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EVALUATION OF HUMAN ACTIVITIES ON GROUNDWATER QUALITY ON SOME SELECTED MARKETS IN ABEOKUTA NORTH AND SOUTH LOCAL GOVERNMENT SOUTHWEST NIGERIA

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ABSTRACT

Anthropogenic activities and inadequate waste management significantly pollutes groundwater quality. This study evaluates the extent of this contamination in groundwater sited proxy to selected markets of Abeokuta North and South Local Government Areas Southwest Nigeria. Twelve (12) Groundwater samples were purposively selected from 4(four) location namely: Itamorin, Lafenwa, Adatan, and Kuto market and analysed for physico-chemical (pH, temperature, electrical conductivity, Biological Oxygen Demand, chloride, sulphate and total hardness) as well as microbiological (Total Bacterial Count, Total Coliform Count, Total Enterobacteriaceae Count) parameters. Result showed that the Biological Oxygen Demand (BOD) values were higher than the guideline which was observed in Adatan Sample One (1). Phosphate concentrations were higher in most the samples, exceeding the 5 mg/L WHO guideline, given as 47.34 mg/L in Kuto Sample 2. The widespread of bacteriological contamination was observed in Total Coliform Counts for all the samples, and Total *E. coli* Counts were also found in all samples. Lafenwa has the highest value of 4.8x10² cfu/ml for TEC, given as 0cfu/ml. These results strongly indicate faecal contamination and organic pollution, directly linked to inadequate sanitation, poor waste disposal practices, and market activities. Human activities in the selected markets of Abeokuta are significantly degrading groundwater quality, posing substantial health risks. Urgent interventions are required, including improved waste management, enhanced sanitation infrastructure, and regular monitoring, to protect public health and ensure sustainable groundwater use.

Keywords: Groundwater, Pollution, Health, Environment, Market

INTRODUCTION

Groundwater remains a cornerstone of water supply in Nigeria, especially in urban centers like Abeokuta, where it supports domestic and commercial needs. The quality of this resource is increasingly threatened by human activities, particularly in bustling market environments that generate significant waste and pollutants. This study synthesizes the need to explore the impact of market-related activities on groundwater quality characteristics, the influence of human actions, market-specific effects, assessment techniques, health risks, providing a foundation for this study. (Oke *et al.*, 2021).

The dependence on groundwater has been intensified due to inconsistent piped water systems, making it a critical resource for local markets and households. The city's rapid urbanization has heightened pollution risks, with markets serving as focal points for waste generation and human activity. Understanding these dynamics is essential for crafting targeted interventions (Adewumi *et al.*, 2022).

In Abeokuta North, shallow wells are prone to contamination from runoff and uncovered sources. Recent report suggests erosion and market proximity as key factors affecting quality in this LGA (Adetoro *et al.*, 2021). Abeokuta South, with its urban density also faces greater contamination from industrial and residential sources. Studies reported high Total Dissolved Solids and heavy metals in central areas, reflecting intense human activity (Idowu *et al.*, 2022).

Geological features, including basement complex rocks, influence groundwater chemistry naturally. However, anthropogenic inputs dominate pollution patterns in urban zones, as noted in recent research. Seasonal effects are significant, with wet season runoff increasing pollutant loads in shallow wells (Owolabi *et al.*, 2022).

Microbial contamination is also a concern, with recent surveys detecting high coliform levels in wells near populated market areas. This trend underscores the need for improved sanitation in market zones. (Ishola *et al.,* 2021). It causes waterborne diseases like cholera. Studies from 2024 note high coliform counts in market-adjacent wells.

Contaminated groundwater poses health risks, with nitrates linked to methemoglobinemia in recent studies. Heavy metals, such as lead, are associated with neurological damage. Recent data from the researchers report the exceedances, highlighting health threats. Chronic exposure to pollutants may lead to kidney and cardiovascular issues. Recent findings emphasize the bio-accumulative nature of metals (Bada *et al.*, 2025).

Therefore, the objectives of this study, aim to identify the major human activities contributing to groundwater contamination, determination of the health risks related to consuming polluted groundwater as well as to identify the factors that maybe responsible for the contamination of the groundwater.

MATERIALS AND METHODS

Study Area Description

The study was conducted in selected markets in Abeokuta North and South Local Government Areas Ogun State, Nigeria. The study area lies between latitude 7°10′N and longitude 3°40′E, covering 808 km², with its headquarters in Akomoje. Abeokuta South. The study area experiences a tropical climate with an average temperature of 27.6°C and annual rainfall of 1238 mm. Markets such as Lafenwa (Abeokuta North) and Kuto (Abeokuta South) were selected due to their high commercial activity and proximity to groundwater sources (Falola *et al.*, 2021).

Geology

The geological formations underlying these areas consist primarily of crystalline basement rocks, including granite, gneiss, and migmatite, which influence groundwater characteristics through their porosity, permeability, and mineral composition (Ogun State Geological Survey, 2024).

Climate

The climate of the study area is tropical, characterized by distinct wet and dry seasons. The wet season, typically spanning from April to October, is marked by substantial rainfall, while the dry season, occurring from November to March, is characterized by minimal precipitation (Nigerian Meteorological Agency, 2023). Temperatures in the region remain relatively high throughout the year, with mean monthly temperatures ranging from 25°C to 32°C.

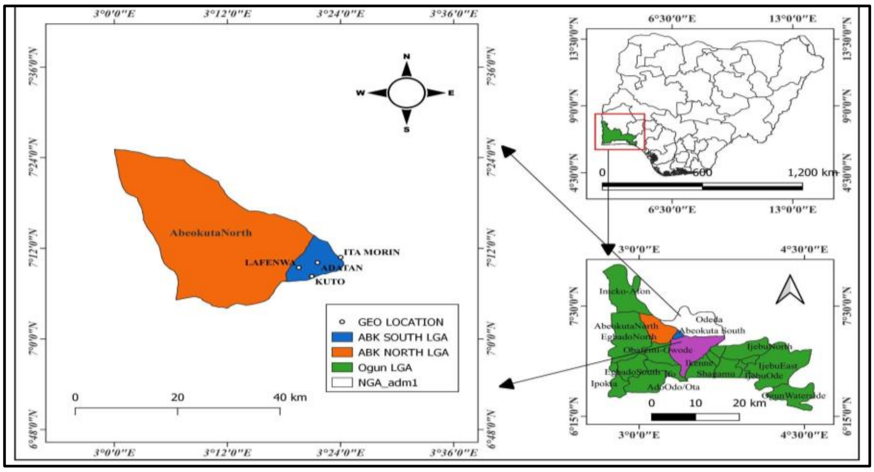

Figure 1: Map of the Study Area
Source: FUNAAB Cartography Laboratory, 2025

Sample Collection

Sampling sites within the selected markets includes (Adatan, Kuto, Ita-morin, and Lafenwa) which were purposively chosen to represent different potential sources of groundwater locations. These points were selected based on proximity to potential contamination sources like drainage channels, waste dumps, and areas of high commercial activity. The samples were taken from six (6) boreholes and six (6) wells in all locations, to account for potential variability in groundwater quality.

The following materials were used for sample collection: sterilized 1-liter polyethylene bottles (for physicochemical analysis), sterilized 30ml universal containers (for bacteriological analysis), a handheld Global Positioning System (GPS) device (Garmin eTrex), waterproof marker pens, sample labels, latex gloves, and a cooler box with ice packs.

Sampling Procedure

The polyethylene bottles were rinsed with the groundwater to be sampled. At each sampling point, after purging the well or borehole for 5 minutes, samples were carefully collected. The bottles were filled to the brim to minimize air bubbles and sealed tightly. Sample labels, containing information such as the sample location, date, time of collection, and sample identification code, were affixed to each bottle.

The samples were immediately placed in the cooler box with ice packs to maintain a temperature of approximately 4°C, thereby minimizing any changes in the physicochemical and bacteriological characteristics of the samples during transportation to the laboratory. This preservation method was chosen to inhibit microbial growth and minimize chemical reactions that could alter the composition of the samples.

RESULTS AND DISCUSSION

The physicochemical and microbiological results of the water samples collected from the study area is presented in Tables 1 and 2. The result shows that pH values from Itamorin and Lafenwa fell within the WHO acceptable range of (6.5-8.5) while that of Adatan (Sample 2: 6.37; Sample 3: 6.24) and all samples from Kuto (5.89, 5.90, 5.85) were acidic. This acidity could be attributed to the infiltration of organic acids from decomposing market waste or local geological influences. Such variations are consistent with findings by (Oluwasanya and Sadiq , 2020), who noted fluctuations in pH values across Abeokuta groundwater due to diverse hydrogeochemical processes and anthropogenic activities. Water temperatures across all sampled locations fell within the WHO standard of 30-40°C, with values ranging from 31.00°C to 31.70°C. All EC values were well below the WHO guideline of 1000 µs/cm, suggesting no widespread high salinity. While the table indicates a WHO standard of "100-200 mg/L" for TDS, the typical WHO guideline for palatability is 500 mg/L (or 0.5 mg/L). Itamorin Sample 1 (0.56 mg/L) and Lafenwa Sample 1 (0.67 mg/L) exceeded the 0.2 mg/L upper limit, and indeed, most samples show values above 0.2 mg/L, indicating high total dissolved solids. High TDS levels, even if not directly toxic, can affect the taste and aesthetic quality of water and potentially lead to scaling in water systems. Gbadebo (2020) similarly reported varying TDS levels in peri-urban groundwater in Abeokuta, indicating the influence of both natural geochemistry and anthropogenic inputs.

Most groundwater samples exhibited DO values above the WHO guideline of 3-5 mg/L, with values exceeding 9.0 mg/L. While high DO is generally favourable for aquatic life, for drinking water, excessively high levels can sometimes be indicative of rapid aeration and can contribute to corrosion in plumbing systems.

Table 1: Result Of the Physical and Chemical Parameters Obtained From the Study Areas

Parameters	Unit	ITAMORIN			LAFENWA			ADATAN			KUTO			WHO guidelines (2022)
		1	2	3	1	2	3	1	2	3	1	2	3	
pH		7.44	6.92	6.50	7.44	7.33	6.73	7.74	6.37	6.24	5.89	5.90	5.85	6.5-8.5
TEMP	°C	31.50	31.60	31.00	31.60	31.40	31.40	31.70	31.40	31.50	31.20	31.30	31.20	30-40
EC	µS/cm	1.08	0.80	0.43	1.30	1.10	0.43	1.16	0.64	0.40	0.37	0.40	0.40	1000
TDS	mg/l	0.56	0.40	0.22	0.67	0.54	0.21	0.58	0.32	0.20	0.19	0.20	0.20	100-200
DO	mg/l	7.00	8.80	9.70	9.80	6.95	10.05	10.00	5.25	7.25	6.70	6.80	9.00	3-5
Chloride	mg/l	176.00	129.00	75.60	116.00	170.00	76.00	196.00	121.00	102.00	105.00	84.00	85.00	100-300
Total Hardness	mg/l	310.00	352.00	132.00	264.00	72.00	170.00	384.00	330.00	166.00	116.00	198.00	206.00	50-200
Calcium	mg/l	18.60	31.00	13.40	29.80	26.20	7.20	20.00	14.80	8.40	7.80	8.40	8.00	20-100
Magnesium	mg/l	291.40	322.00	118.60	234.20	45.80	162.80	363.80	315.20	157.60	108.20	189.60	197.80	50
Bicarbonate	mg/l	170.00	370.00	260.00	260.00	360.00	20.00	280.00	370.00	60.00	220.00	210.00	220.00	20-200
BOD	mg/l	1.50	2.70	3.75	6.60	BDL	2.60	10.00	5.25	BDL	1.05	0.90	2.80	1
Sulphate	mg/l	34.52	70.08	41.47	104.28	87.50	20.86	125.00	24.21	48.72	31.03	96.69	18.04	250
Phosphate	mg/l	8.39	19.05	6.21	33.75	21.05	6.24	45.91	5.99	18.73	10.13	47.34	6.32	5
Nitrate	mg/l	2.85	5.41	1.33	10.25	9.64	1.08	13.61	0.85	6.34	3.53	21.03	1.31	50

Table 2: Result of the Microbial Samples Obtained From the Study Areas

Parameters	Unit	ITAMORIN			LAFENWA			ADATAN			KUTO			WHO guideline(2022)
		1	2	3	1	2	3	1	2	3	1	2	3	
TBC	cfu/ml	3.10×10^5	6.3×10^5	2.9×10^4	13.1×10^5	6.6×10^5	1.8×10^4	7.9×10^5	0.6×10^4	7.2×10^5	4.9×14^3	3.4×10^4	2.7×10^4	0
TCC	cfu/ml	2.1×10^3	8.0×10^3	2.7×10^2	5.9×10^3	3.1×10^3	0	2.1×10^3	1.4×10^2	3.9×10^3	1.0×10^2	0	0	0
TEC	cfu/ml	0	2.7×10^2	0	4.8×10^2	0	0	2.9×10^2	0.4×10^2	0.7×10^2	0	0	0	0

Number of samples = (1.2.3) 12

However, within the context of typical groundwater, such high levels are less common and warrant further investigation into the interaction between the aquifer and the atmospheric conditions or vigorous pumping (Chen *et al.,* 2020).

Chloride concentrations in all samples were found to be within the WHO guideline of 100-300 mg/L. This suggests that there is no widespread saline intrusion or significant contamination from industrial effluents or sewage at levels that would elevate chloride beyond the standard (Balacco *et al.,* 2022). Total Hardness, was higher than the WHO guideline of 50-200 mg/L. Notably, Itamorin (Samples 1 & 2), Lafenwa (Sample 1), and Adatan (Samples 1 and 2) recorded particularly high hardness and Calcium values remained within the WHO limit of 20-100 mg/L. Magnesium valueswere above the WHO guideline of 50 mg/L in all samples. This indicates that Magnesium is the primary contributor to the observed excessive hardness in the groundwater across the study areas. This high hardness can be attributed to the dissolution of magnesium-rich minerals from the underlying crystalline basement rocks prevalent in the Abeokuta Formation (Bankole *et al.,* 2022). However, localized anthropogenic activities like leachates from construction debris or certain industrial wastes could also contribute.

Bicarbonate values were observed to exceed the WHO guideline of 20-200 mg/L in many samples, particularly in Itamorin (Samples 2 and 3), Lafenwa (Samples 1 and 2), Adatan (Samples 1 and 2), and all samples from Kuto. High bicarbonate levels are typical of groundwater flowing through carbonate-rich geological formations, contributing to the water's buffering capacity. However, excessive levels, especially when coupled with high hardness, can lead to scaling problems in pipes and appliances (Hamdi and Tlili, 2024). BOD values revealed significant organic pollution in several groundwater samples, with most samples exceeding the WHO guideline of 1 mg/L. Notably, Adatan Sample 1 recorded the highest BOD at 10.00 mg/L, followed by Lafenwa Sample 1 (6.60 mg/L) and Adatan Sample 2 (5.25 mg/L). These high BOD levels are strong indicators of a substantial organic load in the groundwater, originating from anthropogenic sources such as decomposing organic market waste, domestic sewage seepage, and runoff from unsanitary conditions prevalent in market environments. This finding aligns with the research of Offiong *et al.,* (2020), who linked high BOD in peri-urban Abeokuta groundwater to poor waste management and sanitation.

Phosphate values were found to be above the WHO guideline of 5 mg/L in all samples. Adatan Sample 1 (45.91 mg/L) and Kuto Sample 2 (47.34 mg/L) recorded high concentrations. This increase in phosphate strongly indicates anthropogenic contamination, most likely from the discharge of domestic wastewater containing detergents, leakage from septic systems, and runoff from areas where phosphate-based fertilizers might be used, even on a small scale, within or near the market zones. This is a critical indicator of pollution from human activities, often associated with poor sanitation and waste disposal, a finding consistent with studies on urban groundwater quality (Taiwo *et al.,* 2023).

Nitrate values also fell within the WHO guideline of 50 mg/L. While some samples showed detectable levels, none reached a threshold for health implications typically associated with nitrate pollution from agricultural runoff or concentrated sewage. World Health Organization. (2011).

The microbiological results present the most critical findings of this study, indicating severe and widespread contamination. Total Bacterial Counts (TBC) were higher across all samples, ranging from ($0.6\text{x}10^4$ -$13.1\text{x}10^5$ cfu/ml), with WHO standard of 0 cfu/ml for drinking water. Total

Coliform Counts (TCC) were detected in all the samples, with high values recorded in Itamorin, Lafenwa, and Adatan , while the WHO standard is 0 cfu/ml. Total *E. coli* Counts (TEC) were also detected in all samples in (Itamorin Sample 2, Lafenwa Sample 1, Adatan Samples 1, 2, and 3). The presence of *E. coli* is an indicator of faecal contamination, implying a direct pathway for pathogenic microorganisms into the groundwater. These findings could be as a result of contamination from sewage seepage from faulty septic tanks or overflowing drains, and direct input from human and animal waste associated with market activities. These findings conforms with the studies of Adewale *et al.* (2023) who conducted a health risk assessment around sanitation facilities in major markets in Abeokuta and similarly found microbial contamination to be a significant concern, directly linking it to market activities and poor waste management practices.

CONCLUSION

This study assessed the impact of human activities on groundwater quality in Abeokuta North and South Local Government Areas, Ogun State, Nigeria. The findings revealed that groundwater sources around market areas are affected by various forms of pollution and may pose health risks to consumers. Some samples were acidic, while high Biological Oxygen Demand (BOD) values indicated significant organic pollution and microbial activities. Elevated levels of total hardness, calcium, magnesium, bicarbonate, and phosphate beyond WHO recommended limits suggest chemical contamination and possible effects from domestic and agricultural activities.

The microbiological analysis showed severe contamination, with high Total Bacterial Counts, Total Coliform Counts, and detection of E. coli in several samples, indicating faecal pollution. The presence of these microorganisms above WHO permissible limits confirms that the groundwater is unsafe for direct consumption without adequate treatment. Overall, human activities around the study locations have negatively influenced groundwater quality, creating potential public health concerns.

REFERENCES

Abayomi Oluwatobiloba Bankole, Grace Oluwasanya & E. Enovwo Odjegba (2022). Evaluation of groundwater suitability in the Cretaceous Abeokuta Formation, Nigeria: Implications for water supply and public health. Groundwater for Sustainable Development, 19, 100845. https://doi.org/10.1016/j.gsd.2022.100845

Adewale M. Taiwo, Deborah O. Ogunsola, Mutiat K. Babawale, Onyinyechukwu T. Isichei, Sukurat O. Olayinka, Ifeoluwa A. Adeoye, Ganiyat A. Adekoya and Olamide E. Tayo (2023). Assessment of Water Quality Index and the Probable Human Health Implications of Consuming Packaged Groundwater from Abeokuta and Sagamu, Southwestern Nigeria. Sustainability, 15(4), 3566. https://doi.org/10.3390/su15043566

Bada B.S (2025). Health Risk Implications of Heavy Metals Contamination on Drinking Water in Densely Populated Markets of Abeokuta, Nigeria. Fountain Joumal of Basic Medical and Health Sciences, 1(2), 36-55.

Balacco G, Alfio MR, Fidelibus MD (2022) Groundwater drought analysis under data scarcity: the case of the Salento Aquifer (Italy). Sustainability (2):707. https://doi.org/10.3390/su14020707

Bankole, A. O., Oluwasanya, G., & Odjegba, E. E. (2022). Evaluation of groundwater suitability in the Cretaceous Abeokuta Formation, Nigeria: Implications for water supply and public health. *Groundwater for Sustainable Development*, *19*, 100845. https://doi.org/10.1016/j.gsd.2022.100845

Belle, G., Fossey, A., Esterhuizen, L., & Moodley, R. (2021). Contamination of groundwater by potential harmful elements from gold mine tailings and the implications to human health: A case study in Welkom and Virginia, Free State Province, South Africa. *Groundwater for Sustainable Development*, *12*, 100507. https://doi.org/10.1016/j.gsd.2020.100507

Bello, S. K., Alayafi, A. H., AL-Solaimani, S. G., & Abo-Elyousr, K. A. M. (2021). Mitigating Soil Salinity Stress with Gypsum and Bio-Organic Amendments: A Review. *Agronomy*, *11*(9), 1735. https://doi.org/10.3390/agronomy11091735

Chen, H., Huo, Z., Dai, X., Ma, S., Xu, X., & Huang, G. (2018). Impact of agricultural water-saving practices on regional evapotranspiration: The role of groundwater in sustainable agriculture in arid and semi-arid areas. *Agricultural and Forest Meteorology*, *263*, 156–168. https://doi.org/10.1016/j.agrformet.2018.08.013

Falola, T. O., Adetoro, I. O., & Idowu, O. A. (2021). Assessment of Groundwater Quality in Abeokuta North, Nigeria. American Journal of Water Resources, 9(2), 41–48. DOI: 10.12691/ajwr-9-2-2.

Gbadebo, A. M. (2020). Assessment of quality and health risk of peri-urban groundwater supply from selected areas of Abeokuta, Ogun State, Southwestern Nigeria. *Environmental Geochemistry and Health*. https://doi.org/10.1007/s10653-020-00746-5

Hamdi, R.; Tlili, M.M (2023) Influence of Foreign Salts and Antiscalants on Calcium Carbonate Crystallization. *Crystals*: *13*, 516.

Ishola, S.A, Makinde,V Okeyode, I.C Akinboro,F.G Ayedun, H and Alatise, O.O (2021). Assessment of Pollution Hazards of Groundwater Resource in Abeokuta North Local Government Area, Ogun State, Southwestern Nigeria. Journal of Natural Sciences Engineering & Technology, 15(1). https://doi.org/10.51406/jnset.v15i1.1765

NIMET. (2023). Annual Weather Summary for Southwestern Nigeria. Nigerian Meteorological Agency.

Oluwasanya, G.O., and Sadiq, A.Y. 2019. Spatial and temporal variation of groundwater quality in Abeokuta City. Journal of Natural Science, Engineering and technology 18: 1– 2, ISSN: 2315-7461.

Owolabi Ajayi, Charles Ikechukwu Konwea & Patience O. Sodeinde (2022). “Groundwater Potential Assessment of the Sedimentary and Basement Complex Rocks of Ogun State, Southwestern Nigeria.” Journal of Water and Environment Technology, 20(6), 248-260. DOI: https://doi.org/10.2965/jwet.21-177.

Taiwo, A. M., Ogunsola, D. O., Babawale, M. K., Isichei, O. T., Olayinka, S. O., Adeoye, I. A., Adekoya, G. A., & Tayo, O. E. (2023). Assessment of Water Quality Index and the Probable Human Health Implications of Consuming Packaged Groundwater from Abeokuta and Sagamu, Southwestern Nigeria. Sustainability, 15(4), 3566. https://doi.org/10.3390/su15043566

Taiwo, A. M., Somade, O. C., Ojekunle, O. Z., Atayese, A. O., & Obuotor, T. M. (2023). Human Health Risk Assessment of Metals and Metalloids in Groundwater Resources around the Sanitation Facilities in major Markets from Abeokuta Metropolis, Southwestern Nigeria. *Journal of Trace Elements and Minerals*, *6*, 100105. https://doi.org/10.1016/j.jtemin.2023.100105

Wang, S.-J., Lee, C.-H., Yeh, C.-F., Choo, Y. F., & Tseng, H.-W. (2021). Evaluation of Climate Change Impact on Groundwater Recharge in Groundwater Regions in Taiwan. *Water*, *13*(9), 1153. https://doi.org/10.3390/w13091153

WHO (World Health Organization) 2011. Guidelines for drinking-water quality, 4th edition. Switzerland, Geneva.

World Health Organization. (2022). Guidelines for drinking-water quality (5th ed.). Geneva: WHO.