International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 18
December 2016

Preliminary Study on the Pollution Level of the Niger-Benue/Imo River Systems, Nigeria

Arinze O. Uche[1,2,3]***, Francis D. Sikoki**[2,3]**, Roseline S. Konya**[3]**, Bernard B. Babatunde**[2,3]

[1]African Centre of Excellence, University of Port Harcourt, Port Harcourt, Nigeria

[2]Centre for Marine Pollution Monitoring and Seafood Safety, University of Port Harcourt, Port Harcourt, Nigeria

[3]Department of Animal and Environmental Biology, Faculty of Sciences, University of Port Harcourt, Port Harcourt, Nigeria

*Corresponding Author: ucheo.arinze@yahoo.com

Abstract. A study on the pollution level of the Niger-Benue/Imo River Systems was carried out to investigate the concentration of pollutants in May and July, 2015. Water and sediment samples were collected from five locations along the river systems. The data obtained revealed that the mean metals for the surface water (Na, Mn, Mg, Zn, Pb, Cr, Cd, Cu, K, Ag, Ni, and Ca) were below the limits set by WHO, Federal Ministry of Environment (FME) and Nigerian Industrial Standards (NIS); while Fe was slightly above the limit, ranging from 0.34 to 0.39g/ml. Some mean physicochemical parameters (COD 49.9mg/l; Turbidity 41.2NTU; and Total Organic Content - TOC 226mg/l) were also above the set standards. The sediment had the highest mean value of trace metal concentration of Fe - 17,375mg/kg, next to Barium at 430mg/kg. This is indicative of environmental perturbation due to increased industrial activities and perhaps disregard for environmental rules and regulations.

Keywords: River Nun, Sediment quality, Water Quality, Oil Activities, Niger Delta

1. INTRODUCTION

Nigeria has experienced remarkable increase in industrial activities, particularly in its oil and gas sector (Omokheyeke *et al*., 2014). These industrial activities are geared towards improving man's standard of living through the harnessing of natural resources to produce substances, gadgets, food, clothes and many more for man's use.

However, various contaminants with varying degrees of harm are also produced as by-products of these industrial activities. These contaminants eventually find their way into the aquatic environment either through direct discharges; rainfall or fallouts from atmospheric contaminants; and/or through leaching and runoffs from terrestrial contaminants. In the aquatic environment, contaminants are either taken up by plankton, fish, decomposed by microbes or stored in the sediment (Uche *et al.,* 2015).

The sediment is a natural sink, capable of storing contaminants at various levels and slowly releasing them over time, sometimes more potent than the contaminant was initially. This is possible due to the fact that the rate of change of pollutant concentrations in sediment is extremely slower than in water (Omokheyeke *et al.*, 2014; Uche *et al.,* 2015)

There is also the problem of bioaccumulation of contaminants of various levels in aquatic biota which eventually find its way to man. This is of great concern as fish is a cheap source of healthy protein for the common man.

The Niger-Benue River System of Nigeria is a major river in Nigeria and Africa. It is formed by the River Niger and the River Benue which discharges into the River Niger at a confluence point. The fish fauna of this system is very rich with species adapted to its biannual floods (Ita, 1993).

The River Niger is the third largest African river and the longest and largest in West Africa. Over 260 fish species have been found in this river, including 17 endemic species. Dominant fish families are Cyprinidae, Mormyridae, Mochokidae, Citharinidae, Aplocheilidae and Alestida and the chief food species found here are the catfish, carp and Nile perch (Welcomme, 1986; Lacvaaque and Paugy, 1991).

The Imo River runs through Oyigbo in Rivers State, right in the heart of the Niger Delta Basin. The river has a length of 150miles, its estuary is around 40km wide, and has few links with Andoni River System (this links it to the Niger-Benue River System) close to where it debouches into the bight of Biafra (NEDECO 1961). The river is also connected to the Otamiri River, a very turbulent river. Oil mining activities alongside various industrial activities are still on-going in this area.

These river systems are not only sources of seafood for human consumption but also sources for drinking, washing, swimming, irrigation, other recreational activities and industrial activities.

This study was therefore designed to determine:

i. The water quality variables; and
ii. Some trace metal concentration in the water and sediment along the Niger-Benue/Imo
River Systems

2. MATERIALS AND METHODS

2.1 Study Area

Five stations were selected for water and sediment samplings which are at Makurdi (7˚45ˊ 22.38ˊˊ N/8˚32ˊ 19.78ˊˊ E), Lokoja (7˚ 34ˊ

International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 18
December 2016

06.25′′ N/6°41′ 38.32′′ E), Jebba (9° 7′ 43.03′′ N/4° 49′ 9.87′′ E), Yenogoa (4° 54′ 48.20′′ N/6° 16′ 0.22′′ E) and Oyigbo (4° 53′ 11.65′′ N/7° 7′ 32.23′′ E). The sampling period covered the months of May and July, 2015 (Figure 1). Some activities along the study area can be seen in Plate 1a & b.

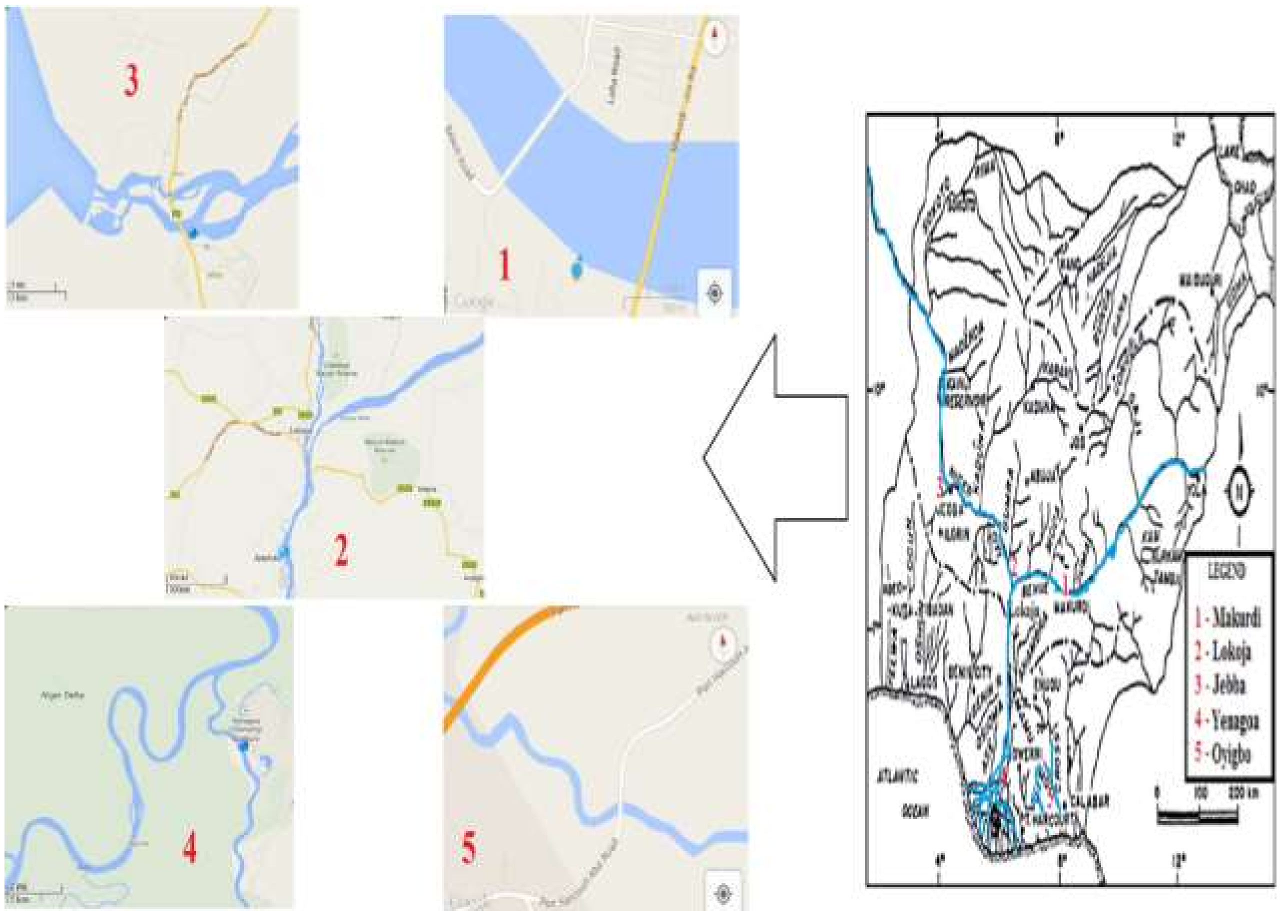

Figure 1: Map of Nigeria Showing the Five Sampling Stations along the Niger-Benue/Imo River Systems

International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 18
December 2016

Plate 1a: Some Activities along the Niger-Benue/Imo River Systems (Source: Field work, 2015)

Plate 1b: Some Activities along the Niger-Benue/Imo River Systems (Source: Field work, 2015)

2.2 Sample Collection and Preservation

2.2.1 Water Sampling

Water samples were collected from each of the five stations in appropriate containers and preserved following Standard methods. The samples were placed in secured ice chests and transported to the Laboratory for analysis.

2.2.2 Sediment Sampling

Sediment samples were obtained from shallow marginal areas with an Eckman grab and placed in properly labeled zip bags. The samples were placed in secured ice chests and transported to the Laboratory for analysis.

2.3 Laboratory Analyses

All analyses were carried out using standard APHA, ASTM and/or USEPA methods.

2.3.1 Sediment Analysis

Metals in Sediment Samples (ISO 18227)

The dried sediment samples were milled using a mixer (Mixer Mill MM400) and 4.5g of the samples were weighed. An additional 0.45g of a binder mix (Hochstwax HWC) was added to each of the pre-weighed fish samples and compressed into pellets using a compressing apparatus (Spectro Hydraulic Press 360) before placing them in the X-ray Fluorescence (XRF) sample compartment for analysis of the eleven (11) metals of interest. The energy dispersive XRF spectrophotometry (SPECTRO XEPOS) was used to run elemental analysis by turning on the X-LabPro version 5.1 Software. A primary fine focus beam provided by the X-Ray tube with a molybdenum anode was automatically mono-chromatised and directed to the sample at a glancing angle less than the critical angle. The tube was operated at 50 kV and 30 mA and the fluorescent x-rays derived from the sample were detected with a solid state lithium-drifted silicon detector of 20 mm^2 front area, cooled with helium gas (Zarazúa et al., 2014; ISO 18227 – 2014). After 21 minutes the elemental analysis result was obtained and the value for the metals of interest recorded in mg/kg.

This method of analysis was used due to its high compatibility level with green chemistry which aims to reduce the use of chemicals and possible pollution of the environment accruing from analytical purposes.. The metals of interest are: Mercury (Hg), Vanadium (V), Sodium (Na), Zinc (Zn), Lead (Pb), Cadmium (Cd), Copper (Cu), Iron (Fe), Nickel (Ni), Barium (Ba), Arsenic (As), Chromium (Cr), Manganese (Mn), and Magnesium (Mg).

Oil and Grease and Total Recoverable Hydrocarbon Content in Sediment Samples (USEPA 8440 and 3550C)

Wet sediment samples were used to measure the oil and grease (O & G) and Total Recoverable Hydrocarbon Content (TRHC) of each of the samples by measuring the absorbance of the sample extracts using a Fourier Transform Infra-red Spectroscopy (FTIR) (USEPA, 2005).

2.3.2 Water Analysis

Metals (APHA 311B, 3111D and ASTM D3651)

Water samples were analysed using the Atomic Absorption Spectrometer (AAS) ensuring the appropriate lamp for each metal was properly inserted before analysis. The toxic metals of interest were: Iron, Manganese, Sodium, Zinc, Lead, Chromium, Cadmium, Cupper, Potassium, Silver, Magnesium, Nickel, and Calcium (APHA, 2012, ASTM, 2013).

Physico-chemistry

Samples were analyzed as presented in Table 1 below:

Table 1: Water Analysis methods and Apparatus

Parameter	Method	Apparatus
pH	APHA 4500-H$^{=}$B	Probes
Conductivity, TDS, Salinity	APHA 2510B	Probes
Turbidity	APHA 2130B	Colorimeter
COD	APHA 5220B	Auto titrator
TOC	BS 1377 Part 3 No.3	Auto titrator
Carbonate	APHA 2320B	Auto titrator
O&G and TRHC	ASTM D3921	Fourier Transform Infra-red Spectroscopy – FTIR
Silica	APHA 4500-SiO_2 C	UV-Spec
Sulphate	APHA 4500 SO_4^{2-} E	UV-Spec
Phosphate	APHA 4500-P D	UV-Spec
Nitrate	APHA 4500 NO_3^- B	UV-Spec
Nitrite	APHA 4500 NO_2^- B	UV-Spec

3. RESULTS

3.1 Mean Water Quality Variables of the Niger-Benue/Imo River Systems

Table 2 shows the mean water quality parameters of the five sampling locations during the two months sampling period. The pH ranged from 6.84 to 7.46, temperature from 27.4 to 27.5°C, conductivity from 56.7 to 249 µS/cm, Total Dissolved Solids (TDS) from 34.2 to 257.0mg/L, salinity was <0.10 $^{o}/_{oo}$, DO from 4.04 to 4.52 mg/L, Chemical Oxygen Demand (COD) from <0.80 to 49.6mg/L, turbidity from

29.8 to 41.2 NTU, Oil and grease (O&G) was <0.40mg/L, and Total recoverable hydrocarbon (TRHC) was <0.30mg/L.

Table 2: Water quality parameters of the Niger-Benue/Imo River Systems and Limits

	Month 1		Month 2			
Parameters	**Mean**	**±SD**	**Mean**	**±SD**	**WHO**	**NIS**
pH	7.46	0.76	6.84	0.77	**6.5 – 9.5**	**6.5 – 8.5**
Temperature (°C)	27.4	0.54	27.5	0.32	**-**	**Ambient**
Conductivity (µS/cm)	56.7	23.43	249	243	**<1,000**	**<1,000**
TDS (mg/L)	34.2	13.97	257	139	**<500**	**500**
Salinity ($^o/_{oo}$)	<0.10	0.00	<0.10	0.00	**<0.02**	**<0.02**
DO (mg/L)	4.04	0.52	4.52	0.36	**>4.0**	**-**
COD (mg/L)	49.6	3.54	0.80	0.00	**<5.0**	**<5.0**
Turbidity (NTU)	29.8	16.3	41.7	14.9	**<5.0**	**-**
O&G (mg/L)	<0.40	0.00	<0.40	0.00	**10.0**	**10.0**
TRHC (mg/L)	<0.30	0.00	<0.30	0.00	**10.0**	**10.0**
Silica (mg/L)	16.2	2.31	19.3	3.68	**<150**	**<100**
Sulphate (mg/L)	3.95	1.28	4.65	1.63	**<100**	**<100**
Carbonate (mg/L)	<1.00	0.00	<1.00	0.00	**50-200**	**50-200**
Nitrite (mg/L)	0.036	0.026	0.060	0.02	**0.06**	**<25.0**
Nitrate (mg/L)	0.27	0.453	0.29	0.46	**<45.0**	**<40.0**
Phosphate (mg/L)	<0.02	0.00	<0.02	0.00	**<100**	**<100**
TOC (mg/L)	155	112	229	200	**<1.0**	**<1.0**

*Figures with the symbol "<" are below the minimum detection limit of the equipment used for analysis

3.2 Mean Trace Metal Concentration in the Surface Water of the Niger-Benue/Imo River Systems

Table 3 shows the mean toxic metal load of surface waters of the Niger Benue/Imo River Systems. Iron (Fe) ranged from <0.34 to 0.39g/mL; Sodium (Na) ranged from 2.58 to 17.38g/ml; Manganese (Mn) ranged from <0.05 to 0.06g/ml; Potassium (K) ranged from 1.23 to 2.12g/ml, Magnesium (Mg) ranged from 1.01 to 2.55g/ml, Calcium (Ca) was from 1.98 to 3.14g/ml; but Zinc (Zn), Lead (Pb), Chromium

(Cr), Cadmium (Cd), Cupper (Cu), Silver (Ag) and Nickel (Ni) concentrations in all both months were below the Minimum Detectable Limit (MDL).

Table 3: Mean Trace Metal Concentration in the Surface Water of the Niger-Benue/Imo River Systems

		TRACE METALS (g/ml)												
		Na	**Fe**	**Mn**	**Zn**	**Pb**	**Cr**	**Cd**	**Cu**	**K**	**Ag**	**Mg**	**Ni**	**Ca**
MONTH 1	Mean	2.85	0.34	0.06	<0.02	0.006	<0.02	<0.02	<0.02	1.23	<0.02	1.01	<0.06	1.98
	±S.D	0.95	0.42	0.02	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.23	0.00	1.04
MONTH 2	Mean	14.61	0.39	<0.05	<0.02	0.006	<0.02	<0.02	<0.02	2.12	<0.02	2.55	<0.06	3.14
	±S.D	17.38	0.47	0.00	0.00	0.00	0.00	0.00	0.00	1.95	0.00	1.26	0.00	2.36
	FME	**200**	**0.30**	**0.50**	**1.50**	**0.05**	**0.01**	**0.05**	**1.00**	**<50.0**	**0.01**	**250**	**0.02**	**200**
LIMITS	**WHO**	**<200**	**0.30**	**0.50**	**3.00**	**0.05**	**0.05**	**0.005**	**1.00**	**50.0**	**0.01**	**<250**	**0.02**	**<200**
	NIS	**150**	**0.30**	**0.20**	**3.00**	**0.05**	**0.05**	**0.01**	**1.00**	**50.0**	**0.01**	**200**	**0.01**	**200**

*Figures with the symbol " <" are below the minimum detection limit of the equipment used for analysis

3.3 Mean Trace Metal Concentration in the Sediment of the Niger-Benue/Imo River Systems

Table 4 shows that in the mean sediment of the Niger-Benue/Imo River Systems, the trace metal load for Iron (Fe) was the highest, ranging from 17,375 to 17618 mg/kg; while Arsenic (As) was the least at <0.05mg/kg. Sodium (Na) ranged from 855 to 867, Barium (Ba) from 408 to 430 mg/kg, Chromium (Cr) was 17.66 to 21.12, Mercury (Hg) was 0.24 to 1.05mg/kg, Cadmium (Cd) was 0.44 to 2.04mg/kg, Zinc (Zn) was 52.90 to 59.30mg/kg, Cupper (Cu) was 14.30 t0 16.64mg/kg, Nickel (Ni) was 15.04 to 16.44mg/kg, Vanadium (V) was 36.90 to 38.70mg/kg; Manganese (Mn) was 508 to 517mg/kg and Lead (Pb) ranged from 14.40 to 16.00mg/kg.

Table 4: Mean Trace Metal Concentration in the Sediment of the Niger-Benue/Imo River Systems

		Trace Metals (mg/kg)												
		Na	**As**	**Ba**	**Cr**	**Hg**	**Cd**	**Zn**	**Cu**	**Fe**	**Ni**	**V**	**Mn**	**Pb**
	Mean	867	<0.50	430	21.12	0.24	0.44	59.30	16.64	17618	16.44	38.70	517	16.00
Month 1	**SD**	935	0.00	287	20.67	0.089	0.089	30.90	5.83	11017	3.28	19.22	518	8.46
	Mean	855	<0.05	408	17.66	1.05	2.04	52.90	14.30	17375	15.04	36.90	508	14.40
Month 2	**SD**	894	0.00	290	17.39	0.10	0.09	27.83	5.04	10976	3.58	17.77	517	8.07

*Figures with the symbol " <" are below the minimum detection limit of the equipment used for analysis

3.4 Mean Nutrient Levels in the Sediment of the Niger-Benue/Imo River Systems, Nigeria

Table 5 shows the mean nutrient concentration in the sediment. Phosphate (PO4) ranged from 21.51 to 40.0mg/kg, Nitrate (NO3) was 0.53 to 0.69mg/kg, Nitrite (NO2) was 0.25 to 0.31, pH ranged from 5.75 to 7.01, while Sulphate (SO4) was <0.02.

Table 5: Mean Nutrient levels in the Sediment of the Niger-Benue/Imo River Systems, Nigeria

		PO4 (mg/kg)	SO4 (mg/kg)	NO3(mg/kg)	NO2(mg/kg)	pH
	Mean	40.00	<0.02	0.69	0.31	7.01
Month 1	**SD**	49.67	0.00	0.43	0.19	0.62
	Mean	21.51	<0.02	0.53	0.25	5.75
Month 2	**SD**	28.80	0.00	0.41	0.15	0.95

4. DISCUSSION

The results presented are data from two months sampling of the Niger-Benue River Systems, Nigeria. However, trace metal levels in the water (Table 2) were below the Permissible levels as stated by WHO, Federal Ministry of Environment (FME) and Nigerian Industrial Standards (NIS) except for Iron concentration level which was higher (0.34 – 0.39g/ml) than the stated limit (0.30g/ml). This is indicative of anthropogenic perturbations especially from industrial activities (Butu and Iguisi, 2013). This high level of Iron corresponds with data from studies in the Niger Delta by Oribhabor and Ogbeibu, 2009. However, the low levels of other metals analyzed are in conformity with other studies by Obire *et al.,* (2003) on Elechi Creek, Chindah and Braide (2004) on lower Bonny River, Omoigberale and Ogbeibu (2005) on Osse River, Southern Nigeria.

Physicochemical parameters (pH, Temperature, Conductivity, TDS, Salinity, DO, O&G, TRHC, Silica, Sulphate, Carbonate, Nitrate, Nitrite and Phosphate) observed in this study were below the set permissible limits by WHO, FME and NIS (Table 1). However, TOC (154.7 – 228.8mg/l); Turbidity (29.8 – 41.2 NTU); and COD (49.6mg/l) were above the set permissible limits of <1.00mg/l, <5.0NTU and <5.0mg/l respectively. The observed values for water quality variables in this study were within the range of values earlier reported works in Niger Delta waters (Chindah and Pudo 1999; Hart and Zabbey, 2005; Sikoki and Zabbey, 2006; Davies *et al.,* 2007; Omokheyeke *et al.,* 2014).

The trace metal and concentrations in the sediment (Table 3) were higher than what was observed in the surface waters (Table 2) which is an indicative of the fact that the sediment is a natural sink, capable of storing pollutants (Uche, *et al.,* 2015).

5. CONCLUSION AND RECOMMENDATIONS

The results clearly show environmental perturbation due to human activities including oil and gas mining, tin mining, cement factories, agricultural practices, waterways transportation, and many more.

It is a clear call for more stringent enforcement of environmental laws and policies to ensure a sustainably clean aquatic environment.

Acknowledgements

I wish to acknowledge the Centre for Petroleum Research and Training (CPRT), University of Port Harcourt and World Bank Group for the platform to study under a world class environment. I also wish to acknowledge the entire Staff of Fugro Nigeria Limited (FNL), Port Harcourt for their provision of laboratory analysis bench space and internship. I am also indebted to the Centre for Marine Pollution Monitoring and Seafood Safety (CMPMSS) for technical support amongst other things.

REFERENCES

Aniefiok E.I, Ibok, U.J, Margaret, U.I. and Petters, S.W., (2013). Petroleum Exploration and Production: Past and Present Environmental Issues in the Nigeria's Niger Delta. *American Journal of Environmental Protection,* 1(4), 78-85

Annual Books of ASTM Standards, (2013). Edition, Section Eleven, Water and Environmental Technology, Volume 11.02, Water (II).

Butu A.W and Iguisi E.O, (2013). Concnetration of heavy metals in sediment of river kubanni, Zaria, Nigeria. *Comprehensive Journal of Environmental and Earth Sciences*, Vol 2(1):10-17

Cowx, I. G., Almeida, O., Bene, C., Brunmett, R., Bush s., Darwoll, W., Pittock, J. and Van Brakeil, M. (2004). Value of River Fisheries. In: Proceedings of the 2nd International Symposium on the Management of Large Rivers for Fisheries. Vol 1 2004. FAO Regional Offices for Asia and the Pacific, Bangkol, Thailand. RAP Publication, 004/16, pp 1-20

Chindah, A.C and Pudo, J.O. (1999). "A Preliminary Checklist of Algae Found in Bonny River in Niger Delta, Nigeria". *Fragm. Geobot* 36 (1): 117-126

Chindah, A. C. and Braide, S. A., (2004). The physicochemical quality and phytoplankton community of tropical waters: a case of 4 biotopes in the lower Bonny River, Niger Delta, Nigeria. *Caderno de Pesquisa series Biologia Universidade De Santa Cruz. Do Sul.*, 16(2) :17-35

Davies, O. A., Allison, M. E. and Uyi, H. S., 2006. Bioaccumulation of heavy metals in water, sedimart and periwinkle (*Tympanotonus fuscatus*) from Elechi Creek, Niger Delta. Africa Journal

Food and Agricultural Organization of the United Nations, FAO (1997). Irrigation Potent in Basin Approach. ISSN 1024-6703. www.fao.org/docrep/w4347E/W4347E00.thm. Accessed: August, 2013.

Hart, A.I. and Zabbey, N. (2005). "Physic-Chemistry and Benthic Fauna of Woji Creek in the Lower Niger Delta, Nigeria". *Environ. and Ecol.* 23(2): 361- 368.

Ita, E. O. (1993). Inland Fisheries Resources of Nigeria. CIFA Occassional Paper No. 20 Rome, FAO. p120.

Lacvaaque, C. and Paugy, D. (1991). Annotated Checklist of the Freshwater Fishes of the Nilo-Sudan River Basin in Africa. *Rev. Hydrobiol. Trop.* 24.131-154.

Lee, K., S.L. Armsworthy, S.E. Cobanli, N.A. Cochrane, P.J. Cranford, A. Drozdowski, D. Hamoutene, C.G. Hannah, E. Kennedy, T. King, H. Niu, B.A. Law, Z. Li, T.G. Milligan, J. Neff, J.F. Payne, B.J. Robinson, M. Romero, and T. Worcester, (2011). Consideration of the Potential Impacts on the Marine Environment Associated with Offshore Petroleum Exploration and Development

Activities. DFO. *Can. Sci. Advis. Sec. Res. Doc.* 060: 12 + 134p.

NEDECO (1961). The Waters of the Niger Delta. Report on an Investigation. The Hague Publishers, Netherland.

Obire, O., Tamuno, D. C. and Wemedo, S. A., (2003). Physico –chemical quality of Elechi Creek in Port Harcourt, Nigeria. Journal of Applied Science and Environmental Management, 9(1): 79-84.

Omokheyeke O., Sikoki F.D., Abdelmourhit L., Akpuluma D., Onyagbodor P., Benkdad A., Benmansour M. (2014). Sediment Geochronology and spatio-temporal and vertical distributions of Radionuclides in upper Bonny estuary (South Nigeria). *Geochronometria,* 41(4):369-376

Omoigberale, M. O. and Ogbeibu, A. E., 2005. Assessing the Environmental impacts of oil exploration and production on the Osse River, Southern Nigeria: 1.Heavy metals. African Journal of Environmental Pollution and Health, 4 (1): 27-32.

Oribhabor, B.J. and A.E. Ogbeibu, (2009). Concentration of heavy metals in a Niger Delta Mangrove Creek, Nigeria. Global J. Environ. Sci., 8: 63-88.

Sikoki, F.D. and Zabbey, N. (2006). "An Aspect of Fisheries of the Middle Reaches of Imo River, Niger Delta, Nigeria". *Environ. Ecol.*24: 309-312

Uche, A.O, Sikoki, F.A, Konya, R.S., (2015). Biological and Chemical Changes Associated with the exposure of Cyprinid Fishes to Some oil field Chemicals in the Niger-Benue river Systems. SPE-178309-MS

USEPA Publication SW-846 (2005). *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Third Edition.

Welcomme, R. L. (1986). "The Niger-Benue River system", In Davies, Bryan R., Walker, Keith F. (Ed). The ecology of River systems. Dordrecht, The Netherlands: Dr. W. Juna Publishers, pp 9-23.