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Observations on the Variations (Seasonal and Spatial) in Water Quality and Ecological Adversity of Uta Ewa, Niger Delta Region, Nigeria

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ABSTRACT

The water quality parameters of Uta Ewa River, Niger Delta Region, Nigeria at three sites were studied for a period of 12 months (January 2010-December, 2010) to determine the variations in water quality and also to establish its ecological adversity. The water samples were collected and treated using standard analytical methods. Results obtained showed some degree of variation along the water course. The values of the parameters sampled increased from sample site 1 (upstream), to site III. Statistical analysis of the results using one-way ANOVA showed significant difference in site 1 to II1 for temperature, pH, Na, TA, TH, Mg, DO, BOD, TSS and Ca ($p<0.05$). However, Ec, K, SO_4, PO_4-P, Cl and TDS showed significant difference ($p<0.05$) only between two sites (site I to II). The studied parameter did not show any threat to the functioning of the biota as they were in line with the approve limit but frequent monitoring should be done to check sudden upsurge.

Key words: Water quality, Uta Ewa, Niger Delta, variations observations

INTRODUCTION

The quest for industrialization and urbanization has invariably led to pollution of surface waters from industrial discharges, domestic sewage discharges and discharges from Agricultural impacts (Akpan and Ufodike, 1995; Benka-Coker and Ojior, 1995; Akpan, 2006; Calamari *et al.*, 1994; Moussa and Kawo, 2005). The Uta Ewa River, is an important water source in Ikot Abasi, the Niger Delta Region. It drains into Imo River estuary and takes a southerly course until it empties into Atlantic Ocean in the Bight of Bonny. It is subjected to effluent discharges from industries sited around the vicinity of the water. Runoffs from farm sites, solids and liquid waste along the course of the water system also aid to pollute the system. Along the bank of the water are confectioneries, gas stations, agro-allied industries and slaughterhouse. Wastewaters from these sources inputed into the river built up nutrients I the system (Ekpe *et al.*, 1995; Akpan, 2006, 2012).

The water source is situated within human settlement which has encouraged the inhabitants to engaged in Agricultural activities. During heavy down pour, the farmlands are eroded, resulting in washing of plant residues, herbicides, pesticides and other inputs into the water body. Nutrients which are constituents of many Agricultural inputs, when in water may enrich the

ecosystem and increase algal growth, leading to eutrophication (Alabaster and Lloyd, 1980). Also Bashir and Kawo (2004), Adebisi (1981) and Bashir *et al.* (2002), noted that industrial and domestic wastes could add large amounts of organic and inorganic substances into suspended matter on spawning sites may affect the biology of fishes (Adikw and Zaki, 1999; Haruna and Abdullahi, 1999). High concentrations of suspended solids reduce transparency and photosynthesis and may dog the gill of fishes (Akpan, 2006). It also reduces the temperature of the surface water. Egborge (1981). Also, water quality parameters such as Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), salinity, pH and conductivity have been associated with water contamination (Akpan, 2012, 2006).

On the whole, Uta Ewa River Serves as a major source of domestic water for Ikot Abasi, hence the need for the study of the water quality parameters of the river so as to ascertain its suitability for human and other usage. The present study reports on the water quality parameters and its ecological implications.

MATERIALS AND METHODS

Samples collection and analysis: The samples were collected and handled in accordance with the method of Clesceri (1998). Surface water and wastewater effluent samples for the analyses were collected from three sampling sites fortnightly for a period of twelve months (January-December, 2010). The samples were collected from downstream of Uta Ewa fish port (Fig. 1),
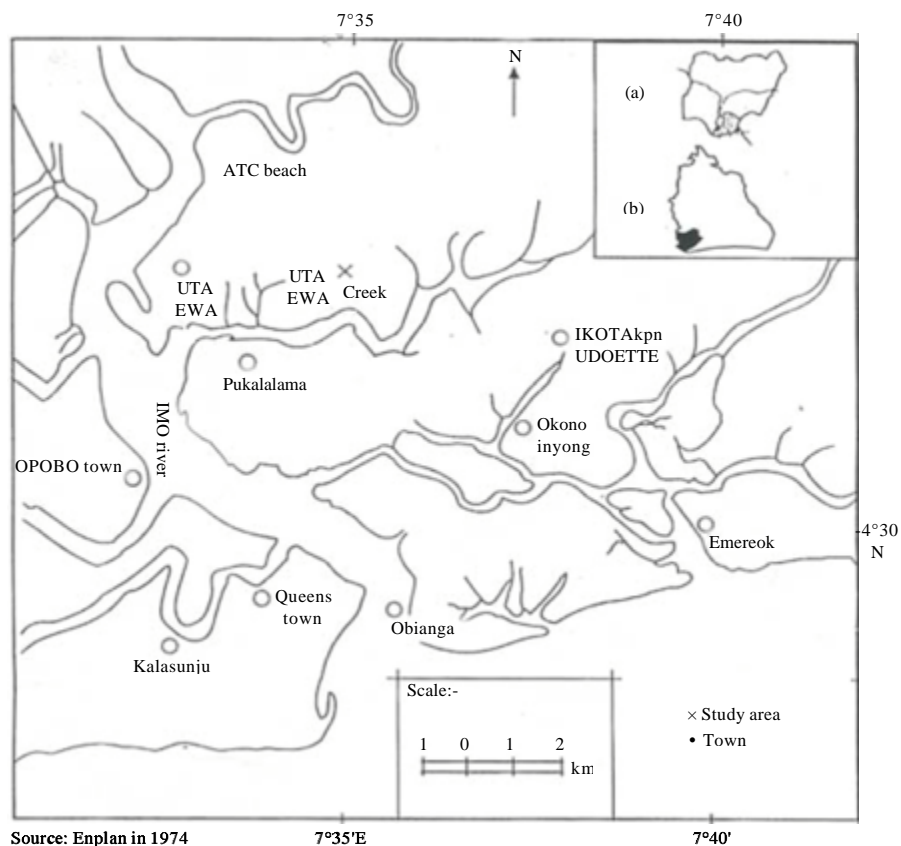

Fig. 1: Coastal zone of South Eastern Nigeria showing UTA EWA creek

because the effluent discharge point of Aluminum Smelting company is located around this area, the Jaja Creek and Esene Creek. The samples collection sites were designated as follows:

Site 1: Esene Creek (domestic waste effluent)
Site 2: Uta Ewa (Harbour area)
Site 3: Jaja Creek (Industrial wastewater effluent)

Samples were collected in all-plastic, 5 L capacity bottles acidified with 1% HNO_3. Analysis of the samples was done within 3 days of collection. Sterile, de-ionized distilled water was used for control treatment. All analysis were replicated for quality assurance of the data and mean results were recorded and expressed in standard units. All pH and temperature measurements were done in situ using a portable digital pH-thermometer (Jenway, UK).

Statistical analysis: Data collected was subjected to statistical analysis (Akpan, 2012) using one-way analysis of variance (ANOVA) to test whether spatial fluctuations had any significant effect on the water quality parameters of the water body and wastewater effluents.

RESULTS AND DISCUSSION

Water quality monitoring remains a vital tool for pollution control and assessment, developing of fishery resources, planning of water control and management as well as control of disease vectors. Observations on the spatial and wastewater effluents are shown in Table 1, while the analysis of variance is capture in Table 2. Spatial variations were observed in all the sites, higher levels of concentrations were noted in site 3. The nutrient, chloride had the highest level of 1412.00 ± 515.04 mg L^{-1}, in site 3, while the lowest was noted for Phosphates in site 1. In site 1 and 2 (Table 2), most parameters were not significantly different, while site 3 did not indicate any significant different with site 1 and 2.

Table 1: Averages of water quality parameters uta ewa river and wastewater effluent samples obtained at various sample collection sites

Parameter	Site		
	1	2	3
pH	5.60±0.45	6.01±0.39	7.02±0.07
Electrical conductivity (µ)	13.30±3.55	17.80±4.94	22.41±843.12
Sodium (mg L^{-1})	0.20±0.11	0.40±0.22	6.30±1.24
Sulphate (mg L^{-1})	0.04±0.58	0.20±0.20	2.90±1.45
Phosphate (mg L^{-1})	0.02±0.04	0.08±0.18	0.13±0.18
Total Alkalinity (mg L^{-1})	18.80±5.07	25.99±8.06	55.31±20.49
Chloride (mg L^{-1})	29.78±13.08	38.99±1.76	1412.00±515.04
Total hardness (mg L^{-1})	14.28±1.49	16.47±1.85	23.80±7.00
Magnesium (mg L^{-1})	13.26±4.64	23.23±6.07	37.31±9.34
Dissolved oxygen (mg L^{-1})	3.94±0.48	4.39±0.48	5.78±0.53
Acidity (mg L^{-1})	15.87±2.52	18.66±2.42	23.32±2.71
Biochemical oxygen demand (mg L^{-1})	1.95±0.18	2.27±0.32	3.19±0.47
Total suspended solids (mg L^{-1})	0.08±0.13	0.10±0.15	0.44±0.11
Calcium (mg L^{-1})	26.05±10.41	40.74±11.4	55.71±10.4
Temperature (°C)	26.70±1.07	26.14±0.54	25.40±0.65
Potassium	0.60±0.30	1.50±2.74	39.60±15.28

Table 2: Analysis of variance of water chemistry parameters at Uta Ewa

Site	Temp	pH	Ec	Na	K	SO$_4$	PO$_4$	TA	Cl	TH	Mg	Do	A	TDS	BOD	TSS	Ca
1	26.8[a]	5.6[c]	13.3[b]	0.2[c]	0.6[b]	0.1[b]	0.02[b]	18.8[c]	29.8[b]	14.2[c]	13.3[c]	3.9[c]	15.9[c]	21.6[b]	1.9[c]	0.1[c]	26.1[c]
2	26.1[b]	6.1[b]	17.8[b]	0.39[b]	1.5[b]	0.2[b]	0.1[b]	25.9[b]	38.9[b]	16.5[b]	23.7[b]	4.4[b]	18.07[b]	90.5[b]	2.3[b]	0.1[b]	48.7[b]
3	25.4[c]	7.0[a]	2241.1[a]	6.3[a]	39.6[a]	2.9[a]	0.1[a]	55.3[a]	1412.2[a]	23.8[a]	37.3[a]	5.7[a]	23.3[a]	1114.4[a]	3.2[a]	0.4[a]	69.4[a]
LSD	0.46	0.17	42.36	0.07	3.03	0.28	0.05	1.37	18.97	0.57	1.17	0.19	0.75	96.10	0.13	0.02	3.83
P	0.164	0.0002	0.0001	0.0001	0.0001	0.0172	0.0926	0.0001	0.0001	0.0001	0.0001	0.0001	0.0012	0.0001	0.0001	0.0001	0.0001

Means with the same letter are not significantly different

The temperature remained conducive through the sites (Table 1). The analysis of variance of spatial variation showed a significant difference (p<0.005) (Table 2). This could be attributed to dilution effect of rainfall which is probably influenced by the degree of isolation or sunshine intensity, substrate composition, groundwater inflow, vegetation cover, reactivity of dissolved compounds present in the water body which usually result in greater solubility of these compound and ions (Mohammed, 2002). Akpan (2006), reported that the temperature of a water body is not constant but tends to vary following a pattern of warming and cooling with seasons. However, the lowest and highest values recorded both in sites and seasons did not amount to the critical thermal minimum and maximum of 8 and 30°C, respectively (Haruna and Abdullahi, 1999).

The dissolved oxygen values along the river was observed with a range of 3.94 mg L^{-1} at site 1 to 5.78 mg L^{-1} at site III. Such could be attributed to the increased input of industrial effluents from the industries around the areas, leached domestic wastes from dumps site, erosional and surface run offs and also anthropogenic activities which progress down the river. These reasons could have attributed the levels of dissolved oxygen values observed, though dissolved oxygen values increased downstream, they were still below 6.0 mg L^{-1}, with no significant different (p>0.005) (Table 2) between sites. According to Alabaster and Lloyd (1980), Moss (1980) and FEPA (1991), when environmental conditions are conducive, a maximum constant level of 5.0 mg L^{-1} of dissolved oxygen is satisfactory for aquatic life and domestic purposes. Therefore, the dissolved oxygen of the Uta Ewa River at areas under investigation was within the approved limits.

The 5 day biochemical oxygen demand values ranged from 1.95 to 3.19 mg L^{-1} of the water samples. Although there were variations between the sites, no significant different (p>0.005) was noted between sites. However, the overall levels are below the WHO (1971) recommended level of 6.0 mg L^{-1} for drinking water. The mean phosphate content through the studied sites was lower than the permissible level of 0.4 mg L^{-1}. However, there was no significant different (p>0.005) between site 1 and site II but significantly differed (p>0.05) with site III.

The fluctuations in conductivity and pH levels with increased distance downstream could be partly due to dilution effect on the water treatment effluent from the river. The mean pH range (5.60-7.02) shows acidic (sites I and II) to near neutrality (site III) nature of the wastewater effluents and river water, respectively. Statistically, significant difference (p<0.05) existed between the sites for pH (Table 2) but for conductivity significant difference (p<0.05) existed only between site II, while site I and II were not significantly differed (p>0.05).

CONCLUSION

From the water samples analysed in Uta Ewa River to note the variations and ecological adversity of area, the parameters so studied were in line with the approve standard. Therefore, the biota of the area can conveniently performed its physiological function without any threat but frequent monitoring should be done.

REFERENCES

Adebisi, A.A., 1981. The physico-chemical hydrology of a tropical seasonal river-upper Ogun river. Hydrobiologia, 79: 157-165.

Adikw, I.A. and M.G. Zaki, 1999. Aspects of the biology of the fishes in the Hadejia-Nguru wetlands, North-Eastern Nigeria III: Reproduction and fecundity. Afr. J. Mater. Nat. Sci., 1: 95-106.

Akpan, A.W. and E.B.C. Ufodike, 1995. Effect of oil exploration and petroleum hydrocarbon utilization on water quality and fauna of Qua Iboe River estuary, (Nigeria). J. Aquat. Sci., 10: 43-52.

Akpan, I.I., 2006. Limnological study of jaja creek with special emphasis on species composition, trophic biology and heavy metals composition of some selected species. M.Sc. Thesis, Department of Zoology, University of Uyo, Nigeria.

Akpan, I.I., 2012. Physico-chemical and biological studies of Imo river estuary, Nigeria. Ph.D. Thesis, Department of Fishery, Michael Okpara University of Agriculture, Umudike, Nigeria.

Alabaster, J.S. and R. Lloyd, 1980. Water Quality for Freshwater Fish. 1st Edn., Butterworth Publishers Ltd., London, UK.

Bashir, H., A.H. Kawo, B.A. Abdullahi and C. Okuofu, 2002. The effects of industrial effluents on the phytoplankton and zooplankton populations in some streams in Kano, Nigeria. Afr. J. Mater. Nat. Sci., 2: 1-6.

Bashir, H. and A.H. Kawo, 2004. Environmental pollution: A case study of wastewater effluent parameters of some industries in Kano, Nigeria. Biol. Environ. Sci. J. Trop., 1: 1-6.

Benka-Coker, M.O. and O.O. Ojior, 1995. Effect of slaughterhouse wastes on the water quality of Ikpoba River, Nigeria. Biosci. Technol., 52: 5-12.

Calamari, D., M.O. Akeek and P.B.O. Ochumba, 1994. Pollution of Winam gulf, lake Victoria, Kenya: A case study for preliminary hazard assessment. Proceedings of the CIFA Seminar on African Inland Fisheries, Aquaculture and the Environment, December 5-7, 1994, Harare, Zimbabwe.

Clesceri, L.S., 1998. Standard Methods for the Examination of Water and Wastewater. American Public Health Association (APHA), Washington, DC., USA., ISBN-13: 9780875532356, Pages: 1220.

Egborge, A.B.M., 1981. The suspended matter content of lake Asejire: A new impoundment in Nigeria. Freshwater Biol., 1: 402-412.

Ekpe, U.J., U. Ekanem and E.R. Akpan, 1995. Temporal changes in some water quality parameters in Iko and Uta Ewa River, South Eastern Nigeria. Global J. Pure Applied Sci., 1: 63-68.

FEPA., 1991. Guidance for the National Water Quality Standards for Human Consumption. Federal Environmental Planning and Protection Agency (FEPA), Nigeria.

Haruna, A.B. and B.A. Abdullahi, 1999. Observations on the seasonal variations in water quality and some ecological implications of Jakara Lake, Kano, Nigeria. Afr. J. Mater. Nat. Sci., 1: 107-112.

Mohammed, S.M., 2002. A review of water quality and pollution studies in Tanzania. Ambio, 31: 617-620.

Moss, B., 1980. Ecology of Fresh Waters. Wiley-Blackwell Scientific Publications, London, UK., Pages: 332.

Moussa, A.D. and A.H. Kawo, 2005. *Clarias gariepinus* as bioindicator of copper, lead and nickel in some ponds around Kano metropolis, Kano, Nigeria. Int. J. Res. Biosci., 1: 1-5.

WHO., 1971. International Standards for Drinking-Water. 3rd Edn., World Health Organization (WHO), Geneva, Switzerland.