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Groundwater Quality of Iyana-Ipaja Metropolis in Alimosho Local Government Area of Lagos State, Nigeria

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ABSTRACT

Groundwater is a source of domestic water supply in Iyana-Ipaja metropolis. The area under investigation is a hub for iron dealers and has very poor drainage and sewage disposal systems. This study is aimed at assessing the quality of groundwater in Iyana-ipaja to ascertain the level of pollution and its suitability for domestic use. Six (6) groundwater samples comprising of three wells and three boreholes were taken, labelled MAM-W, OST-BH, OGS-W, LAS-W, JES-BH and JAS-BH and analyzed for Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total dissolved solids (TDS), pH, Taste, Alkalinity, Hardness and heavy metal contents. All samples were collected in dry season period of year 2018 and analyzed in triplicates according to APHA-AWWA-WEF standard procedures and heavy metals using UNICAM-939 AAS after sample digestion. It was observed that MAM-W and OGS-W had higher COD levels (150 ± 2.692 mg/L; 88.47 ± 0.659 mg/L) than the other groundwater samples while LAS-W and MAM-W had higher TDS mean values of 587 ± 6.318 mg/L and 532 ± 6.191 mg/L respectively. LAS-W also recorded highest BOD value of 5.66 ± 0.231 mg/L. MAM-W and OGS-W recorded higher Fe levels (0.76 ± 0.05 mg/L, 0.54 ± 0.07 mg/L) which is an indication of possible seepage and leaching of iron from corroded iron rods sold in the area over a long time, thus imparting a slight metallic taste to the water sources.

Keywords: BOD, COD, Groundwater, Iron, TDS

INTRODUCTION

One very vital water resource that augments other sources of water like surface water and pipe-borne water is groundwater. As a water source, it plays an important role in all spheres of life especially as it affects the social and economic life of people via its use domestically, industrially and agriculturally. In fact, water is unsurprisingly often said to be life itself (Odunmbaku and Ekute, 2022). A water source depending on its intended use is expected to be of good quality. A water source intended for domestic purposes and drinking is expected to have lower alkalinity as alkalinity in large amounts could impart a bitter taste to the water and may cause eye irritation (Ekute, 2021). Due to the ever-growing population of people in Lagos State, there is a high demand for clean potable water and affordable accommodation which is also scarce. As such, most of the populace tend to live in suburb areas like Iyana-ipaja, Oshodi, Agege, Ayobo, Ajegunle, and so on.

Iyana-ipaja like some other areas of Lagos State is known to have buildings without plans and very compacted such that very little space is left for the construction of wells, drilling of boreholes and construction of septic tanks. It is a norm for sewage from homes in this area to be discharged directly into poorly constructed drainage channels. The wells are oftentimes dug in close proximal locations to the septic tanks which sometimes are just hand-dug and sealed only at the top with a concrete slab. In some cases, the wells which are supposed to be source of good quality water are dug close to the gutters. Another feature of Iyana-ipaja is the presence of commercial iron dealers in the Araromi/Dopemu area of the Metropolis under study. These anthropogenic activities could contribute to the degradation of ground water quality in the area (Yisa and Jimoh, 2010). This thus makes it imperative that the quality of the only water resource in the area be assessed. Therefore, the objective of this study is to evaluate some water quality parameters pertinent to ascertaining the pollution level and is viability for domestic and drinking purposes.

MATERIALS AND METHODS

Sample collection and Preparation

Three hand-dug wells and three boreholes (wells with electric pump) were sampled in the dry season period of the year 2018. During dry season, it is suspected that there will be minimal impact of pollution sources/factors like leachates on ground water quality, though currently a research work is being carried out to ascertain if there is seasonal impact on ground water quality in the study area.The well water samples were drawn out of the well using locally made rubber drawer that has been previously washed with 10% nitric acid and rinsed severally with distilled water (Majolagbe *et al.,* 2011). The water samples were collected as grab samples into polyethylene 1.5L bottles that have been previously cleaned by washing in non-ionic detergent, rinsed with tap water, soaked in 10% nitric acid for 24hours and finally rinsed with distilled water (Olanrewaju *et al.,* 2012; Ekute, 2021). The borehole water samples were collected directly from tap immediately after pumping into polyethylene bottles that have been cleaned as described above.

The samples for BOD determination were collected, pretreated and stored according to the procedure described by Ekute, (2021) in an earlier work on groundwater of Mopin Community. Briefly, the water samples were pre-treated by adding 1ml each of manganous sulphate and alkali-iodide-azide reagent to fix oxygen present in the samples. The water samples were collected from randomly selected streets in Iyana-Ipaja and sampling points chosen based on patronage of residents. They were labelled according to streets names as follows: Modupe Ayoade Mosque Well (MAM-W), Ogun Street Borehole (OST-BH), Ogo-oluwa Street Well (OGS-W), Latona Street Well (LAS-W), Jenrola Street (JES-BH) and Jolaosho Adelowo Street (JAS-BH).

Sample Analysis

The groundwater samples were analyzed for pH (by Electrometric method, alkalinity (acid-baseTitrimetry), total hardness (by EDTA Titrimetry), TDS (TDS meter), Turbidity (Turbidimeter), Chloride (mercuric nitrate colorimetric method), sulphate (turbidimetric method), BOD (Winkler's dilution method), COD (Reflux method) and heavy metal (by Atomic Absorption Spectrophotometry) as outlined in standard procedures of Association of Analytical Chemists (AOAC, 2005) and the American Physical and Health Association, American Water Works Association and Water Environment Federation (APHA-AWWA-WEF, 2006).

In ensuring optimum accuracy of instrumental measurements, blank samples were run in between measurements and all instruments were properly calibrated using Analar grade stock standards and buffer solutions.

RESULTS AND DISCUSSION

Figures 1, 2 and Table 1 showed the results obtained in this study. The pH values of the groundwater samples ranged from 5.98 ± 0.072 to 6.80 ± 0.036 with all values falling within the WHO (2017) permissible limits of 6.5 to 8.5 except OST-BH that had pH of 5.98 ± 0.072. Similar results were documented for groundwater in Oke-Afa and Olusosun area of Lagos State (Yusuf , 2007; Oluseyi *et al.*,2014). pH value lower than 6.5 in water causes corrosion of metal pipes which in turn results in the release of toxic metal like Zn, Pb, Cu (Buridi and Gedala, 2014). This is due to the fact that under a low pH condition, metals tend to go into solution (Taiwo, 2015).

Alkalinity is a measure of the ability of a water source to neutralize acids (Gupta *et al*., 2009). Alkalinity in water is majorly a function of carbonate, bicarbonate and hydroxide ions and other basic compounds like borates, phosphates and silicates if present (Gopalkrushna, 2011; Mahananda *et al.,* 2010).The alkalinity levels for all the water samples were below the standard desirable limit of 120mg/L for alkalinity in potable water. The mean values ranged from 15.00±0.506mg/L to 43.00±0.958mg/L. These values are indicative of the fact that there is no significant impact of domestic wastes or leachates on the alkalinity of the ground water sources. Similar results were reported by Yusuf (2007) and Oluseyi *et al.* (2014).

Turbidity is an essential parameter in determining water quality. Turbidity in water may be due to the presence of a wide variety of suspended materials which could be colloidal or coarse dispersions (Shahida and Ummatul, 2015). The colloidal materials provide sites for chemical adsorption that could be detrimental to health or impact undesirable taste to the water source. The turbidity levels of the groundwater analyzed ranged from 2.79±0.118 to 9.50±0.076 NTU with MAM-W having the highest value of 9.50±0.076 NTU. Based on the WHO (2017) guidelines for drinking water, the groundwater samples from boreholes had turbidity levels below the treshold of 5 NTU. Similar results were documented by Nwaichi and James (2012) for groundwater in selected Niger Delta communities in Nigeria.

Chloride in high concentration in drinking water affects its taste and could cause cancer of the bladder due to its reaction with natural substances and pollutants (Paul,1987). The chloride levels of all the samples were well below the set standard of 250mg/L (NSDWQ, 2007). Nwaichi and James (2012); Etim and Onianwa (2013) reported similar results for groundwater in some Niger Delta communities and communities around Ota Industrial estate. In the same vein, the total hardness levels in mg/L $CaCO_3$ for all the groundwater samples were also lower than the permissible limits of 150mg/L$CaCO_3$. Based on FEPA (2005) guidelines, the hardness levels of the samples which ranged from 24.50 ± 0.449 mg/L $CaCO_3$ to 43.11 ± 0.983 mg/L $CaCO_3$ is indicative of the fact that they are all soft water since they fall within 0-60mg/L $CaCO_3$. Etim and Onianwa (2013) reported similar values for groundwater in an industrial estate. However, Udousoro and Umoren (2014) reported lower hardness levels of 10.70 mg/L $CaCO_3$ for Uruan groundwater in

Akwa Ibom while contrary results (205 to 920 mg/L $CaCO_3$) were reported by Olasehinde *et al.* (2015) for Ogbomosho groundwater.

The BOD concentration for MAM-W, OGS-W and JES-BH were within standard limit of 3.0mg/L. However, OST-BH, LAS-W and JAS-BH exceeded this limit. LAS-W especially had the highest level of 5.60mg/L. This high value could be attributed to closeness of the well to the poorly constructed septic tank of the compound and possible pathogenic contamination of the water source from neighbouring septic tanks in surronding premises. There could also be contamination via stagnant wastewater\sewage channels or unprotected gutters. One of the boreholes, JAS-BH surprisingly had a slightly higher BOD concentration. This could be expected since it was drilled in close proximity to the gutters which were just hand-dug with no ditches and the anthropogenic activities of residents in the area. COD also gives an indication of pollution of a water sourec as it is a measure of all chemicals in the water that can be oxidized. The COD levels obtained in this study ranged from 17.53 ± 0.182 mg/L to 150 ± 2.692 mg/L and were all below the WHO (2017) standard limit of 255mg/L. However, it was observed that MAM-W had the highest concentration (150.00 ± 2.692 mg/L) followed by OGS-W and OST-BH (88.47 ± 0.659 mg/L and 67.22 ± 0.741 mg/L). These values especially for MAM-W and OGS-W could be attributed to seepage or leaching of chemicals into the aquifer over time. Similar results were observed for TDS concentration with MAM-W and LAS-W having the highest values (532 ± 6.191 mg/L and 587 ± 6.318 mg/L). Apart from the leaching and seepage of chemicals, minerals and presence of microbes, the depth of the well could be a contributing factor to the TDS levels in groundwater. A TDS value above 500mg/L renders a water source not fit for drinking purpose and could cause gastrointestinal irritation (Plunkett, 1976).

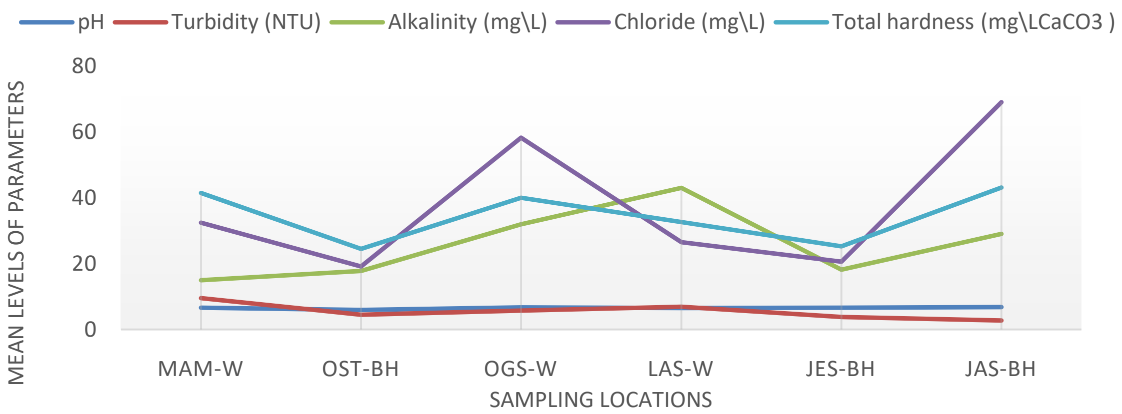

Figure 1: Mean levels of selected physicochemical parameters in groundwater samples

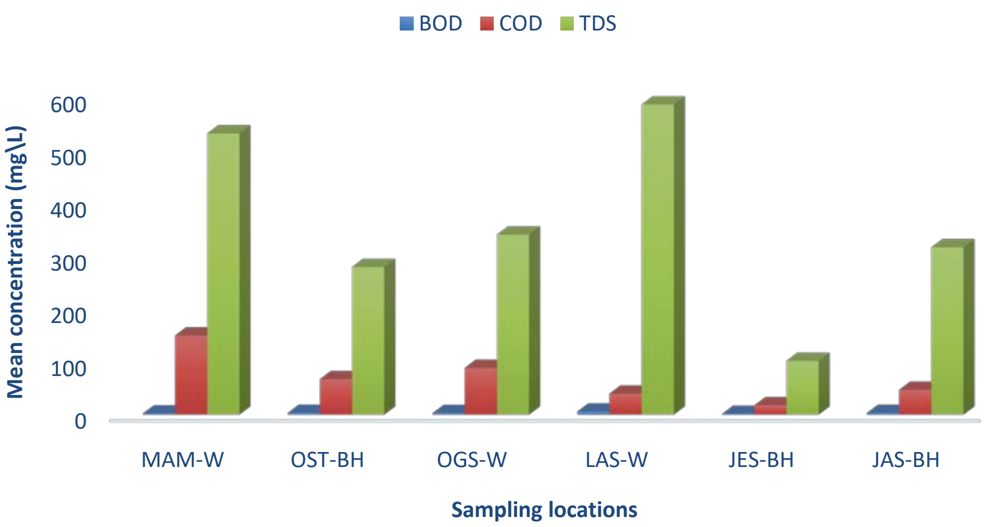

Figure 2: Mean levels of Pollution indicators

Mean levels of Sulphate ranging from 2.06 ± 0.104 mg/L to 60.23 ± 0.781 mg/L were recorded in this study. According to WHO (2017) guidelines, maximum permissible sulphate levels in groundwater is 400 mg/L. It therefore means that the sulphate levels in the water samples were within the permissible limits. However, the values in some of the samples were in contrast to that recorded for some groundwater samples in Lagos City (Yusuf, 2007) and Igbora area of Southwestern Nigeria (Adekunle *et al.* 2007). These variations could be linked to the anthropogenic activities in the area due the use of sulphate-based detergents. Of the four metals analyzed, iron and lead levels were distinct for MAM-W (0.76 ± 0.05 mg/L and 0.67 ± 0.106 mg/L). OGS-W also had a high iron level of 0.54 ± 0.07 mg/L. These sites of sampling have been the domain for iron dealers and some automobile mechanics which could possibly account for these levels. Zinc is an important dietary element but at high levels (>5.0 mg/L; WHO, 2017), it imparts an undesirable taste to water and could have gastrointestinal, cardiovascular, carcinogenic and neurotoxic effect on human health (Sankhla *et al.*, 2019). Zinc levels in the groundwater samples ranged from 0.01 ± 0.002 mg/L to 0.10 ± 0.014 mg/L. These values are below the permissible limit of 5.0mg/L stipulated by WHO (2017).

Table 1: Mean Concentration of selected ions in Sampled Groundwater in mg/L

Parameter	MAM-W	OST-BH	OGS-W	LAS-W	JES-BH	JAS-BH
Sulphate	11.78±0.536	18.21±0.279	26.10±0.592	49.00±0.827	2.06±0.104	60.23±0.781
Zn	0.03±0.004	0.01±0.002	0.04±0.003	0.06±0.004	0.10±0.014	0.02±0.004
Pb	0.67±0.106	ND	0.01±0.002	ND	ND	ND
Fe	0.76±0.050	0.32±0.053	0.54±0.070	0.10±0.022	0.21±0.025	0.13±0.036
Co	ND	ND	ND	ND	ND	ND

This therefore means that the anthropogenic activities in the study area has little or no impact on the level of zinc in the groundwater samples. Similar results were reported by Akhigbe *et al.* (2018) for groundwater within a slaughter area of Trans-Amadi Industrial Layout in Port Harcourt. Cobalt was not detected in all the water samples and Lead was not also detected in some samples. Fe level above 0.30 mg/L is not toxic to man but could impart a metallic taste to the water and gives a brownish coloration (ATS, 2022). Some residents attested that MAM-W and OGS-W had an unpleasant taste and that the water usually have light brown sediments at the bottom when the water is allowed to settle for some time.

CONCLUSION

This study assessed the quality of groundwater in Iyana-Ipaja Metropolis and samples were taken from buildings where residents fetch water more. This study found that some of the boreholes and a hand-dug well is organically polluted. Generally, it was observed that all the water samples analyzed are not suitable for drinking purpose. Almost all of the water samples were suitable for domestic uses except few that have high level of BOD and TDS which makes them not suitable for dishwashing and bathing purpose unless treated.

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