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Assessment of Borehole Water Quality in Nigeria Maritime University, Kurutie – Takeoff Campus and Environment

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ABSTRACT
The assessment of borehole water quality in NMU: Kurutie – Takeoff Campus and environment has been done. The water quality assessment, which is a compelling constituent of the grantee of the health and wellbeing of both students and staff of the university, has been appraised. The physicochemical analysis of the samples A and B are pH of 8.1: 7.0; DO of 3.5mg/L:2.9mg/L; BOD_5 of 2.2mg/L:1.8mg/L; conductivity of 416 µs/cm: 340µs/cm; TDS of 207mg/L: 170mg/L; nitrate of 0.3mg/L:23mg/L; turbidity of 2. 0NTU:12NTU and hardness of 202.2mg/L: 121mg/L respectively. The results show some disagreements between the different sites. Site A recorded the highest pH of about 8.1confirming the total hardness of water at the site. And the same readings for the BOD_5, which show a lower value of it depicting the cleanliness of organic matter. While the electrical conductivity – an estimate of total dissolved solids-depicts higher readings in Site B, which is lesser than the TDS 500mg/L set for drinkable water. It is recommended that quality assessment of the boreholes in order to improve the quality of water supply should be carried out to correct the disparities between sites.

Keywords: *Assessment, Quality, Water, Borehole, NMU, Environment*

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I. INTRODUCTION

The earth's surface gives an important fountain of drinkable water for local communities in very many parts of the African continent, especially in the summer period when there are very limited optional sources (Lapworth et al., 2020). Precisely, water is contaminated when its composition is changed instantaneously or not instantaneously as a result of disposition of waste and related human being operations, so it is not appropriate to drink together with domestic activities. Also, in African countries like Nigeria, better together with drinkable water is still a necessity that has not been met (Ordia and Saidu, 2023). Water utility facilities are sometimes in bad condition or not adequate, thereby giving kinky delivery with impurities like faeces via pipes that have been destroyed together with water wastage (Nayar, 2020).

Drinkable water in the world is of upmost concern because of its vitality to human beings coupled with other life frameworks (Mukherjee et al., 2022). It is presently ascertaining that low water quality causes poor health together with reduced productivity, which is consistently limitable to poverty alleviation, together with a recoverable economy in any geographical zone, as the financial requirement for having appropriate quality water is on the increase, reaching above the average in Nigeria. The popular proverbs 'there is water, water everywhere but no water to drink' and people are being killed because of bad water (Duru, 2009).

Practicably, water is important for all creatures that live together with the conspicuous fact of its movement via cycle which is evaporative, precipitous doubled with runoff. However, water requires being accessible at every time, but the accessibility of water in space, together with time, is limitable to factors of the environment, like climate, the geographical region together with physical conditions. Also, limited factors like the efficiency by which it is preserved can influence the accessibility of water.

The World Health Organisation in 2018 disclosed that about two – billion people cannot get drinkable water supply irrespective of the fact that water is the fundamental requirement of every living being or thing, thereby making the need for ascertainment of the water quality comparable to how it affects users. Also, according to the certified laws on water quality stem from the requirement to secure human health (Kiely, 2007).

Meanwhile, a vital source of drinkable water in Africa, which initiates about two – thirds of the global fresh water, is from ground water. Ground water is the water that appears under the surface of the earth: being in the pore spaces of the soil coupled with the one in the formations of rock fractures. It is well established that ninety-eight percent of the global fresh water is reckoned to ground water, which gives a commonsensible dedicated provision for domestic usage, livestock together with irrigation and is not seem to dry up under natural conditions (William, 2014).

Sincerely, ground water is mostly got through boreholes together with wells. These structures, with a depth of 45m to 50m, warp the main flow field by creating a route that opens another potentiality of mass transfer between the formations of rock, aquifers, and environs coupled with the atmosphere (Berthold, 2010; Akpoveta et al., 2011). Observationally, this indicates that there could be doable spots of pollution in the ground water achingly as the groundwater is taken through boreholes or wells via the interactive water molecules together with the formation of rock doubled with the environs' atmosphere.

Ordia and Saidu (2023) conducted a physicochemical together with microbial appraisal of borehole water in hospitals around Benin City, Nigeria. The results indicated that there are microorganisms in the various water samples investigated. Also, the physicochemical appraisal showed that the pH has the highest reading of 6.06±0.33. It was advised that since the water has the presence of microorganisms, water treatment should be introduced.

Oladipo et al. (2023) performed a quality assessment of borehole water in the Federal Polytechnic Ado Ekiti Hostels, Ekiti State, Nigeria. The results of the investigation revealed that the physicochemical appraisal has mean values of turbidity – 6 NTU, Total Hardness – 195mg/L together with fluoride of 1.59mg/L. The bacteriological assessment indicated no growth on the eosin methylene plates, showing that there is no presence of coliform bacteria in the boreholes dug thereby making the water appropriate for drinkable.

Ugwoha and Nwike (2018) did an analysis of the water quality of boreholes in Choba Campus Hostels of the University of Port Harcourt, Rivers State, Nigeria. The appraisal was done on samples collated from each hostel for physical parameters like true colour, odour, turbidity, total suspended solids, temperature together with total dissolved solids, and chemical parameters like electrical conductivity, salinity, alkalinity, total hardness, chloride, nitrate, phosphate, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, iron, lead and arsenic coupled with biological parameters like total coliform doubled with faecal coliform utilising standards techniques. The results obtained indicate that all the chemical parameters were within the World Health Organisation standard excepting pH, which is between 3.97 -4.49, and the biological parameters were not detected.

Also, water contamination is of great concern in cases like the borehole waters as a result of the drilling process, drilling fluids, chemical casings and other pollution-related substances which contaminate the water (Angulo et al., 1997). This is conspicuously growing and well-established concern about contaminants in waters propelled the study of how the quality of the different boreholes that provide water in the NMU Kurutie Campus and environment can be investigated.

II. MATERIAL AND METHODS

The Nigeria Maritime University, Kurutie Takeoff Campus, is situated in Kurutie Community and the community is in Gbaramatu Kingdom in Warri South West Local Government Area of Delta State, Nigeria. It is bound to lat. 5033'24'N and Long. 5020'19''N with lat/long(dec)5.55676;5.33871 together with a tropical monsoon climate. The daylight temperatures differ from 20^0 to $>35^0$ in the rainy and peak dry seasons respectively (Ari, 2023).

Procedurally, samples of water were collected and labeled A and B respectively. Also, different water quality parameters were collated for the assessment, and they are: Dissolved Oxygen (DO); Five-Day Biochemical Oxygen Demand (BOD_5), pH, Conductivity, tem, nitrate (NO3) together with turbidity. The multi – parametric monitoring device – YSI incorporated: Yellow Spring Ohio and USA-was utilized for the detection of water temperature, DO, pH, conductivity, turbidity, hardness and Total Dissolved Solids (TDS). However, a standard method was used in the determination of the five-day biochemical oxygen demand. The DO content was gotten before and after incubation. The sample incubation was for five days at 20^0C in a BOD_5 bottle of 100cl, and it was calculated after the incubation period.

The following materials and equipment were utilized in the determination of the BOD_5, pH, TDS (mg/l), Conductivity (µS/cm), DO, Nitrate, Turbidity and Hardness (mg/L) : BOD bottle, Sample bottle, DO meter, pipettes, microbiological inoculum, water bath, pH meter, pH calibration buffers, buffer solution, evaporation dish – 100ml beaker, measuring cylinder – 100ml, hot plate, drying oven, analytical balance, glass filter or filter paper – whatman 42, desiccator, conductivity meter, breaker, deionized water, calibration solutions, thermometer, stirring rod, Winkler reagents, nitrate test kit or nitrate ion – selective electrode, turbidimeter or nephelometer, titration kit, barrette, EDTA solution and indicator solution respectively.

Practically, an experiment for the determination of the different parameters was conducted at the Water/Hydraulic and Environmental Laboratory of the Civil Engineering Department, Faculty of Engineering, University of Benin, Edo State, Nigeria and the results were recorded and compared to Ari, 2023.

III. RESULTS AND DISCUSSION

RESULTS

Table 1 is WHO Maximum Values for the water quality of the parameters that are under investigation. It is also called the standard value given by the World Health Organization acronym WHO. **Table 2** shows the variations in water quality parameters. The values were obtained after the experiment of the water in Site A on the NMU Campus, and it is labeled Sample A. Also, **Table 3** contains experimental results of water in Site B in the same outside NMU campus and is named Sample B. **Table 4** is the combination of Sample A and Sample B for the bar chart presentation in **Figure 1**.

Table 1: WHO Maximum Values for water Quality Parameters

Parameters	Min Values	Max value
pH	6.5	8.5
DO (mg/L)	5.0	9.0
BOD_5(mg/L)	1.0	6.0
Conductivity (µS/cm)	50.0	1500.0
TDS(mg/L)	500.0	1500.0
Nitrate(mg/L)	0.1	50.0
Turbidity (NTU)	5.0	25.0
Hardness(mg/L)	50.0	200.0

Table 2: Experimental Result of Sample A

Parameters	Sample A	WHO Standard
pH	8.1	6.5 -8.5
DO (mg/L)	3.5	5.0 – 9.0
BOD_5(mg/L)	2.2	1.0 – 6.0
Conductivity (µS/cm)	416.0	50.0 – 1500.0
TDS(mg/L)	207.0	500.0 – 1500.0
Nitrate(mg/L)	0.3	50.0
Turbidity (NTU)	2.0	5 .0– 25.0
Hardness(mg/L)	202.2	200.0

Table 3: Experimental Result of Sample B

Parameters	Sample B	WHO Standard
pH	7.0	6.5 -8.5
DO (mg/L)	2.9	5.0 – 9.0
BOD_5(mg/L)	1.8	1.0 – 6.0
Conductivity (µS/cm)	340.0	50.0 – 1500.0
TDS(mg/L)	170.0	500.0 – 1500.0
Nitrate(mg/L)	23.0	50.0
Turbidity (NTU)	12.0	5.0 – 25.0
Hardness(mg/L)	121.0	200.0

Table 4: Experimental Results of Sample A and B

Parameters	Sample A	Sample B	WHO Standard
pH	8.1	7.0	6.5 -8.5
DO (mg/L)	3.5	2.9	5.0 – 9.0
BOD_5(mg/L)	2.2	1.8	1.0 – 6.0
Conductivity (µS/cm)	416.0	340.0	50.0 – 1500.0
TDS(mg/L)	207.0	170.0	500.0 – 1500.0
Nitrate(mg/L)	0.3	23.0	50.0
Turbidity (NTU)	2.0	12.0	5.0 – 25.0
Hardness(mg/L)	202.2	121.0	200.0

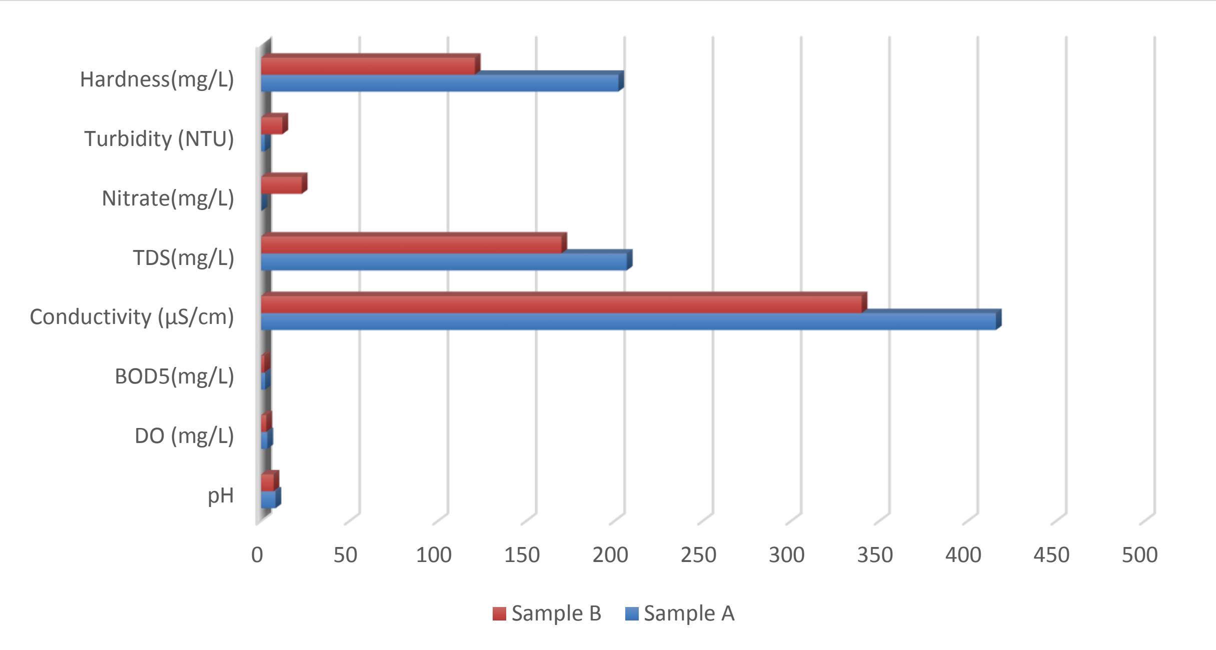

Figure 1: Mean Variation in Water Quality Parameters by the Sample A and B

DISCUSSION

In **Table 2**, Site A recorded the highest pH of about 8.1confirming the total hardness of water at the site investigated. This could be from the basement materials that could have carbonate, bicarbonate or hydroxide origins. However, water hardness is a vital constituent of water because it has a bearing on the portability of the water, and it can be categorized as soft, moderately hard, hard together with very hard.

The pH was mildly alkaline and is not within the WHO standard but is agreeable to the pH of most natural or common waters, which is between 6.0 to 9.0 due to the bicarbonate buffering. Also, in **Table 3**, which contains Site B, has readings of the highest DO concentration, which accords with the lesser temperature measurements. And the same readings for the BOD_5 show lower of the Biochemical Oxygen Demand, depicting cleanliness of organic matter. While the electrical conductivity – an estimate of total dissolved solids-depicts higher readings in Site B, which is less than the TDS 500mg/L set for drinkable water. This can affect the aesthetic quality of usage and the remaining site was far below the World Health Organization standard for drinkable water. The **Figure 1** is a bar chart depicting the mean variation in water quality parameters, and it also reveals comparable water quality parameters of Sample A and B like pH of 8.1: 7.0; DO of 3.5mg/L:2.9mg/L; BOD_5 of 2.2mg/L:1.8mg/L; electrical conductivity of 416 µs/cm: 340µs/cm; TDS of 207mg/L: 170mg/L; nitrate of 0.3mg/L:23mg/L; turbidity of 2. 0NTU:12NTU and hardness of 202.2mg/L: 121mg/L respectively. Finally, the investigation also reveals that the two sites have a nitrate content of 0.3mg/L:23mg/L and it within the World Health Organization standard of not more than 50mg/L as tabulated in **Table 1**.

IV. CONCLUSION

The assessment of borehole water quality in NMU: Kurutie – Takeoff Campus and environment has been done. The water quality assessment, which is a compelling constituent of the grantee of the health and wellbeing of both students and staff of the university, has been appraised. The physicochemical analysis of the samples A and B are pH of 8.1: 7.0; DO of 3.5mg/L :2.9mg/L; BOD5 of 2.2mg/L:1.8mg/L; conductivity of 416 µs/cm:340µs/cm; TDS of 207mg/L: 170mg/L; nitrate of 0.3mg/L:23mg/L; turbidity of 2. 0NTU:12NTU and hardness of 202.2mg/L: 121mg/L respectively. The results show some disagreements between the different sites. Site A recorded the highest pH of about 8.1confirming the total hardness of water at the site. And the same readings for the BOD_5 show lower of the Biochemical Oxygen Demand, depicting cleanliness of organic matter. While the electrical conductivity – an estimate of total dissolved solids-depicts higher readings in Site B, which is less than the TDS 500mg/L set for drinkable water. It is recommended that quality assessment of the boreholes in order to improve the quality of water supply should be carried out to correct the disparities between sites A and B respectively.

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