SPATIAL VARIATIONS OF THREE SELECTED RIVER WATERS QUALITIES IN EBONYI STATE FOR HUMAN CONSUMPTION

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ABSTRACTS

The study focused on spatial quality evaluation of three selected rivers in Ebonyi State for human consumption. The rivers studied were Ubei, Idima and Iyioka rivers. Data was generated using Direct Reading Engineering Method (DREM), Gravimetric Method, Titrimetric Method, Spectrophotometric Method, Atomic Absorption Spectrophotometric Method, Total Viable count for physiochemical and Microbiological analysis respectively. The generated data was further subjected to a statistical analysis using one way analysis of variance (ANOVA) on difference between means of parameters and graphical method to determine the spatial variation of the water qualities.

The results showed that for some variables there is statistical difference between means of parameters with respect to space at various levels of significance. They include Sulphate (1%), Alkalinity (5%), Chemical Oxygen (5%), Nickel (1%), Arsenic (1%), Zinc (1%), Cadmium (1%), Bacteria (1%). Based on World Health Organization and Standard Organization of Nigeria guideline for drinking water, the results of microbiological analysis also indicated that the three selected rivers are polluted with disease causing microorganisms, such as E.Coliform, Salmonella, Bacillus Subtilis, all through the river course. Therefore, the river waters are not good for drinking. The consumers of this river waters are like to suffer the following: typhoid, fever, intestinal problem, diarrhea, skin rash, cholera. Necessary recommendations such as treating the water with Bio-Sand filter before use, amongst others, were made.

KEYWORD: Water quality, spatial, river water, drinking.

1. INTRODUCTION

Water is the most common, widely distributed and useful liquid on earth. No living thing can survive for long without a supply of water. This is because the reactions that go in the body to maintain life throughout the plant and animal world required the presence of water.

Water is a universal solvent. In other words, it has the ability of dissolving a great number of substances. Plants take food in water. Animals make their foods into solution before the body can use it, without water crop cannot grow, without crop animal cannot live and without crop and animal man cannot obtain food for survival. That is to say “no life without water”

Water is unique, it is the only substance that is found in the three states, liquid, solid (ice) and gaseous states. Earth’s water is constantly interacting, changing and in movement. Water freezes at 32^{o}F (0^{o}C) and boils at 212^{o}F (100^{o}C). In fact water freezing point and boiling point are the base line on which temperature is measured.

Although water is one of the most common thing on earth it is not equally distributed over the earth’s surface in terms of space and time (Abbasi, 1993). Water occurs on earth’s surface as surface water and below earth’s surface as ground water. Surface water include lakes, rivers, streams and natural open reservoir but for the purpose of this research, water inform of rivers or streams is being considered.
This work focused on the comprehensive and comparative quality analysis of Ubei, Idima, Iyioka rivers in Ebonyi State, with the view to detecting the spatial variations of the physiochemical and

microbiological parameters in the water, using these to determine the potability or otherwise of the river water.

The type, nature and concentrations of the pollutant in the river depends largely on the catchment characteristics, hydro-geological information, anthropogenic activities, magnitude of flow and level of aqua-bioactivities. For example surface water source that provide drainage outlet for farmland will surely have pollutants from fertilizer, pesticide and herbicides etc. Water can be classified as good or poor quality depending on the contaminants and it concentration.

The water in the natural environment always contains some level of impurities, this is so because water is said to be a universal solvent. It contains dissolved solids and gases and it host to a number of micro-organisms (Otuu, 2011). The water quality is defined by the level of its physical, chemical and microbiological quality and the water quality is also evaluated relative to the requirements for the waters intended used. The continues deterioration of these rivers by some impurities gotten from disposed wastewater from agricultural activities affect the normal life of a water and render it unacceptable and is said to be polluted (Fair et.al, 1996), often times lead to epidemics such as diarrhoea and cholera.

This project aims to analyse the water quality of Ubei, Idima and Iyioka rivers, all in south zone of Ebonyi State of Nigeria, with a view to establishing spatial variations of the water quality parameters with respect to drinking. The advent of industrialization in Ebonyi State has resulted in a large use and demand for Water, especially for agricultural and recreational activities, laundry and domestic use, amongst others. These and many others makes it imperative to carry out a study of the quality in order to know the extent to which these river quality parameters can vary over space with respect to drinking, having in mind that government can use them as a source of water scheme in future. This research study aims bringing into the fore, at given answers to the concentrations or potentials of the different water quality parameters that can impact negatively or positively on consumers. How does the concentration of these water parameters vary with space and to what level would these variations affect the quality of the waters?

2. MATERIALS AND METHOD

2.1 Project Site

The area of study is south zone of Ebonyi State of Nigeria. The study was carried out in three selected rivers, each with six distinct locations of 5kilometers apart. The rivers and their test locations are:

A. Ubei Rivers, with test locations at: (i) Ubei Amaiyi River. (ii). Ubei Etiti River (iii) Ubei Amangwu River (iv) Ubei River Extension 1 (v) Ubei River Extension 11(vi) Ubei River Extension 11
B. Idima Rivers , with test locations at: (i) Idima Okporojo River (ii) Idima Oko River (iii) Idima Amaiyi River (iv) Idima River Extension 1 (v) Ubei River Extension 11 (vi) Ubei River Extension 111
C. Iyioka Rivers, with test locations at: (i) Iyioka by Okwukwo River (ii) Iyioka River Extension 1 (iii) Iyioka River Extension 11 (v) Iyioka River Extension 111 (vi) Iyioka River Extension 1V

2.2 Water Sampling

Water samples were collected from the three different rivers, each having six selected distinct locations of about five (5) kilometres apart. The water samples were collected in January 2011. A total of eighteen (18) river locations / data points were carried out for each parameter (Each parameter test was replicated and an average was taken as the true value of the parameter). The samples collected were properly labelled and transferred to the pharmaceutics laboratory of the Department of Pharmaceutics, university of Nigeria Nsukka for preservation and analysis. The methods employed are as described in the following subsections.

2.3 Direct Reading Engineering Method (DREM)

This was done in situ and was used mainly for the analysis of physical parameters such as total dissolved solid (TDS), pH, Salinity, Electrical Conductivity (E.C), Dissolved Oxygen, Chemical Oxygen and temperature.

A 50ml volume of the water sample was drawn from each container with 50ml glass syringe and introduced into 100ml glass beaker and the physical parameter were activated by pressing gently on the Hacc multimeter (model C150) soft touch button. The value displayed at the LCD panel of the Hacch multimeter stand as the true value of the activated parameter.

2.4 Titrimetric Methods:

This method deals with tritrating the water sample with ethylene diamine tetra-acetic acid (EDTA) with solution for water hardness.

2.5 Spectrophotometeric Methods

This was used in the analysis of nitrate (NO3), Carbonate (CO_3), Sulphate (So_4), and Phosphate (PO_4). This method deals with the absorbance of light path length into the curvette which is directly proportional to the concentrations for a particular compound.

2.6 Gravimetric Methods

The Total Suspended Solid (TSS) was determined by this method. A glass fiber was dried in oven at $100^{O}C$ to obtain a known constant weight W_1, A 50ml volume of each water sample taken at the same dept was filtered through fiber bed. The fiber was dried in desiccator and weighed immediately to obtain the second weight W_2. The total suspended solid was calculated using the equation $TSS= (W_2-W_1)/50$
Where: W_2 = constant weight of solid on the fiber; W_1 = weight of the empty dried glass fiber; 50 = volume of water sample used.

The **Total Solid** (TS) was obtained by calculating the arithmetic sum of the total dissolved solid (TDS) and the total suspended solid (TSS)
TS = TDS + TSS

However, turbidity was obtained direct from the total suspended solid (TSS), using the relationship
Turbidity = TSS/ 50 (Otuu, 2011)

2.7 Atomic Absorption Spectrophotometric Method

This was used in the determination of all the metallic elements such as Lead (Pb), Copper (Cu), Iron (Fe), Nickel (Ni), Magnesium (Mg), Manganese (Mn), Arsenic (As), Zinc (Zn), Cadmium (cd) (Ajali, 2007).
For microbial analysis, the procedure includes the following:-

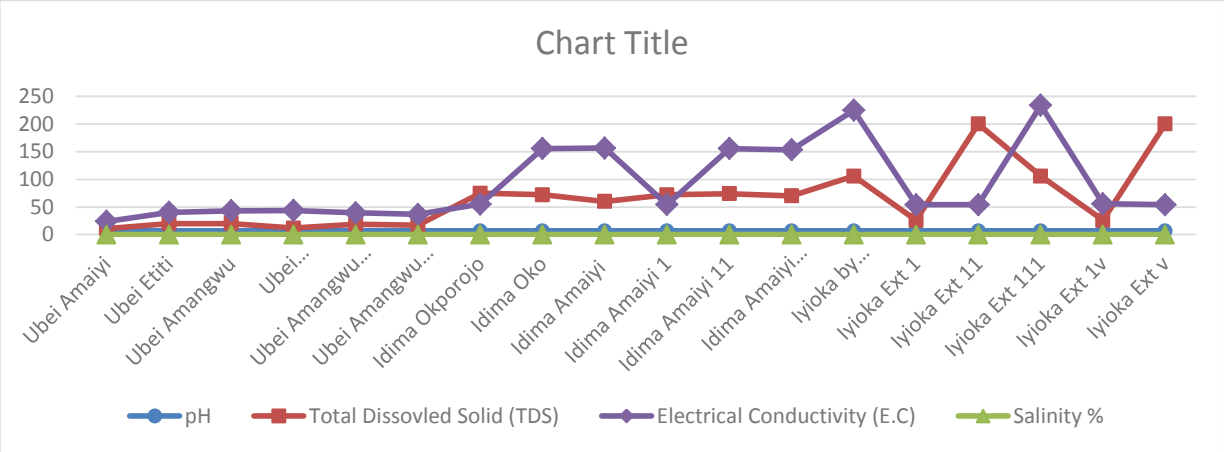
1. Preparation of media
2. Preparation of sterile petri-dish and oven-dried agar plate
3. Preparation of counting which includes dilution and counting.

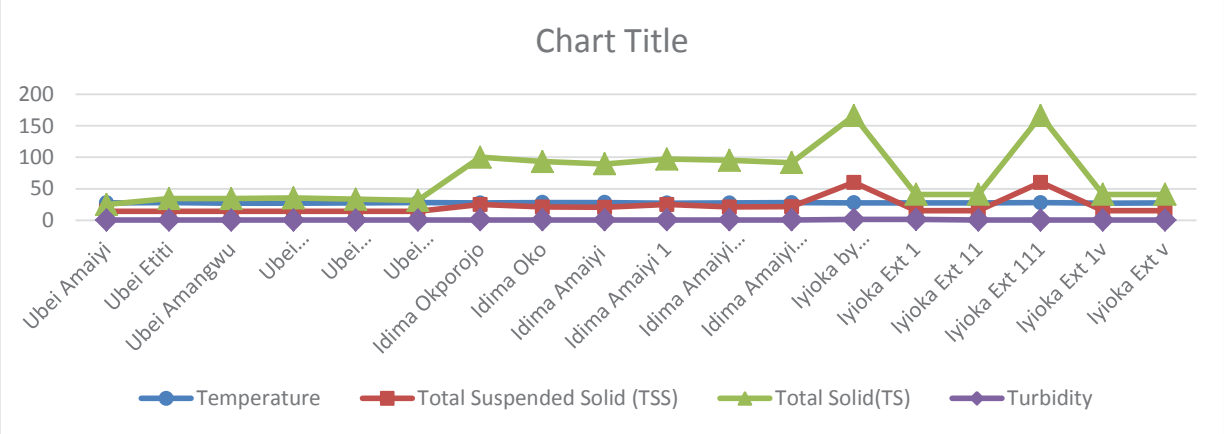
For the purpose of biochemical test, a special growth media was employed for quicker identification. In this case some gram negative bacteria was grown on macconkey agar so as to select coliform through cultural features. Their reactions to glucose and lactose determines the type of disease causing organism present. The results of the analysis are tabulated and shown below for easy study of the variations of the river parameters with the help of descriptive compound line chart. The analysis was replicated to obtain the average value for each analysis. The generated data was further subjected to statistical analysis using

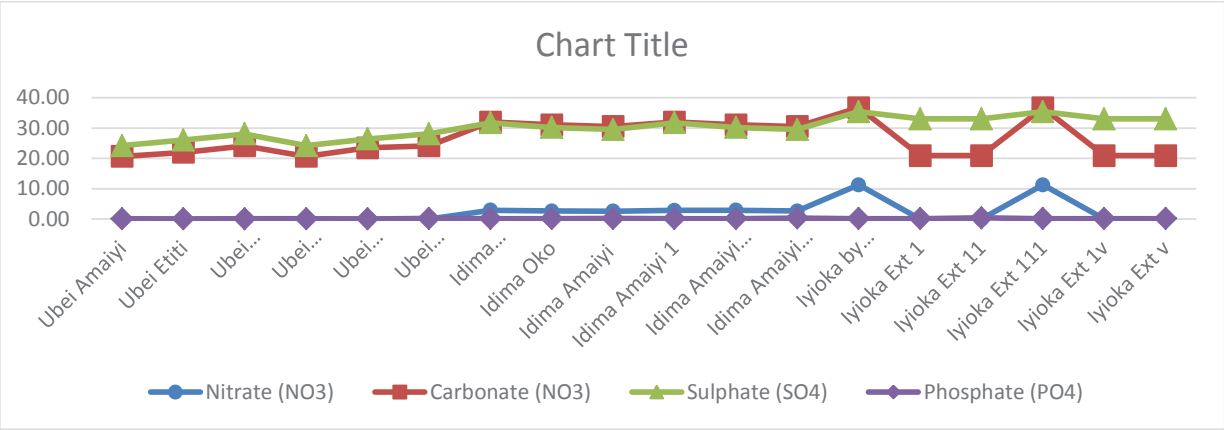
one way analysis of variance (ANOVA) on difference between mean of parameter and a graphical method to determine its quality spatial variations.

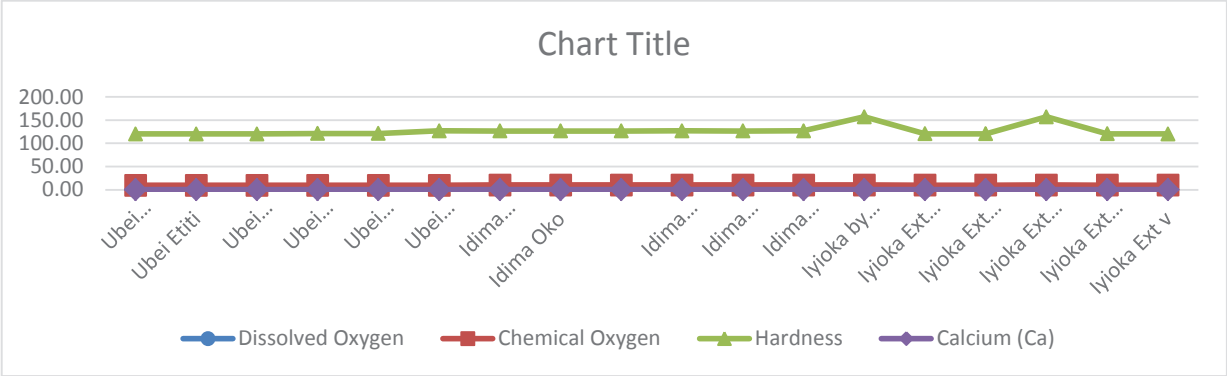
3. RESULTS AND DISCUSSION

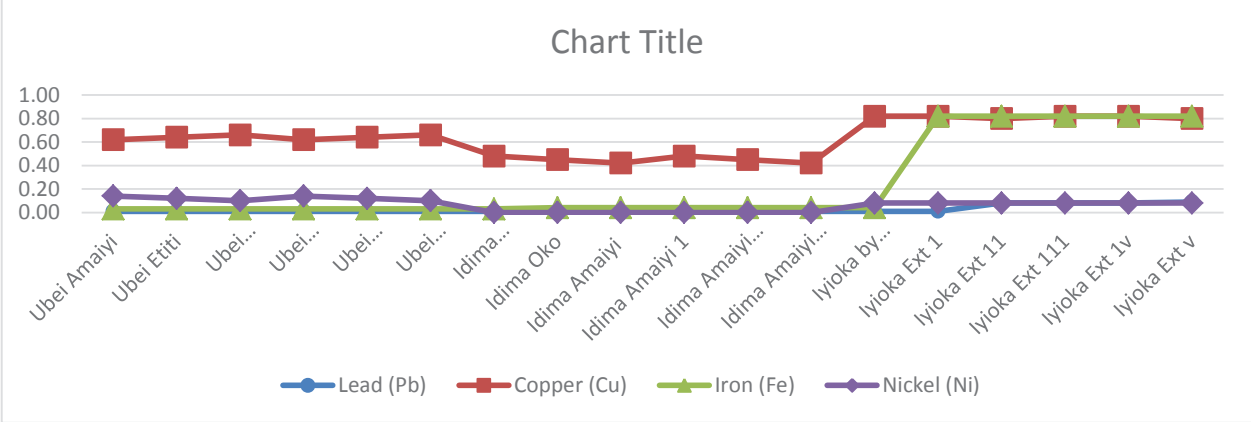
The behaviour of the physical chemical and microbial parameter test are shown in Figure 1.

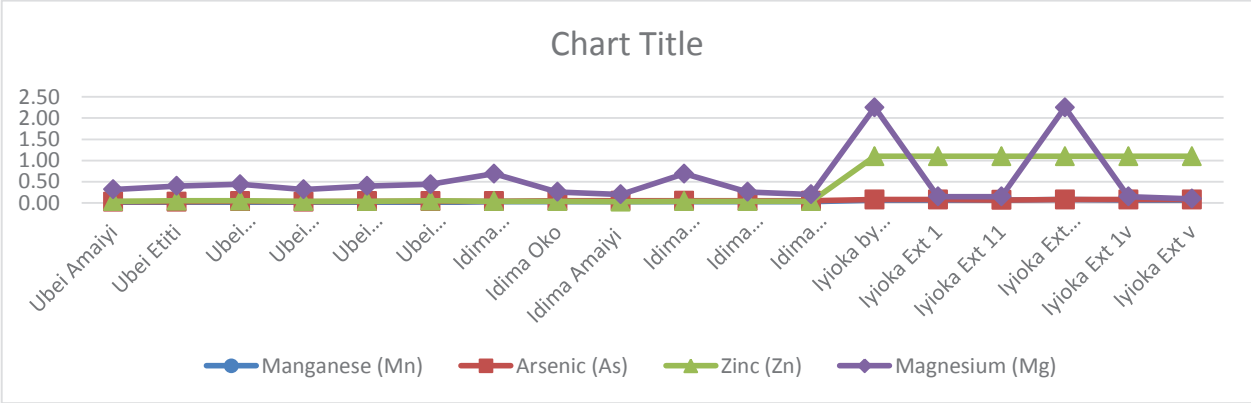












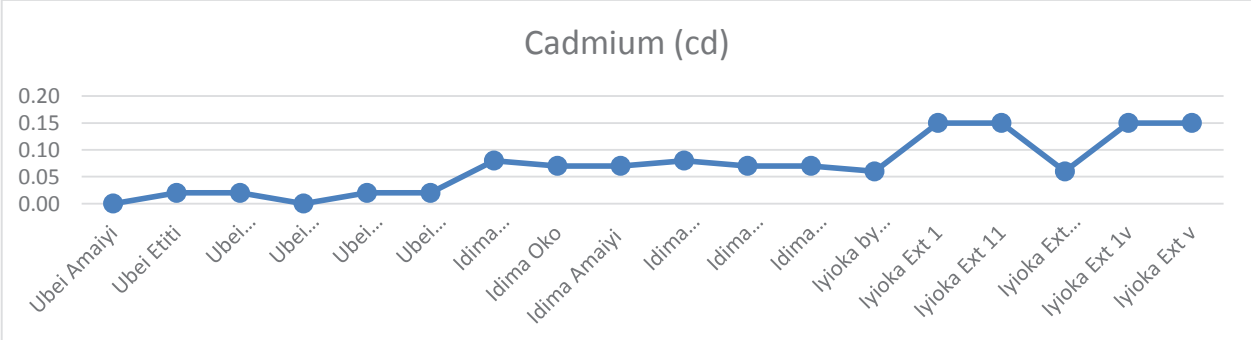


Figure 1: The behaviour of the tested physical, chemical and microbial parameter test

On comparing the water quality of the rivers studied with World Health Organization (WHO) and Standard Organization of Nigeria (SON, 2007) guideline for drinking water, it was observed that the sampled water pH (6.81 – 6.90), Electrical Conductivity (39.80 – 399.11%). Turbidity (0.29 – 1.42 NTU) and Total dissolved solid (26 – 200.17mg/ml), (0.00 – 11.25), copper (0.42 – 0.82), manganese (0.01 – 0.07) fall within a safe range. But Sulphate (24.20 – 35.38), chemical oxygen (9.60 – 10.39), nickel (0.00 – 0.14), arsenic (0.03 – 0.08), zinc (0.04 – 1.10), cadmium (0.00 – 0.15) fall above safe range. The summary of the ANOVA is shown in Table 1.

Table 1: summary of tested ANOVA result with respect to space during dry season

Parameters	**F-CAL**	**F-TAB**	**Level Of Significant**	**Decision**
pH	-0.535	-5.76	NS	Accept
Total Dissovled Solid (TDS)	-2.565	-5.76	NS	Accept
Salinity %	-23.915	-5.76	NS	Accept
Electrical Conductivity (E.C)	-1.409	-5.76	NS	Accept
Temperature	-0.439	-5.76	NS	Accept
Total Suspended Solid (TSS)	-0.827	-5.76	NS	Accept
Total Solid(TS)	-1.874	-5.76	NS	Accept
Turbidity	-1.47	-5.76	NS	Accept
Nitrate (NO3)	-0.805	-5.76	NS	Accept
Carbonate (NO3)	-1.971	-5.76	NS	Accept
Sulphate (SO4)	-18.933	-5.76	1%	Reject
Phosphate (PO4)	-1.293	-5.76	NS	Accept
Dissolved Oxygen	-0.564	-5.76	NS	Accept
Chemical Oxygen	-7.34	-5.76	5%	Reject
Hardness	-0.72	-5.76	NS	Accept
Calcium (Ca)	-0.9	-5.76	NS	Accept
Lead (Pb)	-1.532	-5.76	NS	Accept
Copper (Cu)	-0.455	-5.76	NS	Reject
Iron (Fe)	0	-5.76	NS	Reject
Nickel (Ni)	-84	-5.76	1%	Reject
Manganese (Mn)	-283	-5.76	1%	Reject
Arsenic (As)	-133	-5.76	1%	Reject
Zinc (Zn)	-1000492	-5.76	1%	Reject
Magnesium (Mg)	-0.404	-5.76	NS	Accept
Cadmium (cd)	-0.404	-5.76	5%	Reject
Bacteria	-1.107	-5.76	1%	Reject
Fungi	-2.68	-5.76	NS	Accept

Table 1 shows that there were significant differences in the area of some variables between space at various levels of significance, these includes: sulphate (1%), Sulphate (1%), Alkalinity (5%), Chemical Oxygen (5%), Nickel (1%), Arsenic (1%), Zinc (1%), Cadmium (1%), Bacteria (1%). But, other variables

were not statistically different in their mean values within the period of study. Though, numerical difference may exist but statistical difference did not exist. This is because their F-Calculated (F-CAL) was less than F-Tabulated (F-TAB). On comparing the microbial river qualities of the three selected rivers studied to World Health Organization and Standard Organization of Nigeria (SON) guidelines for drinking water. It was discovered that the three rivers are not good for drinking because of the presence of some organisms such as E.coli., salmonella, bacillus subtilis.

4. CONCLUSIONS AND RECOMMENDATIONS

Iyioka River is the highest polluted river with Iyioka by Okwukwo as the highest polluted location. This is followed by Idima and Ubei River respectively. Generally it was found that there was continuous variation of all the river qualities. Microbiologically the three selected rivers are not good for drinking because of the presence of the bacteria and fungi. Use of Bio-Sand filter together with disinfectant amongst other methods are hereby recommended**.**

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