl and HNO_3 (double acids) in a ratio 3:1 respectively was transferred into the flask containing sediment samples. The mixture was shaken with a mechanical shaker for 40 minutes and filter with whatman filter paper No 42. The heavy metals of the filtrate were then determined (iron, copper, lead, manganese, nickel and chromium) using Unican Atomic Absorption Spectroscopy

Distribution of Particle Size (Sand, Clay, and Silt)

Into 1 litre shaking bottle was weighed 100 grams of the composite soil. Then 50 ml calgon solution, 3 ml of sodium hydroxide and 200 ml of H_2O (water) were added. A mechanized shaker harmonized the mixture for 3 hours. The shaking bottle was removed and placed in mechanical analysis cylinder. Read for an interval of 5 minutes when a froth is formed. Add 1 or 2 drops of amyl alcohol before inserting the hydrometer for readings and appropriate temperature. The process was repeated 5 hours later.

Calculation:

One hundred grams (100 g) of soil sample was taken, the result gives directly the percentage of silt and clay (1st reading) and (2nd reading). Only fifty grams were used (as for some subsoil). The values should be multiplied by 2.

Specified Temperature coefficient as follows;

Corrected result = Reading + (temperature – 19.4 × 3)

Temperature coefficient = (Temperature – 19.4) × 0.3

% clay = H2 + its temperature coefficient

% silt = H1 + its temperature coefficient – (H2 + its temperature coefficient)

% sand = 100 – (% clay + % silt)

Pollution Indices

Enrichment factor, Geo accumulation index, Contamination Factor and Pollution Load Index; and Potential Ecological Risk Index (PERI) using methods of Tomlinson *et al.,* (1980); Hakanson (1980); Sutherland (2000); and Boszke *et al.,* (2004) to determine heavy metal contaminations. The heavy metals for this studied include iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Chromium (Cr), Cadmium (Cd), Lead (Pb), Nickel (Ni) and Vanadium (V).

Enrichment factor

Enrichment factor (EF) is used to reveal sources of contaminants from lithogenic (parent materials) and human induced activities. The (EF) values close to 1.0 indicates crusted origin, values (1.0 < 1.0) suggests a possible release from contaminated soil or depletion of metals, while (EF >1.0) indicates contamination from anthropogenic origin (Nweke and Ukpai (2016). In this study, Iron is chosen as geochemical normalizer because it has a relatively high concentration in the tropics and its chemical sensitive with oxides and hydroxides makes Iron carriers for heavy metals.

Sutherland (2000), reported five categories, which are generally recognized based on enrichment factor (EF): EF < 2: depletion of mineral enrichment or no enrichment;(2 ≤ EF < 5), moderate enrichment;(5 ≤ EF < 20), significant enrichment; (20 ≤ EF < 40), very high enrichment and extremely high enrichment (EF > 40)

Geoaccumulation index (Igeo)

This index is used to evaluate the level contamination (heavy metal) of sediment in a water body. It is expressed by Muller, (1979) and Boszke *et al.* (2004). as:

Where

C_n is the measured concentration of the metal (n) in the sample

B_n is the geochemical background concentration of the metal, n.

Factor 1.5 is used to reduce variations in the background values which may be attributed to lithological variations in soils.

Igeo has seven classification (0 to 6), indicating various degrees of enrichment above the background values and ranging from unpolluted to very highly polluted as expressed by [Muller (1979) and Boszke *et al.* (2004). {Class 0 (practically unpolluted): Igeo ≤ 0;

Class 1 (unpolluted to moderately polluted): 0 <Igeo< 1;

Class 2 (moderately polluted): 1 <Igeo< 2;

Class 3 (moderately to heavily polluted): 2 <Igeo< 3;

Class 4 (heavily polluted): 3 <Igeo< 4;

Class 5 (heavily to extremely polluted): 4 <Igeo< 5

Class 6 (extremely polluted): 5 >Igeo.}

Contamination Factor (CF) and Pollution Load Index (PLI)

Contamination Factor (CF) This tool was used to evaluate heavy metal contamination, Hakanson (1980). The pollution load index is obtained as concentration factor. [CF values were interpreted as follows: If CF < 1: low contamination;(1 < CF < 3): moderate contamination;(3 < CF < 6): considerable contamination and(CF > 6:) very high contamination]

While PLI can be expressed as:

This biometric is given as ;

When (PLI > 1), pollution exists; otherwise,

If (PLI < 1), no metal pollution (Tomlinson *et al.,* 1980).

Potential Ecological Risk Index (PERI)

The potential ecological risk index evaluates the heavy metal pollution in the soils and its toxic-response factor in relation to its ecological effects, Hakanson (1980). Ecological risk factor index expressed as

Where:

(*Er*) is quantitatively expressed as the potential ecological risk of a given contaminant.

Tr is the toxic-response factor for a given substance

Cf is the contamination factor.

Grade used to describe the ecological risk factor (*Eri*< 40: low potential ecological risk; 40 ≤ *Eri*< 80: moderate potential ecological risk; 80 ≤ *Eri*< 160: considerable potential ecological risk; 160 ≤ *Eri*< 320 high potential ecological risk and *Eri* ≥ 320: very high ecological risk.)

The potential ecological risk index (RI) is the sum of the risk factors.

(6)

$i = 1$

Where

Er is the single index of ecological risk factor

i is the count of the heavy metal.

The following categories expressed the potential ecological risk index as given by Hakanson (1980)

(RI < 150: low ecological risk; 150 ≤ RI < 300: moderate ecological risk and RI<300 > 600: very high ecological risk.)

Table 1. Potential Ecological Risk, Grading Standard of Heavy Metals in Sediment .

	Pollution degree of a single heavy metal	RI	Risk level	Risk degree of the Sediment
$E^i_R < 30$	Slight	RI<40	A	Slight
$30 E^i_R < 60$	Medium	$40 \leq Ri < 80$	B	Medium
$60 \leq E^i_R < 120$	Strong	$80 \leq Ri < 160$	C	Considerable
$120 \leq E^i_R < 240$	Very Strong	$160 \leq RI\ 320$	D	Very Strong
$E^i_R \geq 240$	Extremely Strong	$RI \geq 320$	-	Very high

[1] is the potential ecological risk index of a single element; RI is a comprehensive potential ecological risk index expressed by Jiang *et al.,* (2014)

Data Analysis

Different biometrics indices mentioned above were employed revealed the level of contamination across the studied locations and its ecological risk for aquatic organisms.

RESULTS

Table 2. Summary of Distribution Particle Size (Sand, Clay and Silt) of the sediment from the study stations (January, 2016 to December, 2017) of Ethiope River

PARAMETERS	STATION 1 ±SD (Min-Max)	STATION 2 ±SD (Min-Max)	STATION 3 ±SD (Min-Max)	STATION 4 ±SD(Min-Max)	STATION 5 ±SD(Min-Max)	P-value	*SIG
Clay(%)	5.0417±0.231[a] (2.60- 7.50)	8.8±3.628[b] (3.10- 92.10)	5.4917±0.189[a] (3.80- 7.50)	5.4792±0.208[a] (3.50- 7.00)	4.7042±0.337[a] (0.0-6.90)	0.401	P>0.05
Silt(%)	1.8875±0.16782[c] (0.50- 4.20)	2.0250±0.16299[b] (0.80- 3.30)	2.5667±0.15588[a] (1.20- 4.10)	2.4708±0.20399[a] (1.00- 4.80)	1.9667±0.17924[b] (0.0- 3.80)	0.016	**P<0.05**
Sand(%)	93.125±0.374 (89.4-96.9)	92.8833±0.336 (90.1-96.10)	91.946±0.323 (88.70- 95.0)	91.9083±0.436(87.10- 94.9)	85.0±5.350 (0.0-94.50)	0.105	P>0.05

* P> 0.05 = no significant difference, P< 0.05 = significant difference, P< 0.01 = high significant difference, P< 0.001 = very high significant difference. [1]Similar superscript across the row shows that there is no significant difference between the mean of the stations

Table 3. Seasonal comparison of Particle Size (Sand, Clay and Silt) across the study locations.

PARAMETERS	DRY SEASON $\bar{X}$±SE (min-max)	WET SEASON $\bar{X}$±SE (min-max)	P-VALUE	SIG*
Clay(%)	4.727±0.196	6.491±1.091	0.258	P>005
Silt(%)	1.940±0.130	2.305±0.100	0.033	**P<0.05**
Sand(%)	90.95±2.345	90.98±1.168	0.989	P>005
Iron (mg/kg)	199.21±11.89	223.69±9.269	0.119	P>005

* P> 0.05 = no significant difference, P< 0.05 = significant difference, P< 0.01 = high sig.

Enrichment Factor (EF)

Table 4 showed moderate enrichment (2 ≤ EF < 5) for copper, chromium at locations 1-4 : significant enrichment for nickel at locations 1,3 and 4 vanadium at locations 1 and 3 for the wet season for EF values in 2016. More so significant enrichment (2 ≤ EF < 5) nickel and cadmium were at locations 2,3 and 4; chromium at locations 2,3,4 and 5 in 2017. Conclusively no enrichment (EF < 2) for iron for the duration of study

Table 4. Enrichment Factor (EF) :2016

HM	location 1		location 2		location 3		location 4		location 5	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
Fe	1.10	1.63	1.20	1.71	1.64	1.62	1.56	1.44	1.04	1.14
Mn	1.19	2.30	1.36	2.32	1.60	2.38	1.83	1.96	1.11	1.61
Zn	1.37	2.32	1.70	2.33	1.67	2.45	1.96	1.79	1.26	1.53
Cu	1.41	3.00	1.47	3.12	2.55	2.77	2.50	2.11	1.28	1.30
Cr	1.41	2.76	2.08	2.78	3.01	3.73	2.25	3.21	1.57	1.98
Cd	1.28	2.83	2.76	2.90	3.74	3.40	2.24	3.64	1.34	1.85
Ni	2.17	6.90	2.51	3.59	3.26	5.37	3.77	5.51	2.40	2.20
Pb	1.13	2.44	1.93	1.74	2.20	2.18	2.07	2.67	1.04	0.95
V	2.64	7.03	3.08	4.20	4.00	6.74	4.32	2.86	2.72	2.57

Table 5. Enrichment Factor (EF):2017

HM	location 1		location 2		location 3		location 4		location 5	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
Fe	1.12	1.10	1.23	1.15	1.32	1.16	1.36	1.45	1.09	1.10
Mn	2.03	1.21	2.51	2.08	2.90	2.82	3.37	3.15	1.66	1.43
Zn	1.77	1.25	2.18	1.60	2.33	2.15	2.20	2.59	1.65	1.49
Cu	2.18	1.32	2.79	1.81	3.88	3.10	3.74	3.80	2.33	2.03
Cr	3.09	1.39	5.79	5.28	11.47	7.39	10.60	11.20	5.33	3.78
Cd	2.08	1.32	5.86	3.89	9.17	5.72	10.11	9.64	4.47	3.26
Ni	2.34	1.69	6.26	4.67	10.66	8.12	10.34	8.94	5.26	3.96
Pb	1.06	1.41	4.20	2.34	5.74	4.22	4.77	4.84	2.70	1.43
V	2.56	1.89	7.92	5.74	9.44	7.46	11.20	8.29	6.76	4.80

Geoaccumulation index (Igeo)

. **Igeo) values for Table 6 for iron, manganese, zinc, copper, cadmium and lead were {Class 0: Igeo ≤ 0;practically unpolluted except for nickel and vanadium that were (unpolluted to moderately polluted): 0 <Igeo< 1 class 1; chromium, cadmium and nickel were (moderately polluted): 1 <Igeo< 2;at locations 3 and 4 (wet season)** for 2016. Whereas Table 7 recorded **Igeo value for iron across the studied locations were Igeo ≤ 0; practically unpolluted as for the heavy metals analysed for the wet season at station 1.chronmium,cadmium nickel and vanadium were (moderately to heavily polluted): 2 <Igeo< 3; at locations 2, 3 ,4 and 5 varied between season at locations 2 , 3 and 5 for 2017.**

Table 6. Geo accumulation index (Igeo) for dry and rainy season (2016)

HM	location 1		location 2		location 3		location 4		location 5	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
Fe	-0.45	0.12	-0.32	0.19	0.12	0.11	0.05	-0.05	-0.52	-0.39
Mn	-0.34	0.61	-0.14	0.63	0.09	0.67	0.28	0.38	-0.44	0.10
Zn	-0.13	0.63	0.18	0.63	0.15	0.71	0.38	0.26	-0.25	0.03
Cu	-0.09	1.00	-0.03	1.06	0.76	0.88	0.73	0.49	-0.23	-0.21
Cr	-0.09	0.88	0.47	0.89	1.01	1.31	0.58	1.10	0.06	0.40
Cd	-0.23	0.92	0.88	0.95	1.32	1.18	0.58	1.28	-0.16	0.31
Ni	0.53	2.20	0.75	1.26	1.12	1.84	1.33	1.88	0.68	0.56
Pb	-0.41	0.70	0.36	0.21	0.55	0.54	0.47	0.83	-0.53	-0.66
V	0.82	2.23	1.04	1.49	1.42	2.17	1.53	0.93	0.86	0.78

Table 7. Geo-accumulation Index (Igeo) for dry and rainy season:2017

HM	location 1		location 2		location 3		location 4		location 5	
	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	2016	Dry Season	Wet Season	Dry Season	Wet Season
Fe	-0.42	-0.45	-0.28	-0.38	-0.19	-0.37	-0.14	-0.05	-0.46	-0.45
Mn	0.44	-0.31	0.74	0.47	0.95	0.91	1.17	1.07	0.15	-0.07
Zn	0.24	-0.26	0.54	0.09	0.64	0.52	0.55	0.79	0.14	-0.01
Cu	0.54	-0.19	0.89	0.27	1.37	1.05	1.32	1.34	0.64	0.44
Cr	1.04	-0.11	1.95	1.82	2.93	2.30	2.82	2.90	1.83	1.33
Cd	0.47	-0.18	1.97	1.38	2.61	1.93	2.75	2.68	1.58	1.12
Ni	0.64	0.18	2.06	1.64	2.83	2.44	2.79	2.58	1.81	1.40
Pb	-0.50	-0.09	1.49	0.64	1.94	1.49	1.67	1.69	0.85	-0.07
V	0.77	0.33	2.40	1.94	2.65	2.31	2.90	2.47	2.17	1.68

Contamination Factor (CF) and Pollution Load Index (PLI)

The concentration factor in sediments for (Table 8) showed (considerable contamination; 3 < CF < 6): to (CF > 6:)very high contamination] vanadium across the studied locations .while iron, manganese, zinc copper showed (1 < CF < 3) moderate contamination; for the studied locations whereas chromium, cadmium and nickel at locations 3 and 4 revealed (considerable contamination; 3 < CF < 6): for 2016. Table 9 chromium cadmium and nickel recorded (considerable contamination; 3 < CF < 6): to CF > 6:) very high contamination] locations 3 and 4 for both seasons. moderate contamination (1 < CF < 3) was recorded at location 1 for vanadium whereas locations 3 and 4 were CF > 6:) very high contamination and location 5 (considerable contamination; 3 < CF < 6) for 2017. The Pollution Load Index (PLI) ranged values from (1.44 to 3.10) for 2016 and (1 .38 to 5.10) for 2017 showing heavy metal pollution across the studied locations as (PLI > 1).

Table 8. Concentration Factor and Pollution Load Index (PLI) for dry and wet season 2016

		Fe	Mn	Zn	Cu	Cr	Cd	Ni	Pb	V	PLI
location 1	Dry Season	1.10	1.19	1.37	1.41	1.41	1.28	2.17	1.13	2.64	1.45
	Wet Season	1.63	2.30	2.32	3.00	2.76	2.83	6.90	2.44	7.03	3.07
location 2	Dry Season	1.20	1.36	1.70	1.47	2.08	2.76	2.51	1.93	3.08	1.92
	Wet Season	1.71	2.32	2.33	3.12	2.78	2.90	3.59	1.74	4.20	2.63
location 3	Dry Season	1.64	1.60	1.67	2.55	3.01	3.74	3.26	2.20	4.00	2.48
	Wet Season	1.62	2.38	2.45	2.77	3.73	3.40	5.37	2.18	6.74	3.10
location 4	Dry Season	1.56	1.83	1.96	2.50	2.25	2.24	3.77	2.07	4.32	2.37
	Wet Season	1.44	1.96	1.79	2.11	3.21	3.64	5.51	2.67	2.86	2.59
location 5	Dry Season	1.04	1.11	1.26	1.28	1.57	1.34	2.40	1.04	2.72	1.44
	Wet Season	1.14	1.61	1.53	1.30	1.98	1.85	2.20	0.95	2.57	1.61

Table 9. Concentration Factor and Pollution Load Index (PLI) for wet and wet season 2017

		Fe	Mn	Zn	Cu	Cr	Cd	Ni	Pb	V	PLI
location 1	Dry Season	1.12	2.03	1.77	2.18	3.09	2.08	2.34	1.06	2.56	1.92
	Wet Season	1.10	1.21	1.25	1.32	1.39	1.32	1.69	1.41	1.89	1.38
location 2	Dry Season	1.23	2.51	2.18	2.79	5.79	5.86	6.26	4.20	7.92	3.71
	Wet Season	1.15	2.08	1.60	1.81	5.28	3.89	4.67	2.34	5.74	2.75
location 3	Dry Season	1.32	2.90	2.33	3.88	11.47	9.17	10.66	5.74	9.44	5.04
	Wet Season	1.16	2.82	2.15	3.10	7.39	5.72	8.12	4.22	7.46	3.95
location 4	Dry Season	1.36	3.37	2.20	3.74	10.60	10.11	10.34	4.77	11.20	5.07
	Wet Season	1.45	3.15	2.59	3.80	11.20	9.64	8.94	4.84	8.29	4.94
location 5	Dry Season	1.09	1.66	1.65	2.33	5.33	4.47	5.26	2.70	6.76	2.93
	Wet Season	1.10	1.43	1.49	2.03	3.78	3.26	3.96	1.43	4.80	2.27

Potential Ecological Risk Index (PERI)

The potential ecological risk index showed response to toxicity, terminologies used to describe are ecological risk factor (E^iR) and potential ecological risk index (RI). (Table 10) manganese, zinc, copper, cadmium and nickel showed slight pollution E^i_R <30)across the studied locations while lead at location 1 showed medium pollution (30E^i_R<60).Cadmium showed strong pollution across the studied the locations except at location 1 for the wet season that showed medium pollution (30E^i_R<60). The ecological risk factor at locations 1, 3 and 4 showed 160 ≤ RI < 320: very strong ecological risk for 2016.Table 11 : locations 3 and 4 E^i_R≥ 240 Extremely strong pollution for cadmium and very high ecological risk at RI≥ 320 while locations 2 and 5 (wet season)revealed very strong ecological risk 160 ≤ RI < 320 for 2017.

Table 10. Potential Ecological Risk Index (PERI) for dry and wet season 2016

HM		Mn	Zn	Cu	Cr	Cd	Pb	Ni	RI
Tir		1.00	1.00	5.00	2.00	30.00	5.00	5.00	
Sample location				*Eir Values*					
location 1	Dry Season	1.19	1.37	7.03	2.83	38.27	10.86	5.63	67.165
	Wet Season	2.30	2.32	14.99	5.53	84.86	34.49	12.22	156.70
location 2	Dry Season	1.36	1.70	7.34	4.16	82.80	12.57	9.63	119.567
	Wet Season	2.32	2.33	15.59	5.56	87.05	17.96	8.70	139.50
location 3	Dry Season	1.60	1.67	12.74	6.03	112.27	16.29	11.01	161.592
	Wet Season	2.38	2.45	13.83	7.46	102.10	26.84	10.88	165.94
location 4	Dry Season	1.83	1.96	12.48	4.49	67.33	18.86	10.36	117.303
	Wet Season	1.96	1.79	10.54	6.43	109.14	27.55	13.33	170.75

location 5	Dry Season	1.11	1.26	6.38	3.13	40.27	12.00	5.21	69.357
	Wet Season	1.61	1.53	6.48	3.97	55.62	11.02	4.74	84.98

Table 11. Potential Ecological Risk Index (PERI) for dry and wet season 2017

HM		**Mn**	**Zn**	**Cu**	**Cr**	**Cd**	**Pb**	**Ni**	**RI**
Tir		1.00	1.00	5.00	2.00	30.00	5.00	5.00	
Sample location				*Eir Values*					
location 1	Dry Season	2.03	1.77	10.90	6.17	62.40	5.31	11.71	100.29
	Wet Season	1.21	1.25	6.59	2.78	39.71	7.03	8.47	67.04
location 2	Dry Season	2.51	2.18	13.95	11.57	175.87	21.00	31.29	258.36
	Wet Season	2.08	1.60	9.07	10.56	116.76	11.71	23.37	175.15
location 3	Dry Season	2.90	2.33	19.42	22.94	275.07	28.69	53.29	404.63
	Wet Season	2.82	2.15	15.48	14.78	171.52	21.12	40.61	268.50
location 4	Dry Season	3.37	2.20	18.68	21.20	303.33	23.83	51.71	424.33
	Wet Season	3.15	2.59	19.01	22.40	289.24	24.22	44.69	405.31
location 5	Dry Season	1.66	1.65	11.65	10.66	134.13	13.52	26.29	199.57
	Wet Season	1.43	1.49	10.16	7.56	97.71	7.17	19.80	145.32

Discussion

Deteriorating water bodies in our aquatic ecosystem is as a result increased human activities and indiscriminate disposal of all forms of waste. Thereby bio accumulate and making the seabed or littoral a preferential sink to pollutants as well as ecological risk to living organisms in the aquifer**.** Distribution of particle size (Sand, Clay and Silt) of the sediment represents relative proportions of grain sizes, the percentage of classified soil retained on each sieve in a given size range. The percentage particulate size distribution for this present study for sand clay and silt ranged values are sand; 85.0 – 93.13 % clay; 4.70 – 8.80 % and silt; 1.89 – 2.57 % (Table 3) Udebuana *et al.* (2015) reported ranged values sand ; 84.54 - 89.64 %; clay; 1.93 - 3.78 % and silt ; 7.53 % - 19.34 % on grain size in the sediments of Okhwo River similar to the findings of this present study. Guramoorthi and venkatachalapathy (2016) recorded a ranged values of sand;58 .01- 98.33 %, silt ;1.22 - 56.76 % and clay; 0.44 - 2.66 % during the north east monsoon. while during the south west monsoon values for sand; 5.55 to 98.32%, silt; 1.22 to 88.01 % and clay; 0.22 to 11.61 % respectively along the near shore coast off Kanyakumari. Contrary, to this study, predominant clay were reported in their findings of Adesuyi *et al.* (2016) reported a ranged value for sand; 8.40 %± 6.28 % to 9.76 %±4.59, clay; 64.28 % ±22.04 % to 72.36 % ± 14.00%; Silt 18.71 % ± 12.03 %, to 27.32 % ± 22.17 in the assessment of physicochemical characteristics of sediment from Nwaja creek, Niger Delta, and Eulogio *et al.* (2015) on grain size ranged from clay; 67.87 - 77.67 % and sand ranged from 32.43 - 22.32 %. and silt; 18.40% on Influence of grain size in an upwelling ecosystem of central Chile., Similar findings were also reported by This study showed heavy contamination of sediments notably Nickel, Cadmium, Chromium and Vanadium from the different biometric indices used in the evaluating of sediment quality. Similar findings were reported by Nweke and Ukpai (2016) revealed heavy metals contamination mainly from anthropogenic source in soils around mining area, south of Abakaliki. The Report from this finding was contrary to the findings of Ogbeibu *et al.* (2014) revealed sediments were not contaminated by heavy metals but the concentrations revealed impacts of man - made activities of the Benin River. The potential ecological risk index (RI) for this present study showed RI<300 > 600: very high ecological risk at location 3 dry season and location 4 for both seasons (2017) indicating deteriorated environment and high toxic response to aquatic organisms in the study area

Conclusion

The pollution levels of heavy metals recorded in the sediment calls for urgent mitigation, intensive cum proper continuous monitoring of anthropogenic activities be done periodically and to be followed by remediation.

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