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Water Quality Studies of Okitankwo River in Owerri, Nigeria

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Abstract

Okitankwo River is part of the Imo River drainage basin, one of the three largest river basins in south-eastern Nigeria. The river is seasonal, flowing actively during the rainy season (May-November) but gets reduced to isolated water pools during the dry season (December – April). The river flows across the northern periphery of Owerri metropolis along a course with relatively sparse human population, but active agricultural activity. Since the river is used for various domestic applications, this study was carried out as part of a general monitoring of the river physico-chemical characteristics. The chemical parameters investigated using LaMotte pollution test kits, were dissolved oxygen, carbon dioxide, ammonia-nitrogen, zinc, pH, phosphate, sulfide, silica, chloride, nitrate-n, hardness and alkalinity. The results were compared with World Health Organization (WHO) and Environmental Protection Agency, U.S. (EPA) water quality standards. Apart from transparency that was low due to siltation, none of the parameters exceeded WHO/EPA threshold. Overall, the results tend to suggest that the river was not under a serious threat from chemical pollution at the time of the study. It is recommended that pollution studies of the river be conducted periodically and necessary action taken to prevent an eventual total siltation and blockage of the river bed.

Keywords: chemical parameters, Nigeria, Okitankwo River, pollution.

1.0 Introduction

With increasing human activities, especially industrialization, it is very difficult to maintain completely unpolluted water in all drains, streams, rivers and lakes (Enger and Smith, 2006). Even in areas of low industrialization, as in this study, organic matter is a significant water pollution problem because it decays in the water. As the micro-organisms naturally present in the water break down the organic matter, they use up available dissolved oxygen from the water. If too much dissolved oxygen is removed, aquatic organisms die. This leads to further breakdown of wastes by anaerobic bacteria. Anaerobic respiration produces chemicals that have foul odor and unpleasant taste and, generally, renders such a water body hazardous for any form of human usage.

Even apparently harmless nutrients are pollution problems. Large quantities of nutrients such as nitrogen and phosphorous compounds from fertilizer, sewage, detergents and animal wastes lead to eutrophication with far-reaching negative consequences for human use of such waters. Similarly, physical particles can negatively affect water quality as these particles can alter the clarity of water, cover spawning sites, act as abrasives that injure organisms and carry toxic materials (loc. cit.).

Okitankwo River, the site of this study, is part of the Imo River drainage basin, one of the three largest river basins in south-eastern Nigeria. Unlike most of the rivers in this drainage basin, Okitankwo River has received little or no research attention, perhaps due to its seasonality. There is no recorded work on the water quality of Okitankwo River, hence this study. The river flows actively within the rainy season (May-November) (see Figures 3 and 4) but gets reduced to isolated water pools during the dry season (December – April) (see Figures 5 and 6).

The river runs a course on the northern periphery of Owerri municipality across a watershed with relatively sparse human population, but active agricultural activity. It is a source of water to inhabitants of the area for various domestic uses. The water sometimes serves as a source of drinking water to

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some segments of the population who either boil it or allow it to sediment before consumption.

A previous study, (Okorie and Acholonu, 2008), investigated the physico-chemical characteristics of Nworie River, another river within Owerri municipality. The present study is part of a general determination of water quality of rivers within the Owerri municipality as baseline for future monitoring of impact of urbanization on the river systems within the area. Owerri is the administrative capital of Imo State of Nigeria. The prospects of growth in number and size of human settlements is high. Thus the rate of urbanization is high with over 700 persons per km^2 (NDDC, 2006).

2.0 Materials and Methods

Water samples were collected in three replicates from Okitankwo River in Owerri in the month of September 2009, which fell within the rainy season in Nigeria (see Figure 3). Owerri lies within latitude 5° 41' and 50 31, and longitude 6° 55E and $7^0$10E (see Figures 7 and 8). Water collection was done using clean plastic containers. The water samples were collected aseptically and at a depth of 1 – 3 meters by rinsing the containers with the river water and immersing them below the water surface and capping securely when full to eliminate the possibilities of air bubbles in the containers.

The water samples were transported immediately to the Animal and Environmental Biology laboratory of Imo State University, Owerri where the chemical tests were conducted. LaMotte test kits were used to determine the chemical characteristics of the river. The LaMotte test kits operated on a combination of titration and colorimetric procedures which were followed as described by the manufactures. The chemical parameters tested were dissolved oxygen, carbon dioxide, sulfide, silica, nitrate-n, phosphate, chloride, zinc, pH, alkalinity, hardness and ammonia nitrogen. The test results were recorded, analyzed, and compared with World Health Organization (WHO) and Environmental Protection Agency, U.S.A. (EPA) water quality standards.

3.0 Results and Discussion

Table1 and Figure 1 show values of the chemical parameters tested and their comparison with WHO and/or EPA water standards while Table 2 and Figure 2 compares the water quality of Okitankwo River with that of Nworie River, another river within the Owerri municipality.

The results of the analysis tend to suggest that Okitankwo River is relatively unpolluted, as shown by the fact that all the values of the parameters fell below the WHO/EPA thresholds. Organic pollution was also relatively low. Although one needs full bacteriological analyses to be definitive about organic pollution, the relatively high dissolved oxygen content and the low carbon dioxide concentration are indicative of some organic pollution taking place. The ammonia concentration of 1.5 ppm in the river is indicative of some organic pollution and further supports this view. The presence of ammonia is indicative of fresh organic pollution. The values of the other parameters were considered normal for a relatively undisturbed river. The pH level of 6.0 in this study is normal, as natural waters usually fall within the pH range of 5.0-8.5 (Renn, 1970). The nitrate level is also normal, falling far below the threshold of 10.0 ppm. High nitrate levels usually indicate pollution from agricultural fertilizers, sewage, manures, legumes, etc. The low nitrate level is also backed up here by a low phosphate level. The amount of phosphates found in natural waters is generally not more than 0.1 ppm, unless the water has become polluted from waste water sources or excessive drainage from agricultural areas (Willoughby, 1976). The low chloride level of 10.0 ppm is also to be expected. Large amounts of chloride in natural water are usually due to passage of such waters through natural salt formations in the earth or it may be an indication of pollution from sea water or industrial and domestic wastes (Renn, 1970).

The differences shown in the comparison of Okitankwo and Nworie Rivers (Table 2) are not surprising. Nworie River passes through the city centre with intense human activities on its watershed. Most of the sewage drainage networks in Owerri were designed to empty into Nworie River. Therefore large quantities of municipal sewage, consisting primarily of organic matter from food preparation, discarded food, garbage, cleaning of clothes and dishes, and human wastes steadily empty

Table 1: Chemical parameters of Okitankwo River compared with WHO/EPA standards.

Parameters Tested	Average Readings [1](ppm)	WHO/EPA Standard (ppm)
Dissolved oxygen	6.4	4.0 - 5.0
Carbon dioxide	7.5	10.0
pH	6.0	6.5 – 9.0
Sulfide	<0.2	2.0
Silica	0.5	2 - 25.0
Zinc	0.0	5.0 - 15.0
Chloride	10.0	250.0
Nitrate-N	<0.2	10.0
Phosphate	<0.2	5.0
Ammonia –N	1.5	2.0
Calcium hardness	0.0	3.0 – 150.0
Magnesium hardness	5.0	70.0 – 75.0
Total hardness	5.0	50.0
Phenolphthalein alkalinity	0.0	-
Total alkalinity	12.0	3.08

[1]All in ppm, except pH

Table 2: Chemical parameters of Okitankwo River compared with Nworie River

Parameters Tested	[1]Okitankwo River [3](ppm)	[2]Nworie River (ppm)
Dissolved oxygen	6.4	2.3
Carbon dioxide	7.5	21.9
pH	6.0	5.8
Sulfide	<0.2	<0.2
Silica	0.5	3.7
Zinc	0.0	-
Chloride	10.0	14.3
Nitrate-N	<0.2	0.28
Phosphate	<0.2	<0.3
Ammonia –N	1.5	2.2
Calcium hardness	0.0	-
Magnesium hardness	5.0	-
Total hardness	5.0	13.6
Phenolphthalein alkalinity	0.0	-
Total alkalinity	12.0	-

[1]This study; [2]Adapted from Okorie and Acholonu (2008); [3]Except pH.

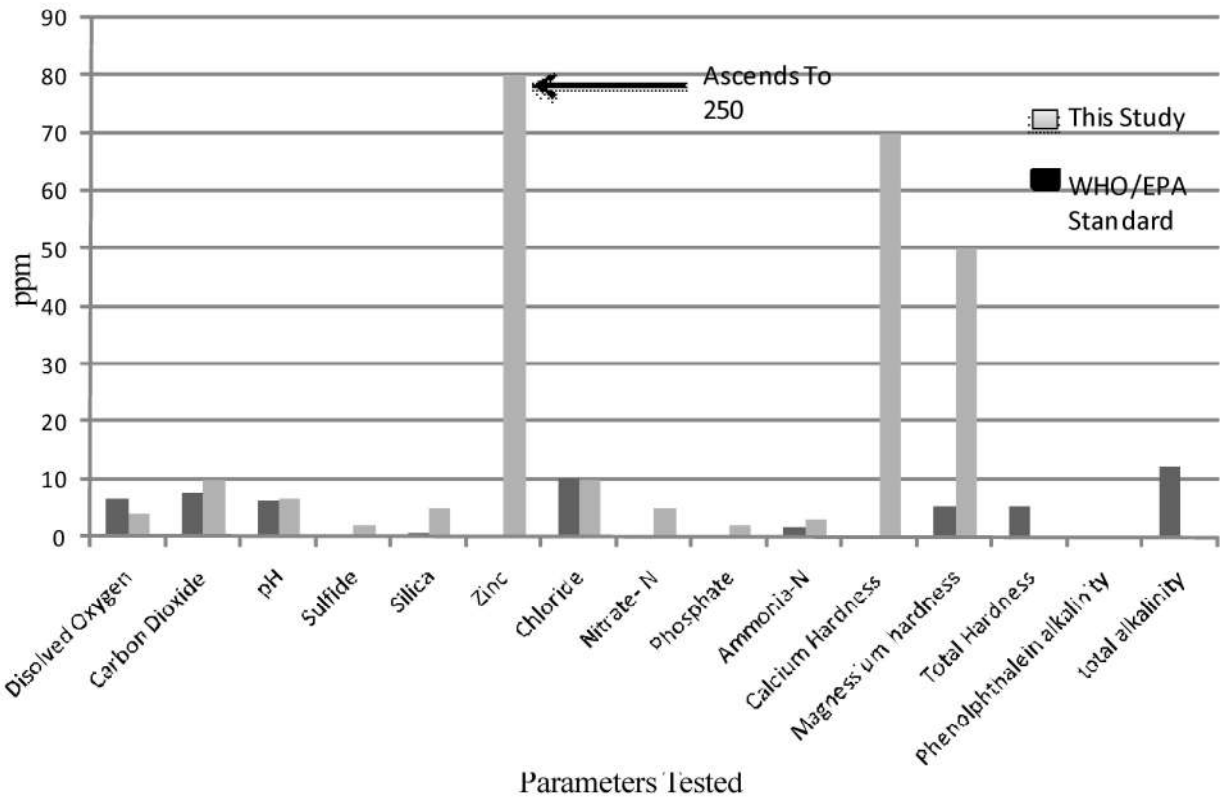

Figure 1: Chemical parameters of Okitankwo River compared with WHO/EPA standards

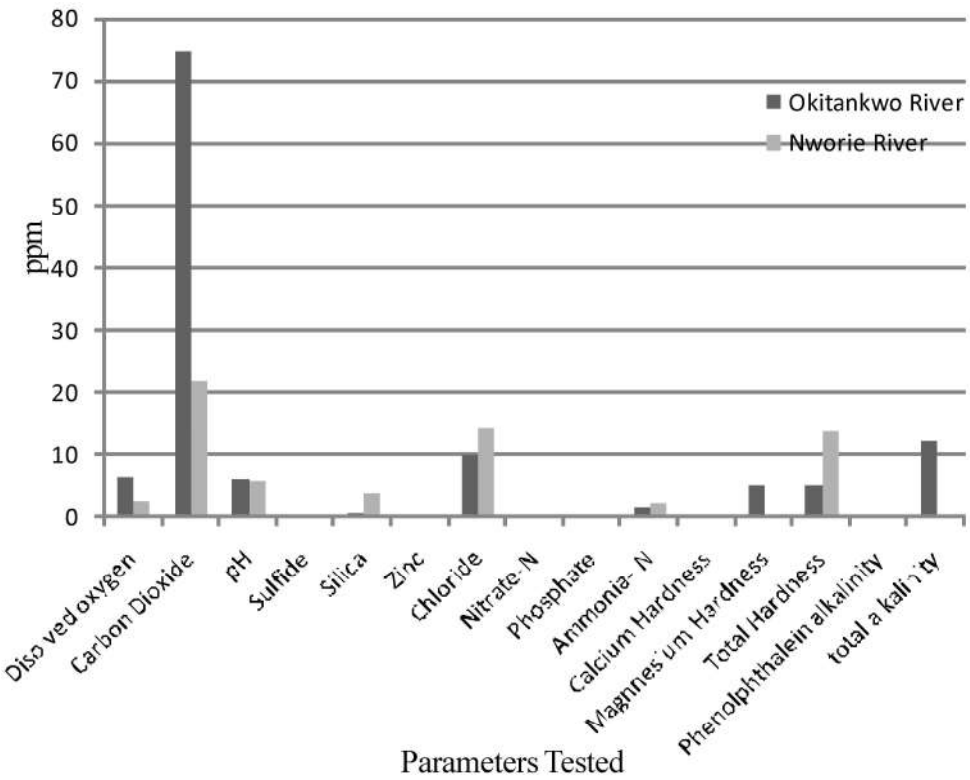

Figure 2: Chemical parameters of Okitankwo River compared with Nworie River

Figure 3: Student collecting water sample

Figure 5: Okitankwo at advanced stage of dry season. River bed almost dry.

Figure 4: Okitankwo at peak of rainy season

Figure 6: Okitankwo River reduced to seasonal pools

Figure 7: Map of Nigeria showing Imo State in which Owerri is located (from maps.google.com).

Figure 8: Owerri, the study location (from maps.google.com).

into the river. Okitankwo River, on the other hand, flows through the sparsely populated outskirts of Owerri municipality with relatively low human activity and minimal level of pollution from municipal sewage. Thus, dissolved oxygen level concentration in Okitankwo River is significantly higher than that of Nworie River. ($P < 0.05$). Conversely, carbon dioxide level in Nworie River is significantly higher than that of Okitankwo River. ($P < 0.05$) In situations of organic pollution, oxygen is consumed by the decay process while more carbon dioxide is produced. The higher ammonia-nitrogen level of Nworie River again confirms it is facing a higher level of organic pollution than Okitankwo River.

It is highly predictable that, as human population spreads northwards of Owerri, Okitankwo River will come under severe pollutional stress, not only from organic wastes but also from siltation. Already the river is seasonal, active only during the rainy season. It could disappear completely in the future as a result of siltation, if it is not rehabilitated. River rehabilitation could be achieved through avoiding all construction work within at least 50m strip on both sides of the river, re-aforestation of this immediate watershed, and de-siltation of the river bed.

References

Enger, E.D. and Smith, D.F. 2006, Environmental Science: A study of interrelationships, 10th Ed., McGraw Hill Higher Education Boston pp 483.

NDDC (2006). Niger Delta Regional Development Master Plan, Niger Delta Development Commission, Port Harcourt, 258 pp.

Okorie, P.U. and Acholonu, A.D.W. 2008, "Water quality studies of Nworie River in Owerri, Nigeria", Journal of the Mississippi Academy of Sciences **54 (4),** 232-238.

Renn, C.E. 1970, Investigating water problems, LaMotte Chemical Products Co., Chestertown, Maryland, 50 pp.

Willoughby, L.G. 1976, Freshwater Biology, Pica Press, New York, 167 pp.