CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187
http://doi.org/10.5281/zenodo.4792220

Online at: http://www.iajps.com *Research Article*

SIGNIFICANCE EFFECT OF URBANIZATION ON GROUNDWATER QUALITY IN WARRI METROPOLIS OF DELTA STATE

Malumi T[1]., Malumi S.O[2]. and Aniesedo J.M.[3]

[1]Department of Civil Engineering Technology, Delta State Polytechnic Ozoro, Delta State, Nigeria

[2]Department of Science Laboratory Technology, Delta State Polytechnic Ozoro, Delta State, Nigeria

[3]Department of Statistics, Delta State Polytechnic Ozoro, Delta State, Nigeria

Article Received: April 2021 **Accepted:** April 2021 **Published:** May 2021

Abstract:

This research is based on the significant effect of urbanization on ground water quality in warri metropolis as a case study. This research Aim to ascertain how urbanization has altered the groundwater quality in the study area, to aware the inhabitant to know the danger of sitting of borehole around septic tanks and dump site, also to provide quick solution to the observed problem, in order to minimize the contamination. Water sample were collected from five different boreholes sited around septic tanks and refuse dump within the study area. (Sample 1, 2, 3, 4, and 5). Physiochemical and bacteriological methods were used to analyze the water samples in laboratory. Parameters were compared with 2011 W.H.O permissible limit for drinking water. The average of the test results of the 18 parameters obtain include pH (4.9), Temp°c (30.74), TDS (46.9), Conductivity (91.85), DO (3.3), BOD (1.05), Chloride (16.12), Phosphate (0.59), S (0.10), No_2 (0.62), NO_3 (<0.01), NH (0.07), Turbidity (0.86), TSS (1.4), Ka^+ (0.13), Z^+ (9.8), Fe^+ (1.4), Mercury (<0.01), coliform count (48). the test results were compared, all parameters were within the limit except pH, coliform count, Turbidity, Iron, and temperature. With the variation graphs, the water quality in the study area is fairly good. For suitability the water should be properly treated before use and monitoring policy for sitting boreholes, septic tanks, and dump sites should be ensured.

Corresponding author:

Malumi, T.

Corresponding author's email- nnannasandra@gmail.com

QR CODE

Please cite this article in press Malumi, T et al., ***Significance Effect Of Urbanization On Groundwater Quality In Warri Metropolis Of Delta State****.., Indo Am. J. P. Sci, 2021; 08(05).*

INTRODUCTION:

Water is one of the prime natural resource. Accepting this important fact, the account for economic and growth activities of all kind is a matter of high concern. In this modern era, there is huge decline in fresh water due to population increase, urbanization, industrialization and concentrated agricultural actions. Urbanization is one of the most detrimental forces affecting good water quality. It has also led to the insufficient availability of surface water causing people to be dependent on ground water resource to fulfill their needs.

Numerous towns and cities fulfill their demand from ground water and surface water through natural water bodies and also from various concealed boreholes. Regular water quality monitoring of the water resource is absolutely necessary to access the quality of ground water for industrial, agricultural uses and ecosystem health and hygiene.

Evaluation of water quality is based on the physiochemical and bacteriological parameters. The conventional methods for evaluating water quality are based on the comparison of experimentally determined parameters with the existing guideline (Niell, 2005). So physiochemical and biological experiment are such approach which minimize the data volume to a great extent and simplified the expression of water quality status.

Water availability with good quality and adequate quantity is very important for human life and other purposes. Therefore, water quality is considered as an important factor to judge environmental changes which are strongly associated with social and economic development. (International journal for engineering research application, 2011). In developing countries there are water resource issues and problems, Which has presented special challenges that have led to lost of human lives, and it will recorded that about 1.8 billion people mostly children die every year as a result of water related diseases such as diarrhea. It has also being predicted, in developing countries; fresh water will scare in the future due to urbanization, increase in population and industrial activities. (World Health organization, 2012). Therefore, water quality monitoring program is necessary for the protection of fresh water resource. There is growing need to develop robust methodology to evacuate aquifer vulnerability and ground water pollution risk to support the gap knowledge between the environmental engineers and the people that need to deal with the gathered information.

Water quality is used to describe the condition of the water, including its chemical, physical and biological characteristics, usually with respect to its suitability for particular purpose which may include drinking, swimming, agricultural and industrial uses. (Diersing, 2009). Water as a fundamental resource, almost every aspect of life meaningful development is closely dependent on it quality and quantity (sonnga, 1981).

Ground water Constitute an important source of water for domestic supply and other uses. It is the cheapest means of supplying the much-needed potable water to majority of citizens in a country. Ground water has unique features which render it suitable for public water supply (offodile, 2000). Ground water is widely distributed and can be frequently develop incrementally at point near the water demand, thus avoiding the need for large scale storage over surface water lies in its availability in practically all parts of the country, although in varying quantity. Water treatment is particularly important as it account for about 88% safe drinking water in urban areas, where it is widely distributed and the infrastructure needed for treatment and transportation of ground water do exist (Jain, 1995)

In urban centers, ground water is important resource, where urban dwellers rely on a combination of both hand dug well and public/private drilled borehole for their drinking water. Improving the quality of ground water can result in tangible benefits to heath. Therefore, efforts should be made to achieve a good drinking water quality as safe as practicable. Safe drinking water as defined by world Health organization is the water that does not represent any significant risk to heath over a life time of consumption in different sensitivities that may occur between life stages.

However, water of higher quality may be required for some purposes such as medical, pharmaceuticals, food production and other domestic uses. Diseases related to contamination of drinking water Constitute a major burden on human health and so intervention to improve on water quality is crucial. In order to assess the suitability of water for diverse uses, there is need to compare the results of water analysis with world health organization standard. On the other hand physiochemical and bacteriological method is a very useful and efficient method for assessing the suitability of water quality. It is also very useful tool for communicating the information on overall water quality to the concerned citizens and policy makers. (Triantafis, 2009)

MATERIALS AND METHODS:

STUDY AREA

This study area is warri metropolis, an oil hub in South-South Nigeria and houses an annex of the Delta State Government House. It shares boundaries with Agbarho, Sapele, Okpe, Udu and Uvwie, although most of these places, notably Udu, Okpe, Uvwie have been integrated to the larger cosmopolitan warri. It is a commercial capital city of Delta State, with a pollution of over 311,970 people according to the national population census figure for 2006. It lies within 5^0 45 E latitude and 5.517^0N longitude. It has rivers, stream and lakes running through its land area. Its land size is approximately 1520 square kilometers. The city is one of cosmopolitan cities in southern Nigeria comprising originally of urhobo, itsekiri, and ijaw people, warri is predominantly Christian with Mixture of Africa traditional religion like most of the southern Nigeria.

SAMPLING

The grab and composite sampling method was used (Rao, 2004; Metcalf 2003) in collecting water samples from the pumped borehole water quantities at various location. 1litresterilised transparent plastic bottles, labeled according to location were used in collecting the samples for physiochemical and bacteriological parameter analysis. Sample bottles were thoroughly washed and rinsed from the facility where the sample is been collected before collecting the samples. Minimum space was left in each the sample bottle, except those for D.O. determination, to allow for expansion of water. The bottles were immediately stored in a cooler fill with ice (to prevent alteration of water constituents) and transported from collection site to Ekpan Tudaka environmental consultant laboratory, warri Delta State, for analysis due to the fact that parameter which are physical must be insitu (carried out the day water sample was collected), some of these insitu test includes temperature, electric conductivity, PH, total dissolved solid (TDS) and dissolved oxygen while the others can be carried out some other time. Note: water sample was further preserved in the laboratory with refrigerator.

Table 1: location of water sample

SAMPLES	LOCATION OF SAMPLES
Borehole 1	Metronnex Road Warri Sapele Road
Borehole 2	3rd Marine Gate Safia Close
Borehole 3	MCC Road
Borehole 4	Janpan Road
Borehole 5	PTI CAMPUS

LABORATORY ANALYSIS OF WATER SAMPLE

The water samples were collected from selected area of warri Metropolis was analyzed for 19 physiochemical parameters in the laboratory by following the established procedures.

A) P^H AND TEMPERATURE TESTPROCEDURE:

1. With power on, select the calibrate mode
2. Place electrodes into pH 7 buffer and stir moderately
3. Press yes to select the two-buffer calibration which brackets your sample range
4. When Ready is displayed beside the reading, indicating electrode stability, press on to change buffer valve or Press yes to accept buffer valve
5. Remove the electrodes from the first buffer. Rinse with deionized water
6. Place the electrodes into second buffer and stir moderately
7. When ready is displayed beside the reading, indicating electrode stability, Press no to change buffer valve or Press yes to accept buffer valve
8. After the second buffer valve has been entered, press yes. The electrode slope will be displayed, Press yes to accept
9. Remove the electrodes from buffer. Rinse with deionized water. Place electrodes into sample. When Ready is displayed, record the sample result.

B) ELECTRICAL CONDUCTIVITY/ TOTAL DISSOLVED SOLID TEST

Calibration and measurement procedure:

1. Switch on the power.
2. Clear any previous calibration data (press clear for five seconds).
3. Place the conductivity cell in the calibration solution.
4. Select the required working unit for conductivity.
5. Select conductivity mode and wait for the reading to stabilize.
6. Using ……. Keys, adjust the reading so that the correct value for the standard is displayed than press the enter key

⇧ ⇩

7. Transfer cell to sample and record reading when stable
8. The mode key can now be used to select the required measurement mode (µs; MΩ; TDS °C)

C) TURBIDITYTEST PROCEDURE:

1. Switch on the power and allow the instrument to warm up for 30 minutes
2. Insert a 0 NTU polymer standard into the chamber and cover
3. Set the range switch to 20NTU
4. Use zero control potentiometer, set the meter to read 0
5. If the meter can't be made to read zero, then set the zero-control knob at mid-range so that the arrow on the knob points at the letter O on the word control.
6. With a small screwdriver, set the course zero pot so that the meter reads as close to zero as possible. An exact zero can now be set with the zero control knobs.
7. Insert a 10 NTU standard solution into chamber and cover
8. Set the range switch to 20
9. If the meter does not read 10.00, adjust the potentiometer marked 20 with screwdriver until the meter reads 10.00
10. With the 10 NTU standard solution in the chamber and covered, set the range switch to 200
11. If the meter does not read 10.00, with a screwdriver adjust the potentiometer Marked 200 until the meter reads 10.00
12. Replace the standard solution with sample and set the meter to appropriate range.
13. Allow the value to stabilize, record the sample result.

D) TOTAL SUSPENDED SOLD (TSS) TEST (FILTRATION TECHNIQUE) PROCEDURE:

1. Weigh the Millipore filter paper (Xmg) and Put the TSS filtration assembly in place
2. Place the Millipore filter paper properly And hold tight the filter paper with the aid of the clamp, the shake water sample vigorously
3. Measure an aliquot of 250ml of the water sample, transfer the water sample into the filtration flask
4. Then commence the filtration with the aid of filtration pump, and carefully remove the filter paper and put it in the oven for dry for about 30mins, then transfer straight into a dessicator.
5. Weigh the filter paper plus the recovered solid (mg)

Calculation: TSS (Xmg/l) = [Y- X} × 100/ml of sample

E) HEAVY METALS TESTEXCHANGEABLE CATION IN WATER:

Procedure is as follow (using wet oxidation method)

1. Measure about 100ml of a well-mixed water sample into a 150ml beaker and add 5.0ml of concentration of HNO_3
2. Evaporate the solution to near dryness on a hot plate, making sure that the sample does not boil (use low to medium heat), and allow the beaker and the contents to cool
3. Add another 5.0ml of concern. HNO_3 to beaker and cover immediately with a watch glass, and return the beaker to the hot plate and set a gentle reflux action of the solution by increasing the temperature of the hot plate (medium to high), and continue heating with the addition of HNO_3 as necessary until light color residue is obtained (digestion is completed)
4. Add 1-2 ml of concern. HNO_3 to the residue and wash with distilled water, then filter into 100 ml volumetric flask to remove silicate and other insoluble materials.
5. Make up to the mark with distilled water and store the solution in 125ml polypropylene bottle
6. Then use atomic Absorption Spectrophotometer (model Varian 220 Fast Sequential)

F) DISSOLVED OXYGEN TEST:

Procedure is as follows using Winkler's method

1. Fill a 250ml brown bottle with the sample, making sure that bubbles are not trapped in.
2. Add 2ml of $MnSO_4.5H_2O$ well below the surface of the sample, and add 2ml of alkaline. Iodide solution at the surface of sample Stop carefully so as to avoid inclusion of air bubbles and mix thoroughly by rotating and inverting the bottle several times and allow the precipitate to settle completely.
3. Add a pipette 1ml of diluted Sulphuric acid or 85-90% orthophosphoric6 acid and replace the stopper and thoroughly mix the content by rotating.
4. Measure 100ml of the solution into the conical flask and titrate immediately with 0.0125N $NaS_2O_3.5H_2O$ using an indicator 2ml of starch Solution is added towards the end of the titration. The color changes from straw yellow to colorless at endpoint.

Calculation: DO = $V1\frac{N\,(8)\times 100}{V2}$

Where

V1 = volume of 0.0125N $NaS_2O_3.5H_2O$
V2 = volume of sample taken
N = Normality $NaS_2O_3.5H_2O$

G) CHLORINE TEST

Procedure simply as follow

1. Measure 100ml of sample into a 250ml of conical flask
2. Add 1ml of K_2CrO_4
3. Titrate with 0.014N $AgNO_3$
4. The color of sample changes from yellow to reddish brown at the endpoint

Calculation: $\mathrm{Mg/(Cl\text{-})} = \frac{35.5 \times \mathrm{Cb} \times \mathrm{Vb00}}{\text{ml of sample}} \times \frac{100}{1}$

Where

C_b = concentration of $AgNO_3$ (Normality)

V_b = volume of $AgNO_3$ (consumed)

E) BOD TEST PROCEDURE USING DILUTION METHOD:

1. Dilute the sample in ratio 1:5 with Dilution water in brown bottles
2. Fill another two brown bottles with only Dilution water
3. Determine the initial DO in one of the mixtures of sample and Dilute
4. Also determine the initial DO in one of the bottles containing only Dilution water
5. Place the other bottles in incubator (the one that contains mixture of sample and Dilute water only)
6. After 5-days determine the DO in the diluted sample and the blank by titrating 200ml against 0.0125Nthiosulphate.

Calculation: BOD $= \frac{(X - Y\,az)\,(a + z)/\,100}{a+1}$

Where X= vol. Of 0.0125N thiosulphate required for 200ml of original Dilution (ml)

Y = vol. Of 0.0125N thiosulphate required for 200ml of incubated Dilution (ml)

A = vol. Of Dilution water to 1 volume of sample (ml)

. z = diff between volumes of 0.0125N thiosulphate 200ml of dilution water before and after incubation (ml)

F) SULPHATE TEST PROCEDURE

APPARATUS	**CHEMICALS**
Volumetric flasks (100ml capacity)	Barium chloride salt
Pipettes (100ml)	NaCL-HCL solution
Cuvette (25ml)	Alcohol-Glycerol mixture

EQUIPMENT: HACH DR2000 (absorbance mode)

Preparation of 1000mg/L sulphate stock standard and working solution

- Dissolve 1.479g of anhydrous $NaSO_4$ in 500ml of distilled water in 1000ml size volumetric flask; make to volume with distilled water.
- From the stock solution, prepare lower concentration of 2.0, 4.00, 6.00, 8.00, and 10.00mg/l, in 100ml volumetric flask employing serial dilution method ($C_1V_1=C_2V_2$) standard

PROCEDURE

1. Measure, quantitatively, 70ml of each standard solution into the volumetric flask
2. Add 10ml of NaCL-HCL and shake, then add 10ml of Alcohol- Glycerol mixture, shake again.
3. Add 5.0g of finely divided BaCL2 crystal and make the volume to mark, and then read the absorbance values, at 380nm on HACH DR200 UV- Visible Spectrometer, for standards and reagent blank.

G) AMMONIUM TEST USING COLORIMETRIC METHOD

APPARATUS	CHEMICALS
Volumetric flasks (25ml capacity)	Tri-sodium phosphate solution 5%, Phenol salt,
Pipettes (25ml)	alkaline bleach (common bleach 3.5%)
HACH DR2000	Sodium hydroxide solution, Ammonium stock
PH meter	standards solution

Preparation of 1000mg/L ammonium ion stock and working standard solution

- Dissolve 2.965g of NH_4CL salt in 500ml of distilled water in 1000ml capacity volumetric flask, after the dissolution, make the volume to mark with distilled water.
- Prepare from the 1000mg/l standard stock solution 0.50, 1.00, 1.50, 2.00 and 2.5mg/l into 100ml capacity volumetric flasks. Also prepare a reagent blank.

Procedure

1. Place 20.0ml of each standard solution in 50ml volumetric flask and add 4.0ml tri-sodium phosphate solution, 10ml of phanate reagent 1 and shake gently
2. Add 2.5ml of 3.5% alkaline bleach and shake gently, then Make the volume to mark
3. Allow color development for about 25minutes
4. Carry out the same for the reagent blank
5. Read the absorbance of the standard and reagent blank on DR2000 at 635nm

H) COLIFORM BACTERIA TEST

Procedure involve the probable Number (MPN)

1. First sterilized all the apparatus, material and growth medium using autoclave
2. Prepare three sets of five test tube containing 9ml MC conkey broth
3. Inoculate 1ml of the water sample to dilute 9ml of sterilized distilled water for serial dilution, and pour 1ml each in a first set of test tube. Pour 0.1ml to second set of test tube and 0.01ml to the third set.
4. Mix the inoculums with the growth medium in the test tube by agitating gently
5. Invert the Durham tube in each tube and cover, then incubate the bottles at 37c for 48 hours
6. Observe each tube for acid production which signify micro organism growth through color changes, and gas production in the Durham tube.
7. Combine the number of positive tubes in each set and arrange orderly and read out the combination from the standard MPN table to obtain the estimated number of coli form cells present in 100ml of the original water sample (using McCrady's statistical table).

NITRATE/NITRITE TEST PROCEDURE

1. Set up a number of reaction tubes in a wire rack containing 10ml of sample, blank and standard solution prepared from sodium nitrate for nitrate and sodium nitrite for nitrite, spacing them so that empty space surrounds each tube.
2. Set the rack in a cool water bath, add 2ml NaCL solution prepared from (300g of NaCL crystals in distilled water) to the sample, standard and blank solution.
3. Mix thoroughly by swirling and then add 10ml H_2SO_4 prepared from (500ml of concern. H2SO4 to 125ml distilled water) to each solution.
4. Again swirl to mix thoroughly and allow to cool.(if any turbidity or color is observed, dry the tubes using clean tissue paper
5. Replace the rack of tubes to mix thoroughly and now place the rack of tubes in well stirred boiling water bath that maintain a temperature of not less than 95c. Let them remain there for 20minutes
6. Remove the samples and immerse them in a cold water bath, when thermal equilibrium is attained, remove the tubes and dry them with tissue paper .
7. Read the standard and samples against the reagent blank at 410nm in the Spectrophotometer.

SAFETY PRECAUTIONS TAKEN IN THE LABORATORY

1. The following safety materials should be worn when carrying out the above experiments Hand glooves, Eye goggles, and laboratory coat.
2. Instruments should be handled with care.
3. Experimental precautions should be strictly follow
4. Ensure accurate readings when recording results.
5. Avoid distractions and horse play.

After the laboratory tests, the following observed values were arrived for the various sites:

TABLE 2: TEST RESULT TABLE

s/n	Parameters	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Borehole
1	PH	4.25	4.37	5.31	5.14	5.53
2	Temperature	23	23	23	23	
3	Total Dissolved Solid	40.72	44.56	60.20	69.73	19.34
4	Conductivity	80.10	87.92	117.45	136.95	36.82
5	Turbidity	0.80	1.20	0.90	0.62	0.80
6	Dissolved Oxygen	1.80	2.70	2.50	4.40	5.10
7	Chlorine (mg/l)	9.73	14.76	24.19	26.62	5.10
8	Phosphate (mg/l)	0.08	0.15	0.27	0.31	<0.01
9	Sulphate (mg/l)	0.87	1.06	1.18	1.29	0.59
10	Nitrate (mg/l)	0.04	0.10	0.34	0.57	<0.01
11	Nitrite (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
12	Ammonium (mg/l)	0.02	0.05	0.11	0.15	0.01
13	TSS (Mg/l)	1.00	2.00	2.00	1.00	1.00
14	Potassium (mg/l)	0.10	0.13	0.17	0.22	0.04
15	Zinc (mg/l)	1.21	2.11	2.26	2.45	1.10
16	Total iron (mg/l)	1.21	1.32	1.64	1.95	0.88
17	Mercury (Mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
18	Coliform count (MPN/100ml)	20	70	10	120	20

RESULTS AND DISCUSSION:

RESULTS

The test results were compared using the 2011 World Health Organization standard for drinking water. As shown below

TABLE 3: WORLD HEALTH ORGANIZATION PERMISSIBLE LIMIT FOR DRINKING WATER (2011)

S/N	PARAMETER	W.H.O LIMITS
1.	PH	6.5-8.5
2.	Temperature(^{O}C)	24-29^{0}C
3.	Tds (mg/l)	600mg/l
4.	Conductivity(µs/cm)	1000 µs/cm
5.	Dissolved oxygen (mg/l)	> 4.00mg/l
6.	Total hardness(mg/l)	500mg/l
7.	Color (tcu)	50 tcu
8.	Chloride (mg/l)	250mg/l
9.	Sulphate (mg/l)	400mg/l
10.	Phosphate(mg/l)	Not available
11.	Nitrate (mg/l)	30mg/l
12.	Nitrite (mg/l)	3mg/l
13.	Potassium(mg/l)	occurs in drinking water at concentration below standard well below standard
14.	Turbidity (NTU)	1NTU
15.	Zinc(mg/l)	3mg/l
16.	Iron(mg/l)	0.3mg/l
17.	Lead(mg/l)	0.01mg/l
18.	Mercury(mg/l)	0.06mg/l
19.	Calcium(mg/l)caco3	75.00mg/l
20.	Magnesium(mg/l)	50.00mg/l
21.	Ammonium	0.02mg/l
22.	Total Coliform	0

COMPARED RESULT

The table briefly showed the compared test results.

Table 4: Compared Test Result With W.H.O, 2011, Permissible Limit

s/n	Parameters	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Borehole 5	Standard limit
1	PH	4.25	4.37	5.31	5.14	5.53	6.5-8.5
2	Temperature	31.7	31.1	29.8	30.5	30.6	24-29
3	Total Dissolved Solid	40.72	44.56	60.20	69.73	19.34	600
4	Conductivity	80.10	87.92	117.45	136.95	36.82	1000
5	Turbidity	0.80	1.20	0.90	0.62	0.80	1 NTU
6	Dissolved Oxygen	1.80	2.70	2.50	4.40	5.10	Not available
7	Chlorine (mg/l)	9.73	14.76	24.19	26.62	5.10	0.07
8	Phosphate (mg/l)	0.08	0.15	0.27	0.31	<0.01	Not avialable
9	Sulphate (mg/l)	0.87	1.06	1.18	1.29	0.59	500
10	Nitrate (mg/l)	0.04	0.10	0.34	0.57	<0.01	50
11	Nitrite (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	3
12	Ammonium (mg/l)	0.02	0.05	0.11	0.15	0.01	0.2
13	TSS (Mg/l)	1.00	2.00	2.00	1.00	1.00	
14	Potassium (mg/l)	0.10	0.13	0.17	0.22	0.04	Present @ below standard
15	Zinc (mg/l)	1.21	2.11	2.26	2.45	1.10	3
16	Iron (mg/l)	1.21	1.32	1.64	1.95	0.88	0.3
17	Mercury(Mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	0.03
18	Coliform count (MPN/100ml)	20	70	10	120	20	0

ANALYSIS OF RESULT

From the test result observed, using table 4.1 above, it was very clear to note the different between the observed values and the standard values set by the world health organization (W.H.O 2011) as the maximum permissible limit for drinking water. This is seen in the pH value, coli form count, temperature, turbidity, and iron, for the five (5) samples under analysis. The reason for this drop and increase can be proven under this study, as the underground flow of the septic tanks around the bore-holes and this may be due to other environmental factors. **N: B** Nation was made as stated below.

After the test for the highlight parameters were done, it was notice that some observed value were not detected as presented by <0.01

VARIATION OF WATER QUALITY TEST PARMETERS AROUND SAMPLING LOCATION

From TABLE 2 the variation of the highlighted parameters for each water sample were within the permissible limit, except pH, coli form-count, temperature, turbidity, and iron. Which are shown below, to known the contaminated water sample and way to eradicate the observed problem, most especially pH, turbidity, total iron and coliform-count to ensure safe drinking water in the study area. And also, to best explain to the inhabitants to be aware of the current situation of the water quality they have been consuming.

VARIATION FOR PH VALUE

Below **Fig 1** show the variation of PH in the different sample location and indicate that five sample location are acidic characterized, because value are below 6.5.

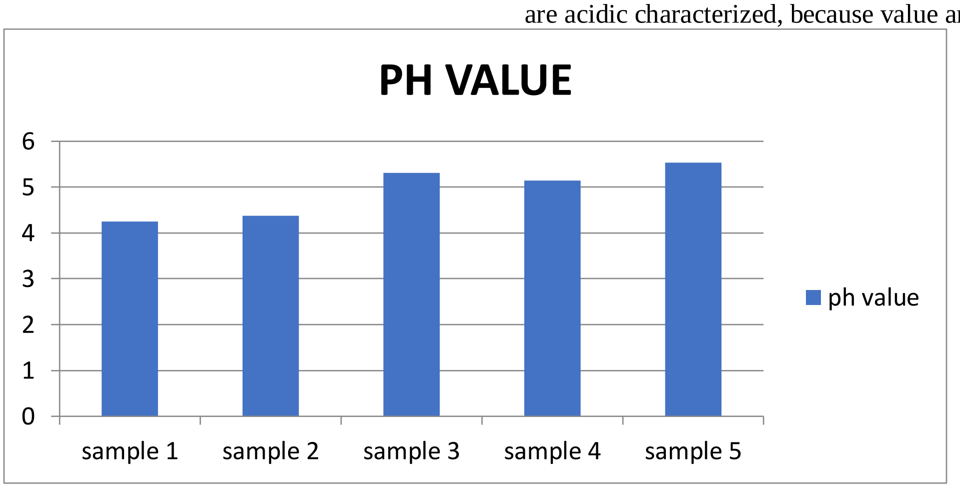

FIG 1: Variation Graph Of pH Value

VARIATION OF TURBIDITY

As shown below, the turbidity of the sample 1, 3, 4, and 5 are not above the permissible limit 1 NTU, except sample 2, this indicates sample 2 contain some sediment.

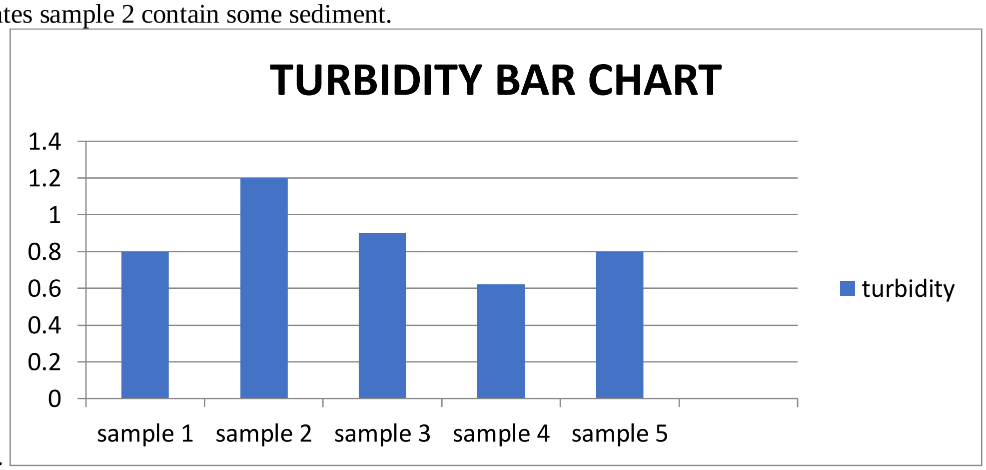

Fig 2: Variation Graph of Turbidity

VARIATION OF IRON (HEAVY METALS)

The heavy metals include zinc, iron, and mercury which are within, except iron that is above the permissible limit of iron as prescribe by W.H.O

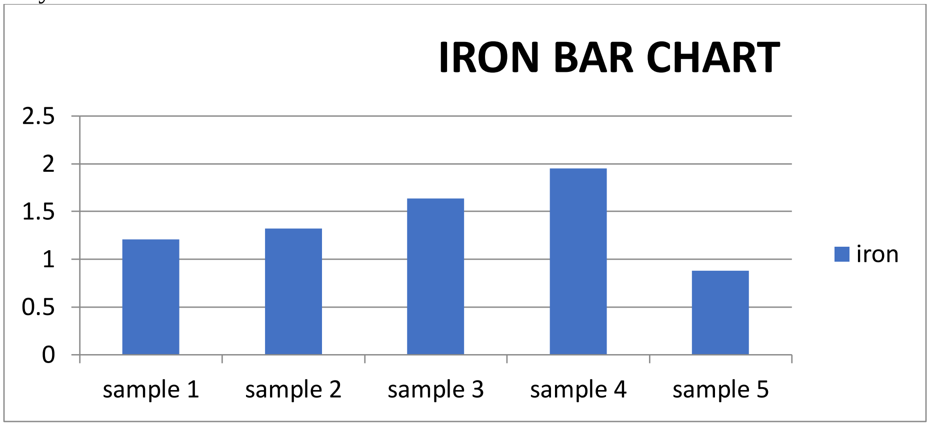

FIG 3: Variation Graph of Iron (Heavy Metals)

VARIATION OF TOTAL COLIFORN COUNT

From the W.H.O 2011 standard, and the variation of total coli form count in the water sample is above the permissible limit, this indicate the five samples are highly contaminated with bacteria's.

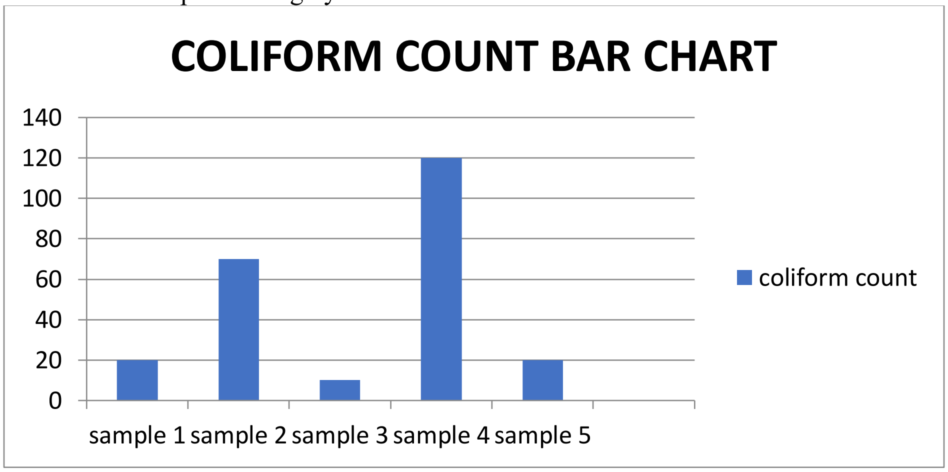

FIG 4. Variation Graph of coliform count

DISCUSSION:

The value of eighteen physiochemical and bacteriological parameters of ground waters was used for the analysis of the ground water quality in warri metropolis to ascertain it suitability for human consumption and for other domestic uses. This is base on the fact that, human activities and industrial activities can potentially affect the water quality. From the test result and the set permissible standard established by world health organization (W.H.O, 2011), including the variation graph of the various` parameters PH value of the whole water sample indicate that the water in the region of warri metropolis is acidic, but not very acidic, and is contaminated with bacteria. The possible way to handle this problem is to raise PH value using calcite, (crushed and screened white marble media which can inexpensively neutralize the acidic of low PH waters to neutral, less corrosive influent). A calcite filter will typically raise the PH of the water. And also for iron, turbidity, bacteria, the water should be disinfected, equalization, neutralized e.t.c.

CONCLUSION AND RECOMMENDATION:

CONCLUSION

The physiochemical and bacteriological parameters of the water samples in the study area was conducted to evaluate the suitability of water for drinking purposes. This test method provides an easy way of understanding the overall water quality and water management.

The water quality rating at more of the sampling sites clearly showed that the status of the ground water body within the study area of warri Metropolis is partially suitable for drinking or for domestic uses, because some parameters are within the World Health Organization (WHO,2011,) standard guidelines for drinking. It was also observed that the pollution load was relatively high in areas where the pH is low (4.5, 5.0), coliform count (20, 10, 120, 70) owing to the fact that the bore hole were close to septic tanks and refuse dump site, which may be a major cause of the pollution of the ground water. However, there is need for regular monitoring of water quality in order to detect changes in physiochemical and bacteriological parameters concentration and convey it to the public.

RECOMMENDATIONS

After the exposure from the above study, the following recommendations were made:

i. A further study should be done in the study area to show the direction of flow of the underground water, so as installation of new bore holes will be done in an area that doesn't favour pollution as a result of flow of the water from the septic tanks situated around the bore holes.

ii. The water from the study area should be used for domestic purposes but not drinking as it doesn't possess excellent water quality. If this water must be adopted for drinking, further treatments should be conducted to make it safer for drinking.

REFERENCES:

1. Almeida, C. A., Quintar, S., Gonzalez, P., and Mallea, M. A. 2007. Influence of urbanization and tourist activities on the water quality of the Potrero de losFunes Rittver (San Luis-Argentina). Environmental Monitoring and Assessment, 133, 459– 465.
2. ARGOSS. 2001.Guidelines for assessing the risk to groundwater from on-site sanitation. BGS Report CR/01/142, Keyworth.
3. Buchanan, S.; Triantafilis, J. 2009 Mapping water table depth using geophysical and environmental variables.Groundwater, 47, 80.
4. Debels, P., Figueroa, R., Urrutia, R., Barra, R., and Niell, X. 2005. Evaluation of water quality in the Chilla'nRiver (Central Chile) using physicochemical parameters and a modified water quality index. Environmental Monitoring and Assessment, 110, 301–322.
5. Diersing, Nancy (May 2009). "Water Quality: Frequently Asked Questions". Flourida keys national marine sanctuary
6. Edmund J. S. Sonuga-Barke, Paul Webley 1981 Children's Saving: A Study in the Development of Economic Behavior.
7. Fayose and ola 1990, Subsurface Evaluation of Source Rock and Hydrocarbon Potential
8. Foster, SSD and Hirata, R. 1988.Groundwater pollution risk assessment: a methodology using available data. PAHO-CEPIS,Lima.
9. Foster, SSD, Lawrence, AR and Morris, BM. 1998. Groundwater in urban development. World Bank Technical Paper no 390, Washington DC.
10. International journal of engineering research and application volume 1, 2011. Determining water quality index for the evaluation of water quality
11. Lerner, DN (2nd ed) 2004.Urban groundwater pollution. IAH International Contributions to Hydrogeology, 24. Balkema.
12. Morris, BL., Lawrence, AR., Chilton, PJ, Adams, B, Calow, R and Klinck, BA. 2003.

a. Groundwater and its susceptibility to degradation: A global assessment of the problems and options for management. Early Warning and Assessment Report Series, RS, 03-3. UNEP, Nairobi, Kenya.

13. Offodile, 2000Nigerian Journal of Industrial and Systems Studies: NJISS. Volume
14. Oyem, M.N. (2014), Hydrogeology and groundwater perspectives (1st ed.) Nigeria, Justice Jeco and publishing Global, Benin City.
15. WHO, 1984, Global Perspectives on Health Promotion Effectiveness
16. WHO/UNICEF. 2004. Meeting the MDG drinking water and sanitation target: a mid-term assessment. Joint Monitoring Programme, Geneva and New York.
17. Schmoll, O, Howard, G, Chilton, PJ and Chorus, I (eds).2006. Protecting Groundwater for Health: Managing the Quality of Drinking Water Sources./IWA, London
18. eschooltoday.com/pollution/water-pollution/causes-of-water-pollution.html
19. eschooltoday.com/pollution/water-pollution/effects-of-water-pollution.html
20. eschooltoday.com/pollution/water-pollution/industrial-causes-of-water-pollution.html
21. eschooltoday.com/pollution/water-pollution/prevention-of-water-pollution.html
22. eschooltoday.com/pollution/water-pollution/types-of-water-pollution.html
23. eschooltoday.com/pollution/water-pollution/what-is-water-pollution.html
24. https://inspiredliving.com/cuzn-water-filtration/acid-water-low-pH.htm
25. https://en.m.wikipedia.org/wiki/Water_treatment
26. https://www.britannica.com/science/water-table
27. https://en.m.wikipedia.org/wiki/Water_cycle
28. https://en.m.wikipedia.org/wiki/Warri
29. https://water.usgs.gov/edu/earthgwquality.html

30. http://water.usgs.gov/edu/urbanquality.html
31. https://en.m.wikipedia.org/wiki/Urbanization
32. techalive.mtu.edu/meec/module04/Basics3.htm
33. www.businessdictionary.com/definition/leaching.html
34. www.studylecturenotes.com/basics-of-sociology/what-are-the-causes-of-urbanization
35. www.farnellfamily.com/cfarnell/why/uses.html