**ASSESSMENT OF WATER QUALITY OF SELECTED BOREHOLE WATER FROM ISOKO NORTH LGA, DELTA STATE NIGERIA**

**AN MSc PROPOSAL**

**BY**

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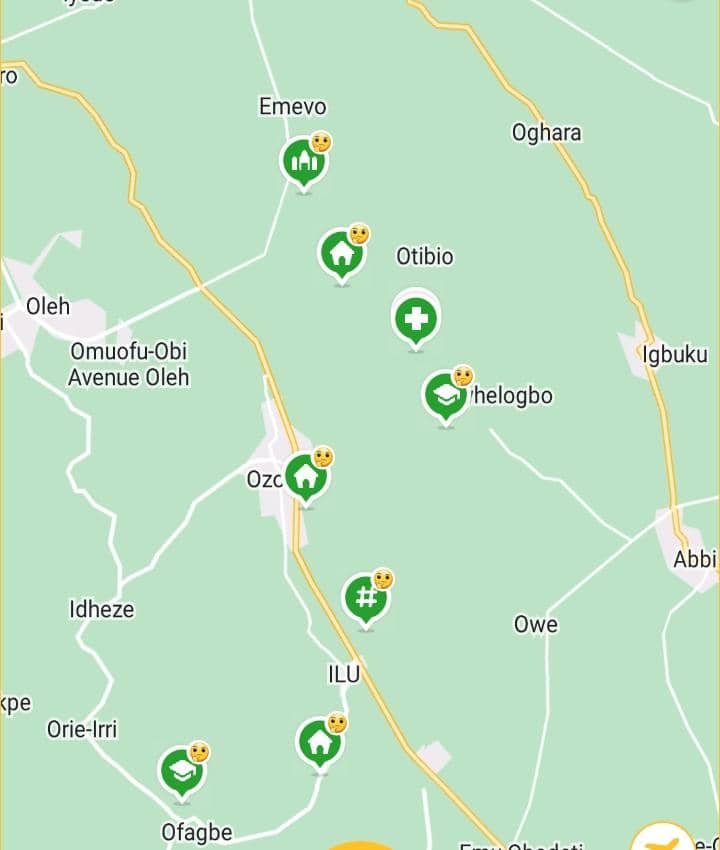
**Chapter Three**

**Methodology**

**3.0 Materials and Method**

**3.1 Study Area**

The study area is a local government area within Delta State and lies between latitude 5.5919ON and longitudes 6.2164OE. Isoko-north is home major towns including Ozoro, Ellu, Emevor, Otor-Owhe, Owhellegbo, Ofagbe, Ovrode, Otor-Igho, Igbuku-Owhe and Erawha characterized by two climatic seasons (rainy and dry season). During the rainy season (between April and October), this area usually experienced high water table levels and seasonal flooding within many of its villages.



\*\*Emevor

\*\*Ozoro

\*\*Ellu

\*\*Owhellegbo

\*\*Ovrode

\*\*Otor-Igho

\*\*Igbuku-Owhe

\*\*Erawha

\*\*Otor-Owhe

\*\*Ofagbe

**Figure 1.1:** Map of the Study Area

**3.2 Sampling Technique**

Groundwater sample will be obtained in accordance with procedure mentioned in Drinking Water Test Specification (DWTS), 2019. The manual grab method will be employed in collection of groundwater samples from different boreholes located around the study area while taking into account, pollution sources, Map of site and area description.

Water sampling bottles (High density polyethylene plastic containers) will be used to obtain ten 500mL of water samples from available water collection source.

Firstly, water samplers will be cleaned in accordance with ASTM standard 1996, by washing with a phosphate free detergent and rinsed with clean tap water. Since, heavy metals tests are to be done, the sample containers will be rinsed also with 10% solution of nitric acid and deionized water.

Water taps will be prepared by inspection and removal of anti splash devices or rubber hose will be turned on and allowed to run for 2minutes. Sampling bottles will then be rinsed twice with the running water sample before being filled to the brim to avoid air space for oxygen by placing the bottle under the tap without closing and reopening the tap (Drinking Water Test Specification (DWTS), 2019). The bottle will be allowed to overflow for 1minute before pH and Temperature test will be done (for cases were samples cannot be taken to the laboratory immediately)and tightly fixed, stored and labeled based on sample point (for example, S1- first sample). Samples should be stored in ice pack at 4OC.

**3.3 Reagents**

The Reagents that will be used for this study include

1. Buffer 4,7 & 10
2. Standard potassium Chloride (0.1M)
3. Anhydrous KCl
4. Bromocresol green methyl red indicator solution
5. Ammonun chloride
6. Magnesium salt of EDTA
7. Conc nitric acid
8. Conc hydrochloric acid
9. Conc sulphuric acid
10. Silver sulphate crystal
11. Sodium hydroxide
12. Phenolphthalein indicator solution
13. Banun chloride

**3.4 Reagent Preparation**

1. Buffer Solutions:buffer solutions will be prepared by dissolving a weak acid (or base) with a soluble salt of its conjugate. This will be achieved for buffer 7 solution by mixing 1.2g of sodium dihydrogen phosphate and 0.885g of disodium hydrogen phosphate in one litre of distilled water. For buffer 10 solution will be dissolved in 5.4 g of ammonium chloride in 20 ml of water and an addition of 35 ml of 10 M ammonia and diluting to 100 ml. while for buffer 4 solution, 5.04 g of disodium hydrogen phosphate and 3.01 g of potassium dihydrogen phosphate with be dissolved in one litre volume of distilled water.
2. Standard potassium Chloride (0.1M): Standard potassium chloride will be prepared by dissolving 7.45g of potassium chloride in 1000 ml of water.

**3.5 Sample Preparation**

Samples will be collected from different communities Ozoro, Ellu, Emevor, Otor-Owhe, Owhellegbo, Ofagbe, Ovrode, Otor-Igho, Igbuku-Owhe and Erawha in Isoko-North Local Government Area of Delta State, Nigeria, using plastic container to obtain ten 500 ml of water samples from the different boreholes. Firstly the water samplers will be cleaned in accordance with ASTM standard 1996 by washing with a phosphate free detergent such as Arial soap and rinsed with clean tap water. Since, heavy metal test will be done, the sample containers will be rinsed also with 10% solution of nitric acid and deionized water. The anti-splash device will be turned on and allow to run for 2 minutes, the sampling bottles will be rinsed twice with the running water before filled to the brim to avoid air space for oxygen by placing the bottle under the tap without closing & reopening the tap (drinking water test specification (DWTS), 2019). The bottle will be allowed to overflow for 1minute before pH value and temperature test will be carried out and tightly fixed, stored and labeled based on sample location/point. Samples will be stored in ice pack at 2 - 8oC.

**3.6 Determination of Physicochemical Parameter and Water Quality Index of Samples**

The groundwater samples that will be collected from different communities during the wet and dry season will be analyzed for 19 parameters such as pH, turbidity, temperature, Electrical conductivity, total dissolived solids (TDS), total hardness, bicarbonate, carbonate chloride, sulphate, phosphate, nitrate, fluoride, calcium, magnesium, sodium, potassium, iron, total coliform using the APHA (2017) standard for examination of water and waste water.

Thereafter, the WQI is calculated for the purpose of reporting the current state of the water of study area.

**3.6.1** **Determination of pH and Temperature of Water (ASTM 1293B)**

The pH meter will be turned on. The pH electrode and temperature probe will be rinsed with distilled water and wiped with a soft tissue paper. The pH electrode and probe will be inserted into a buffer solution of pH 4 and the reading will be allowed to stabilize before the calibration button is punched. The pH electrode and probe will be rinsed with distilled water, wiped clean and inserted into a buffer solution of pH 7 and the reading will be allowed to stabilize before the calibration button will be punched. The pH electrode and probe will be rinsed with distilled water, wiped clean and the pH electrode will be inserted into a buffer solution of pH 10 and the reading will be allowed to stabilize before the calibration button will be punched. This will complete the calibration of the pH meter. The electrode and probe will again be rinsed with distilled water and wiped clean before inserted into various water samples and allowed to stabilize before readings are recorded.

**3.7.2** **Determination of Turbidity**

Turbidity meter will be turned on and allowed to standard for 30minutes before it will be calibrated. Calibration will be done by inserting a solution of 400 N T U into the turbidity meter and adjusting with the calibration knob. Calibration will be done with the use of a distilled solution to 0 N T U and the knob will be used to adjust the reading to 0 N T U. Water samples will then be poured into the sample cells and readings recorded after the readings had stabilized.

**3.7.3** **Determination of Total Dissolved Solids (TDS)**

TDS meter will be turned on and the probe rinsed with distilled water and wiped clean with a soft cloth of tissues paper. The probe will then be immersed into the samples and readings recorded. The probe will be rinsed with distilled water and wiped clean before the determination of TDS in other water samples

**3.7.4 Electrical Conductivity**

Electrical conductivity meter will be turned on and the probe rinsed with distilled water and wiped clean with a soft cloth of tissues paper. The probe will then be immersed into the samples and readings will be recorded. The probe will then be rinsed with distilled water and wiped clean before the determination of EC in other water samples.

**3.7.5 Bicarbonate**

25ml of water sample was poured into a conical flask and 3 drops of Methyl orange indicator added. The estimated concentration was obtained by titration of the mixture in the conical flask with 0.1N sulphur acid until colour changes from orange to pink and endpoint recorded.

**Where;**

N = Normality of H2SO4 used

**DETERMINATION OF CHEMICAL OXYGEN DEMAND AND (COD) (ASTMD1252)**

0.4gofHgSO4 will be placed in a 250ml conical flask and 20 ml of the sample will beadded. 30ml of concentrated H2SO4 containing AgSO4 will also beadded. 10ml of 0.25NK2Cr2O7 solution will also be added and the mixtures shake vigorously. The flask will be attached to a condenser and then refluxed for 2hours; the condenser will be cooled and washed down with distilled water. The mixture will be diluted with 1ooml of distilled water and cooled at room temperature. Excess dichromate will be titrated with standard Fe(NH4)2(SO4) using 2drops of ferroin indicator and the colour changed from blue–green to reddish brown (endpoint). Finally, a blank (20ml of distilled water)will be subjected to the same treatment as the sample.

Where;

A=ml of standard ferrous sammonium sulphate used for blank.

B=ml of standard ferrous ammonium sulphate used for sample.

M=Molarity of Standard ferrous ammonium sulphate.

**DETERMINATION OF BIOCHEMICAL OXYGEN DEMAND (BOD) (APHA 507)**

The temperature will be brought to 20oc and aerated until saturated usually for 30 minutes. The BOD of the sample will be estimated. Three dilutions will be selected for each dilution and the appropriate volume of samples pipetted into a 250ml dark brown bottle with a glass stopper. Each bottle will be filled with distilled water to about 1cm of the bottle neck and the water samples siphoned into the BOD bottle through a length of flexible rubber tubing which will be kept below the surface of the distilled water. A Bottle will be also filled with distilled water to serve as a blank. All six bottles will be incubated at 20oc for five days. After this period, the dissolved oxygen in each bottle will be measured.

Where;

DO1 = DO of the diluted analyzed sample at the first day

D02 = DO of the diluted analyzed sample at the fifth day

DO3 = DO of the diluted sample at the first day

DO4 = DO of the diluted sample at the fifth day

Vt = Volume of BOD bottle

Ve = Volume of sample taken

**DETERMINATION OF TOTAL SUSPENDED SOLIDS (TSS) (ASTM1868)**

**FILTRATION TECHNIQUES**

The Millipore filter paper (X-mg) will be weighted and the TSS filtration assembly put in place. The millipores paper will be placed properly. The filter paper will be held tight with the aid of a clamp. The water will be stirred vigorously and 250ml of the sample transferred into the filtration flask. The filtration will be commensedd with the use of a filtration pump, after which the filtered paper will be removed and placed in an oven for drying for 30minutes. The filter paper will again be weighted plus the recovered solids (Y-mg).

Where;

X= weight of filter paper without solids

Y= weight of filter paper with solids.

**TOTAL COLIFORM COUNTS (APHA 9222A1)**

All apparatus, materials and growth medium were sterilized using an autoclave. Three sets of five test tubes /mc cartney bottles containing 9ml of mc conkey broth were prepared. 1ml of water sample was added to 9ml of sterilized distilled water for serial dilution. 1ml of the serial dilution was poured into each of five sets of test tubes containing the mc conkey broth. 0.1ml of the serial dilution was introduced into the second set of test tube and 0.01ml to the third sets. The innoculum was mixed with the growth medium by little agitation. The test tube was covered and inverted. The bottle was incubated at 37OC for 48 hours. Each test tube was then observed for acid production which signify microorganism growth through colour change, and gas production in the test tube. The number of positive tubes in each set was combined and arranged orderly. The number of combination was read from the standard MPN table to estimate the number of coliform cells present in 100ml of the original water sample (using McGrady’s Statistical table).

**DETERMINATION OF LEAD AND TOTAL IRON (ASTM D6785)**

The machine will be calibrated with various standard solutions of Lead, Copper, Iron and Chromium. The specific wavelengths for each heavy metal will be selected. They include; Lead (283.3nm) and iron (248.3nm). 10 – 30ml of the samples will be measured into a conical flask and a conveyor hose pipe will dipped into the water samples. The conveyor hose pipe will in turn suck up the sample into the flame at a specific wavelength of the parameters to be measured given the concentration of parameters of interest.

**DETERMINATION OF CARBONATE (CO32) AND BICARBONATE (HCO3)**

10ml of water sample was poured into a conical flask and 2 drops of phenolphthalein indicator added. A colour change of pink indicates the presence of carbonate. The estimated concentration was obtained by titration of the mixture in the conical flask with 0.1N sulphur acid to colourless point and endpoint recorded.

10ml of water sample was poured into a conical flask and 2 drops of Methyl orange indicator added. The estimated concentration was obtained by titration of the mixture in the conical flask with 0.1N sulphur acid until colour changes from orange to pink and endpoint recorded.

**Where;**

N = Normality of H2SO4 used

**3.7.8 Quality Control and Quality Assurance**

Glasswaves that will be used for this study will be washed with detergent, rinsed thoroughly with deionized water and dried before use. Also all reagents and chemicals to be used will be of high analytical grade. Precautions, appropriate quality assurance will be duly observed for reliability and accuracy of results. Duplicate & laboratory control samples will be run a QC sampler.

**3.7.9 Data Analysis**

All data that will be obtained in this study will be represented in a tabular form.

Average calculation on water quality parameters will be estimated by statistical calculation of mean value

Data obtained from water analysis will be assessed to evaluate significant difference in quality of water samples using Statistical Package for Social Science (SPSS)

Water Quality Index (WQI) – This arithmetic value will be obtained by comparing the mean values of the parameters assessed in the water samples with the maximum permissible limits by known regulatory bodies.

The calculation of WQI is made by using the following equation.

∑Q1W1

∑W1

Water Quality Index =

V1-V0

Water Quality Scale = 100 X

S1-V0

The quality rating scale (Q) for each parameter is calculated by using the expression

Where V1 = Estimated concentration of the ith parameter of interest in the analyzed water

V0 = The ideal value of the ith parameter in pure water

V0 = 0(except pH = 7.0 and Do = 14.6mg/l

S1 = Recommended standard value of the ith parameter

The unit weight (w1) for each water quality parameter is calculated by using unit weight = K/S1

K=

∑1/S1

1

Where K proportionality constant and can also be calculated by using the above equation

**3.7.10 Expected Contributions to Knowledge.**

1. This study will help to identify the different variations in borehole water quality parameter in Isoko-North Local Government Area.
2. It will help to create awareness of the overall state of the water quality through application of water quality index
3. The study will be used to determine the extent of borehole water contamination/pollution as well as evaluating or creating mitigating measures to stop ground water contamination in the study area (Isoko North Local Government Area Delta State, Nigeria.
4. It will establish the human risk associated with drinking borehole water without proper treatment.

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