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# Physiochemical Analysis of the Quality of Groundwater in Egbeta, Ovia North East Local Government Area of Edo State, Nigeria

Adegbite,Joseph T[1], Aigbogun, Christopher O[1], Kuforijimi, Olorunsola[2]
[1,2]*Department of Physics, University of Benin, Benin City, Edo State, Nigeria*
*Corresponding Author: Adegbite,Joseph T*

***Abstract:*** *Physiochemical study of the groundwater in Egbetawas carried out to ascertain the quality of the potable water in this community. Water samples from the two functioning boreholes and one hand-dug well in the areawere collected. The water samples collected were analysed in a physiochemical manner to determine the level of purity and contamination from heavy metal, Anions, Cations and other materials. The result of the physiochemical analysis shows the presence of heavy metals like, Iron, Zinc, Chromium, and Lead, with Iron available at a range that exceeds WHO standard in the three samples collected. The highest concentration of Iron is found in the CSB with value of 8.0 mg/l, this accounts for the yellow to reddish brown coloration reveals by the water obtained from this borehole, while Zinc, Chromium and Lead exist at a range that is below the WHO standard, Also, trace elements like Calcium, Sodium, Magnesium and Potassiumpresent within the acceptable range of WHO standard, except potassium in sample CACB and CSB that far exceeds the WHO standard. The geology of the area is known to affect the quality of groundwater due to the effectof human activities in the study area.*

***Keywords:*** *Groundwater, Physiochemical, Quality, Borehole, Hand-dug Well*

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## I. Introduction

An upsurge in the population of both rural and urban areas has increased the pressure on the natural resources especiallythe groundwaterfor both domestic and industrial consumption. A wide spread concernis now being raised on the degradation of water quality due to its physiological importance to human body. About 80% of the diseases that affect the world population and more than one-third of the deaths in the developing countries are as a result ofwater contamination. Chan *et al*., (2007) stated that the drinking of harmful water has been mentioned as one of the major causes of these diseases. Sunpriya, (2014) andBayode*et al.*, (2012) assessed the impact ofsome waste dumpsite on the groundwater quality insome parts of Akure metropolis and the parametersanalysed - pH, electrical conductivity, total dissolvedsolids, Calcium, and Nitrate concentration exceededWHO prescribed limit for drinking water. Thewater samples collected within the vicinity of thedumpsite implyleachates might have contributed tothe concentration level. Imoisi*et al.*, (2012) examined the effect of municipal wastes onthe quality of groundwater in Benin City and foundconcentration levels of physicochemical and bacteriologicalloading higher in wells close to dumpsite thanthose far away. Eni *et al.*, (2011)assessed the impact of urbanization on the subsurfacewater of Calabar town, they noted some impurities in the water like acidic, Nitrateand faecal coliform have very high concentration inthe wells. Results of multiple regression show faecalcoliform,pH, and chlorine have positive relationship withurbanization. Amadi*et al.*, (2010) examined the effect ofurbanization on groundwater quality of Makurdimetropolis. The results of the analyses show water samplescollected within the vicinity of dumpsite have low pH, higher concentration of iron, manganese, calcium andtotal dissolved solids and total coliform when comparedto those far away from the dumpsite suggesting leachate influence. Tse and Adamu, (2012) carried outthe chemical and bacteriological analyses of hand dug wells in Makurdi town, they noted the water to be slightly acidic,moderately hard, low total dissolved solids. Heavy metalsuch as iron, zinc, copper, lead and cadmium occur intraces, while high concentration of coliform is noted inall the wells.Ayantobo*et al.*, (2012)assessed the quality of water from hand dug wells in Ibadan, they deduced that nitrate, faecal coliform and total coliform atobjectionable levels are pronounced in wellslocated close to domestic wastes, abattoir, pit latrineand stagnant water and drainage. Atarhe and Egbuna, (2013) assessed the quality of waterfrom hand dug well in Akure town, they discovered the groundwater tobe acidic, with electrical conductivity to exceed WHOprescribed limit for drinking water.Ho*et al*., (2001) specified that increase in human populations has been ascribed to cause most of the slowdecline of water quality and urbanization.Rahmanian*et al*., (2015) and EPA (2014)stated that the acceptable standard of water quality for the total coliform counts is 120 cfu/mL.

**Geology of the Study Area**

The various formations in the geology of Edo State are: Benin, Bende Ameki, Ogwashi-Asaba, Imo and Nsukka. The geology of the study area is characterized by deposits laid during the tertiary and cretaceous periods. The area is underlain by sedimentary rock constituting part of the Benin formation which is made up of over 90% massive, porous, coarse sand with thick clay/shale interbeds having high groundwater retention capacity. Soil particles vary from coarse grained to fine grained in some areas, poorly sorted, sub-angular well-rounded particles with lignite streaks and fragments.

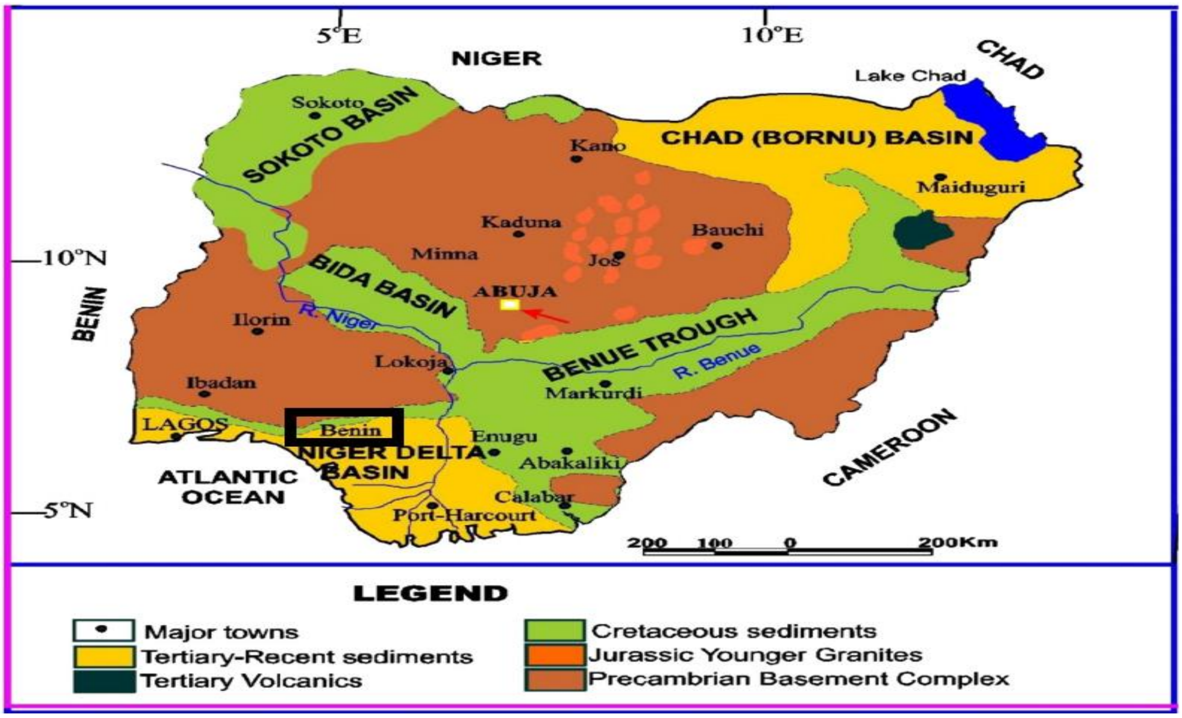


**Figure 1.** Geological Map of Nigeria Showing the Study Area in black Rectangle (Adapted from Obaje, 2009 andOmeje*et al*., 2013)

## II. Materials and Method

Reconnaissance survey of the community was carried out and water samples were then collected from the two functioning boreholes and one hand-dug well present in three different locations in the community:The Cherubim and Seraphim Borehole (CSB) (Figures 2 and 3), Catholic Church Borehole (CCB) and the Christ Apostolic Church Well (CACW). The samples were taken to the laboratory for physiochemical analysis which was carried out in Elite Environmental Consultants and Laboratories Limited, Uselu, Benin city. The heavy metals in the water samples were analysed with the help of the Automatic Absorption Spectrophotometer (AAS), the Anions in the samples were analysed using the Ultra-violent Spectrophotometer (UVS), the cations using the Flame Photometer, the Dissolved oxygen (DO) and the Biological oxygen demand (BOD) was analysed using the Winkler's method, the pH of the water samples was analysed using the pH-meter, while the Total Dissolve Solid (TDS) was analysed using the TDS-Meter and the conductivity meter was used to determine the conductivity of the water samples.

## III. Results and Discussion

The results from the physiochemical analysis of the water samples are presented in the Tablebelow.

Summary Table of Physiochemical Analysis of the Water Samples

| PARAMETER | UNIT | CACW | CCB | C&SB | WHO STANDARD |
|---|---|---|---|---|---|
| pH | -log | 5.59 | 6.89 | 6.27 | 6.5-9.5 |
| Conductivity | µs/cm | 86 | 24 | 64 | 1200 |
| Total dissolved solid | Mg/L | 43 | 12 | 32 | 500-1500 |
| Dissolved oxygen | Mg/L | 14.8 | 13.2 | 10.4 | 1000 |
| Calcium | Mg/L | 4 | 2.4 | 4.8 | 200 |
| Magnesium | Mg/L | 7.2 | 0.96 | 9.12 | 50 |

| | | | | | |
|---|---|---|---|---|---|
| Total hardness | Mg/L | 10 | 6 | 12 | 0-75 |
| Alkalinity | Mg/L | 15.25 | 7.63 | 22.88 | 100 |
| Chloride | Mg/L | 24.94 | 6.96 | 18.56 | 100-250 |
| Sodium | Mg/L | 17.2 | 4.8 | 12.8 | 200 |
| Potassium | Mg/L | 22.36 | 6.24 | 16.64 | 12 |
| Sulphate | Mg/L | 0.08 | 0.17 | 15.4 | 200 |
| Nitrate | Mg/L | 0.43 | 0.07 | 2.82 | Oct-50 |
| Iron | Mg/L | 0.4 | 0.6 | 8 | 0.1-0.3 |
| Zinc | Mg/L | 0.02 | 0.02 | 0.04 | 3 |
| Chromium | Mg/L | <0.005 | <0.005 | 0.02 | 0.05 |
| Lead | Mg/L | <0.005 | <0.005 | <0.005 | 0.05 |

From thesummary table of results above, the pH for all the three samples ranges from 5.59 to 6.89, which is an indication of weak acidity, with the sample for CACW falling below the WHO standard while the other two samples for both CCB and CSB both falls within the range of WHO standard for pH. The electrical conductivity (EC) of the water ranges from $24\mu s/cm$to $86\mu s/cm$, the total dissolve solid (TDS) ranges from 12 mg/l to 43 mg/l, the dissolved oxygen (DO) ranges from 10.04 mg/l to 14.8 mg/l, biological oxygen demand (BOD) ranges from 3.16 mg/l to 6.4 mg/l, chemical oxygen demand (COD) ranges from 13.93 mg/l to 18.6 mg/l, the total hardness (TH) ranging from 6.0 mg/l to 12.0 mg/l, with the CSB having the highest and thus, the hardest and CCB having the lowest value. The alkalinity of the three samples ranges from 7.63 mg/l to 22.8 mg/l, which far exceed the WHO standard of 10 mg/l for alkalinity, except for the CCB which is slightly below the WHO standard.

The results of the physiochemical analysis reveal the presence of four heavy metals, Fe, Zn, Cr and Pb, Lead (Pb) and Zinc (Zn) fall below the WHO standard of 0.05 mg/l and 3.0 mg/l (respectively) in the three samples analysed. Also, Iron (Fe) was also found to exceed the WHO standard of 0.3 mg/l in all the three-sample analysed, with CSB having the highest value of 8 mg/l why CCB and CACW both have the values of 0.6 mg/l and 0.4 mg/l respectively. Chromium (Cr) was also found at a range that is below the WHO standard of 0.05 mg/l.The results of the analysis further show the following trace elements, Sodium (Na), Potassium (K), Chloride, Sulphate, Nitrate, and Phosphate, at a value that is far below the WHO standard, except for potassium which has its value at the CACW and CSB to be 22.36 mg/l and 16.64 mg/l respectively which exceed the WHO standard of 12 mg/l. The cation composition in the samples is shown in the order of K>Na>Mg>Ca.
The high value recorded by potassium and Iron can be traced to the weathering of the basements rocks which is rich in Iron and potassium.

**Figure2:**Picture of Cherubim and Seraphim Borehole

**Figure3:** Picture of water sample collected from the Cherubim and Seraphim Borehole

## IV. Conclusion

This research considered the physiochemical parameters of Two (2) boreholes and one (1) hand-dug well in Egbeta. The resultsshow the presence of heavy metals like, Iron, Zinc, Chromium and Lead. Iron is available at a range that exceeds WHO standard in the three samples collected. The highest concentration of iron is found in the CSB with 8.0 mg/l value, this account for the yellow to reddish brown colouration shown by the water obtained from this borehole. Zinc Chromium and Lead occur at a range that is less than the WHO standard in the samples, also trace elements like Calcium, Sodium, Magnesium and Potassiumpresent at a range that is within the acceptable WHO standard, except Potassium in sample CACB and CSB that far exceeds the WHO standard.The geology of the area is concluded to influence the quality of groundwater in the study area.

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