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ASSESSMENT OF WELL WATER QUALITY IN ONDO WEST LOCAL GOVERNMENT AREA, ONDO STATE, SOUTHWESTERN NIGERIA

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ABSTRACT

This study assessed the quality of well water in Ondo West Local Government Area (LGA), Southwestern Nigeria, to determine its suitability for human consumption and domestic use. Rapid urbanization and a heavy reliance on untreated hand-dug wells have made local groundwater vulnerable to contamination from proximity to pit latrines, refuse dumps, and agricultural runoff. Using a stratified random sampling method, ten water samples were collected across various communities and analyzed for physicochemical parameters and heavy metal concentrations. Physicochemical results revealed that water temperatures (28.20°C to 28.83°C) and Total Dissolved Solids (85.00 to 86.75 mg/L) remained within WHO and NSDWQ limits. However, pH levels (6.00 to 6.51) were slightly acidic, and Total Hardness (290.5 to 780.0 mg/L) significantly exceeded the 200 mg/L threshold, indicating high calcium and magnesium concentrations. Heavy metal analysis for Lead, Cadmium, Chromium, Nickel, and Cobalt showed that concentrations were within permissible national standards, though Lead and Nickel were detected and attributed to natural leaching and subsurface geological formations. The findings suggest that while heavy metal levels are currently safe, the high hardness and acidic nature of the water necessitate treatment before consumption to mitigate long-term health risks.

Keywords: Groundwater Quality, Heavy Metals, Physicochemical Analysis, Agricultural run-off

INTRODUCTION

Water is an important natural resource for sustaining life, supporting ecosystems, and facilitating socioeconomic growth. Water is required for human consumption, sanitation, agriculture, industry, energy production, and recreation (WHO, 2017). Access to safe water is recognized as a basic human right and its availability in sufficient quantity and quality is essential for human life and community well-being (UNICEF, 2021).

Despite its abundance on Earth, the distribution of water resources is highly uneven. Globally, about 97% of the Earth's water is saline**,** while only about 3% is freshwater **a**nd less than 1% of this freshwater is readily available for human use in rivers, lakes and groundwater (FAO, 2020). This limited accessible freshwater must support the world's growing population, which places significant pressure on water resources, particularly in developing nations.

Water supply and quality are equally important. Physical, chemical or microbiological contaminants can contaminate water, making it unfit for human consumption. Diseases including cholera, dysentery, typhoid, and diarrhea are linked to contaminated water and continue to be major sources of morbidity and mortality, particularly in low- and middle-income nations (Prě-Ustün *et al.*, 2019). In order to guarantee that drinking water satisfies accepted requirements for human health and use, water quality assessment is essential.

Examining the water's physicochemical and biological characteristics is a common method of evaluating its quality. In order to connect human activity and land use to water contamination, advances in water monitoring also incorporate risk assessments and GIS techniques (Oyedele and Akinluyi,2022). Access to drinkable water is still a major problem in Nigeria. The National Bureau of Statistics (NBS, 2020) estimates that 40% of Nigerians lack access to clean drinking water, which makes them heavily dependent on untreated groundwater sources like boreholes and wells. Shallow hand-dug wells are extremely susceptible to pollution by human activities such inadequate sanitation, inappropriate waste disposal, agricultural runoff, and industrial effluents, even though groundwater is typically thought to be cleaner than surface water (Adewumi *et al*., 2019).

In Southwestern Nigeria, groundwater particularly well water remains the major source of domestic water for many households. Ondo State, located within this region, is no exception. Ondo West Local Government Area (LGA), with its growing urbanization and population expansion, depends largely on hand-dug wells for domestic water needs. However, the proximity of wells to pit latrines, refuse dumps, drainage channels, and farmlands often compromises water quality (Ajayi *et al*., 2020). Previous studies in the state have reported microbial contamination and elevated chemical pollutants in groundwater (Elemile *et al*., 2022) raising concerns over public health risks.

Ondo West Local Government Area (LGA) is a densely settled education and commercial hub where households commonly use private or communal wells for drinking, cooking and hygiene. Population projections suggest substantial growth since the 2006 census, implying greater pressure on local water sources and infrastructure (Prüss-Ustün *et al*., 2019). In such settings, shallow wells are particularly vulnerable to contamination from on-site sanitation, waste disposal, and urban run-of frisks that intensify with unplanned urbanization.

Empirical studies across southwest Nigeria, including nearby Akure and other Ondo State communities, have repeatedly reported microbiological contamination (e.g., total coliforms, *Escherichia coli*) and, in some cases, problematic levels of physicochemical constituents (e.g., iron, nitrates, and selected heavy metals) in groundwater from hand-dug wells and boreholes. These findings are linked to factors such as proximity to pit latrines or refuse dumps, poor well construction/protection, and inadequate household water handling. Such evidence underscores the need for localized water-quality assessments to guide remediation and risk communication.

International and national guidelines provide benchmarks for assessing drinking-water safety. The World Health

Organization (WHO) recommends zero detectable *E. coli* per 100 mL of drinking water and sets guideline values for priority chemical contaminants to minimize both acute and chronic health risks (WHO, 2017). Nigeria's Standard for Drinking Water Quality similarly stipulates maximum permissible limits for microbial and chemical parameters and serves as the regulatory reference for national monitoring and enforcement (NSDQW, 2017). Applying these standards to local well water enables evidence-based classification of risk and identification of priority interventions.

Given the heavy reliance on groundwater in Ondo West LGA and the documented susceptibility of shallow wells in comparable southwestern settings, a systematic assessment of well water quality is both timely and policy-relevant. Such an assessment will establish the current status of key microbiological and physicochemical indicators against WHO and NSDWQ limits, water-quality outcomes to well siting and construction/sanitary conditions and generate actionable recommendations for households, local authorities and water resource managers aimed at reducing water-borne disease risks and improving access to safely managed drinking water.

Literature Review

Groundwater Quality

As the primary accessible reservoir of freshwater, groundwater constitutes approximately 30% of global freshwater supplies (FAO, 2020). Because it undergoes natural filtration while seeping through geological layers, it is generally better protected from contaminants than surface water (Freeze & Cherry, 1979). Consequently, it serves as a critical and often safer resource for potable and household water, particularly in developing regions where surface sources frequently face pollution risks.

The integrity of groundwater resources is governed by a combination of lithogenic and anthropogenic influences. Geogenic processes allow for the dissolution of minerals specifically iron, manganese, arsenic, and fluoride from the surrounding aquifer matrix into the water supply (WHO, 2017). Concurrently, human interventions such as intensive agriculture, industrial operations, and inadequate waste management systems introduce hazardous pollutants, including nitrates, heavy metals, and pathogens (Foster & Chilton, 2003). This vulnerability is particularly acute in developing regions where reliance on shallow, hand-dug wells increases the risk of contamination due to minimal surface buffering and insufficient structural protection.

Water Quality

Water quality is defined by the chemical, physical, and biological properties of water as they relate to its intended application, ranging from human consumption and recreational use to the maintenance of aquatic ecosystems. Systematic assessment involves the measurement of specific parameters, including pH, dissolved oxygen, and turbidity, alongside the quantification of pollutants such as heavy metals, nutrients, and pathogenic microorganisms (Chapman, 1996). Evaluation is typically conducted by comparing these measurements against established regulatory standards to determine compliance, which is often ensured through targeted treatment processes. Ultimately, these benchmarks serve as critical indicators of ecosystem health, the safety of human interaction, the degree of anthropogenic pollution, and the overall potability of the water supply.

Water quality has a significant impact on water supply and oftentimes determines supply options. Water quality is a measure of the condition of water based on the presence and levels of pollutants, contaminants and naturally occurring substances that can affect human health. High quality water is free from harmful microorganisms, toxic chemicals and other substances that can cause diseases or adverse health effects. Regulatory standards such as those set by the World Health Organization (WHO) and Environmental protection Agency, (EPA) provide guidelines to ensure water safety (Fewtrell and Barthram, 2001) Water quality issues in developing countries like Nigeria include scarcity of drinking water, poor infrastructure for water and sanitation access, water pollution and low levels of water security. Over one billion people in developing countries have inadequate access to clean water.

The main barriers to addressing water problems in developing countries include poverty, costs of infrastructure, poor governance. The contamination of water remains a significant issue because of unsanitary social practices that pollute water sources. Almost 80% of diseases in developing is caused by poor water quality and other water-related issues that cause deadly health conditions such as cholera, malaria and diarrhea.

Well Water Quality in Urbanizing Settings

Wells remain the primary source of groundwater in rapidly growing urban and peri-urban communities across Africa and Nigeria. A well water is an excavation or structure created in the ground by digging or drilling to access groundwater in underground aquifers. This type of water bearing permeable rock, sand or gravel. This type of water is typically stored in the voids between soil particles or in fractures of rock formations and its quality and quantity can be influenced by geological conditions, such as the type of aquifer and its recharge rate (Bouwer, 2002).

well water can be an excellent source of portable water, it is susceptible to contamination from surface runoff, agricultural chemicals and septic systems. Regular monitoring and maintenance of well systems are crucial to ensure the water remains safe for consumption (Gibss *et al.,*2004) The well water is drawn by a pump or using containers such as buckets that are raised mechanically or by hand. Well water issue in developing countries include scarcity of drinking water, poor infrastructure and water and sanitation access, water pollution and low levels of water security. Over one billion people in developing countries have inadequate access to clean water. The main barriers to addressing water problems in developing countries like Nigeria include poverty, costs of infrastructure and poor governance. Most hand dug wells and even some boreholes in Ondo west local Government Area dry up in the middle of dry season leaving the town with acute shortage of portable water. This suggests that the groundwater source is seriously geologically and climatically influenced.

In urbanizing settings, population expansion, unplanned settlements, and inadequate infrastructure place enormous pressure on water resources. Wells are often constructed close to septic tanks, pit latrines, refuse dumps and drainage systems which increases the risk of microbial and chemical contamination (Agyemang *et al.,* 2019). Urbanization not only threatens water quality but also complicates water governance. Rapid population growth often outpaces investments in municipal water supply, forcing communities to depend on untreated well water. Consequently, well water in urbanizing areas becomes a double-edged sword: it is accessible and affordable, but it also poses significant public health risks if not properly monitored and managed. Understanding the dynamics of groundwater and well water quality in such contexts is therefore essential for ensuring water security, particularly in developing regions such as Southwestern Nigeria.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in Ondo West LGA, located in Ondo State, Southwestern Nigeria. The area lies between latitudes 7°05′ and 7°15′ N and longitudes 4°45′ and 5°05′ E. Ondo West has an estimated population of over 230,000 people (NPC, 2006) with the majority relying on hand-dug wells, boreholes and streams for domestic water supply. Inadequate piped water infrastructure, rapid urbanization and poor sanitation practices make groundwater sources vulnerable to contamination. The climate is characterized by a tropical rainforest zone, with a distinct wet season (April – October) and dry season (November – March). Common economic activities include farming, petty trading and small-scale industries, which may influence water quality through agricultural runoff, waste disposal and septic tank leakages.

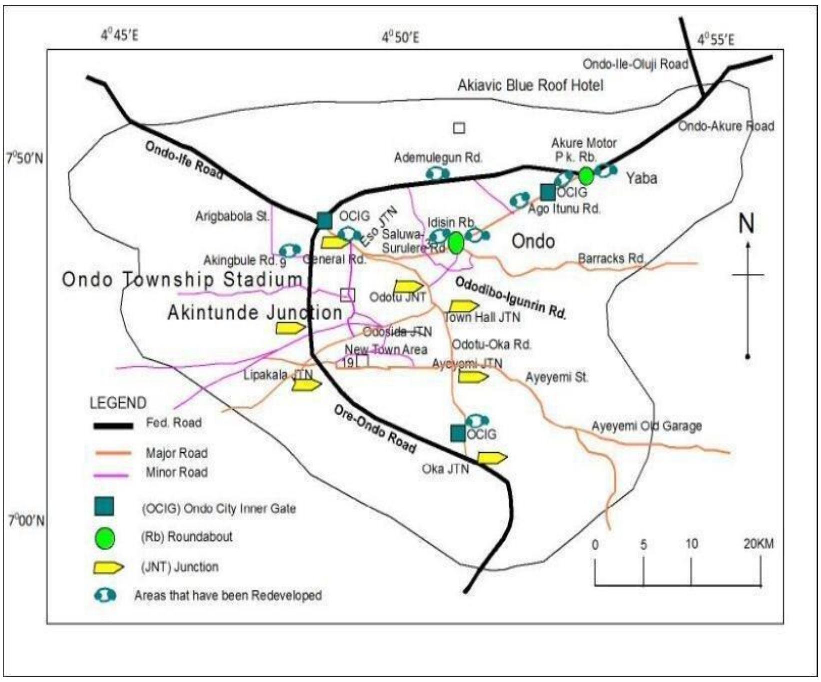

Figure 1: Map of Ondo State Showing Study Sites

Selection of Sampling Stations

A total of 10 well water samples were collected from different communities within Ondo West LGA. Selection were based on accessibility, frequency of use and proximity to potential pollution sources such as latrines, septic tanks, refuse dumps and farmlands. A stratified random sampling method were used to ensure coverage of different wards in the LGA.

Sample Collection

The samples were collected using screw capped one litre can be using sterile trend gloves. The container was washed with detergent, bleached with concentrated HNO_3, rinsed thoroughly with distilled water and with the respective well water samples. Each container was rinsed with appropriate sample before sample collection. A composite sample was formed by mixing samples in equal proportion. Samples for biological analysis were collected in air tight bottles and immediately stored in cooler loaded with ice. All samples were labelled and bear the information on samples site, date and time of collection and purpose of collection. Samples were collected according to guideline recommended by WHO for water sampling and analysis (WHO 2021) Samples collected were taken to laboratory for analysis. Permission for access was sort and received for all resident where well water samples was collected. The tubes normally used for residents for well water collection were used for sample collection as well before transferring to the sterilized screw capped one litre plastic containers.

Data Analysis

Descriptive and inferential statistics were used to analysed the data collected in this study. One- way ANOVA was used to analyse and compare the differences among the wells water samples from different sampling locations. All analysis was carried out using Microsoft excel 365 and Statistical package for social sciences (SPSS).

RESULTS AND DISCUSSION

Physicochemical Parameters of Well Water in the Study Area

The results of the analyzed samples of the well water from the different locations within Ondo west Local Government area, Ondo State, Southwestern Nigeria, are presented in Table 1. A comparison of the results with the World Health Organization (WHO, 2017) and Nigeria Standard for Drinking Water Quality (NSDWQ, 2017) threshold limit for drinking water is also shown in Table 1. The temperature of the well water samples across all stations ranged between 28.20 °C to 28.83 °C. The highest value was recorded in Ade super (28.83±3.60) while the least value was recorded in Oduduwa (28.20±4.30). The maximum value of pH (6.51±0.01) and TDS (86.75±5.74) was recorded in Yaba, while the minimum value (6.00±0.30) and (85.00±5.60) was recorded in Oka and Oduduwa Respectively. The highest value of DO was recorded in Oduduwa (7.02±0.53) while the least value (6.45±1.05) was recorded in Ade super. Total hardness values varied widely across the stations, ranging from approximately 290 mg/L to 780 mg/L. Chloride concentrations ranged from 27.30 mg/L to 77.78 mg/L across the stations, in which the Highest value was recorded in Oka (77.78±25.75) while the least value (27.30±1.17) was recorded in Fagun. The maximum value of Nitrate was recorded in Ade super (1.77±0.08) while the minimum value was recorded in Oduduwa (1.21±0.36). Sulphate concentrations varied from 17.66 mg/L to 55.39 mg/L across the sampling stations. The highest value of magnesium (4.75±1.24) was recorded in Oduduwa while the least value was recorded in Yaba (3.79±0.28).

Results of Concentrations of Heavy Metals in Well Water
The concentration of heavy metals in water samples from the studied well water was conducted to assess the pollutant load of the well water. The mean concentration of heavy metals in the well water samples in this study is shown in Table 2. The value of Lead in the well water from different sample locations ranged from 0.003±0.00 mg/l – 0.050±0.07 mg/l. The highest value was recorded in Oduduwa (0.050±0.07 mg/l) while the lowest value was recorded in Adesuper (0.003±0.00 mg/l). The maximum value of Cadmium (0.003±0.00) was recorded in Fagun while the minimum value was recorded in Yaba (0.001±0.00). However, similar values of Cadmium were recorded in Oduduwa, Oka and Ade super (0.002±0.00). Similarly, Consistent values of Chromium (0.001±0.00) were recorded in Oduduwa, Yaba and Adesuper while Oka and Fagun recorded zero values (ND). The highest value of Nickel (0.002±0.00) was recorded in Fagun while zero value was recorded (ND) in Oka and Adesuper (ND). Similar values of Cobalt (0.001±0.00) were recorded in four stations except Oka in which cobalt was not detected (ND).

Table 1: Physicochemical Parameters of Well Water of Ondo West LGA in Comparison with WHO and NSDWQ

Parameters	Oduduwa	Oka	Yaba	Ade super	Fagun	WHO Limits (2017)	NSDWQ Limits(2017)
Temp	28.20±4.30	28.53±4.69	28.32±5.48	28.83±3.60	28.28±3.99	28-30^{0}c	20-30^{0}c
p^H	6.42 ± 0.09	6.00±0.30	6.51±0.01	6.14 ± 0.38	6.15 ± 0.01	6.5–9.5	6.5 – 8.5
DO	7.02±0.53	6.79±0.34	6.88±0.47	6.45±1.05	6.52±1.30	5.0-9.5	7.50
TDS	85.00±5.60	85.50±5.60	86.75±5.74	86.00±3.30	85.75±6.02	500	500 - 1500
EC	491000±59396. 97	149100±12445. 08	444000±43840. 62	474000±15556. 35	296100±24168	500	500
BOD	1.85±2.44	1.99±2.18	2.85 ± 0.40	2.50 ± 0.68	2.05 ± 0.45	5	10
Hardness	745.0±318.19	290.5±170.41	578.5±765.79	510.0±403.05	780.0±466.69	200mg/l	150mg/l
Chloride	44.68±4.68	77.78±25.75	56.26±9.36	45.51±17.55	27.30±1.17	250mg/L	250mg/L
Nitrate	1.21±0.36	1.64±0.23	1.69±0.10	1.77±0.08	1.74±0.03	10-50mg/L	50mg/L
Sulphate	55.39±11.79	17.66±0.86	54.36±1.92	43.44±29.83	40.53±33.58	250-500mg/l	100mg/l
Magnesium	4.75±1.24	4.1±0.76	3.79±0.28	4.74±0.54	4.55±0.88	50mg/L	30mg/L

Field work; 2025

Table 2: Mean Concentrations of Heavy Metals in Well Water in the Study Area

Heavy metals	Oduduwa	Oka	Yaba	Adesuper	Fagun	NSDWQ
Ph	0.050±0.07	0.005±0.00	0.004±0.00	0.003±0.00	0.010±0.00	0.05
Cd	0.002±0.00	0.002±0.00	0.001±0.00	0.002±0.00	0.003±0.00	0.01
Cr	0.001±0.00	N.D	0.001±0.00	0.001±0.00	N.D	0.05
Ni	0.001±0.00	N.D	0.001±0.00	N.D	0.002±0.00	0.10
Co	0.001±0.00	N.D	0.001±0.00	0.001±0.00	0.001±0.00	0.01

ND: Not Detected

Discussion

Physicochemical parameters of the well water

The range of values obtained for the physico-chemical parameters investigated in this study fell within the standard limits recommended by the Nigeria Standard for Drinking Water Quality and World Health Organization. The values of the physico-chemical parameters recorded in this study are consistent with those reported in similar well waterbodies in Nigeria such as: Oloruntade *et al.* (2012), Abulude *et al.* (2013), Olubukola *et al*. (2022) and Udeh *et al*. (2025).

The temperatures recorded in this study ranging from 28.20^{0}C to 28.83^{0}C and these values are within WHO's recommended limits (28-30^{0}C) and NSDWQ threshold limits (20-30^{0}C). The temperature value recorded in this study are inconsistent with the values recorded by Olubukola *et al*. (2022) and Udeh *et al*. (2025) in their respective studies on well water, but the values are slightly higher than the values obtained by Sharma *et al*. (2012), Cosmas *et al*. (2015) and T. yahya *et al*. (2022). The values obtained in this study could be attributed to the climatic condition of the study area (Joseph *et al.,* 2019). Temperature of water is often controlled by environmental factors and may be indicative of dissolved materials in the water, because Higher temperatures can accelerate the dissolution of solids (Yasmin *et al.,* 2023).

The pH level of water indicates its hydrogen ion concentration and this is considered essential because many biological functioning depend on certain pH ranges (Nayla, 2019). The values of pH recorded in this study varied from slightly acidic to slightly alkaline with pH values ranging from 6.00±0.30 to 6.51±0.01 signifying slightly acidic water. All the pH values recorded in this study are slightly below the WHO and the NSDWQ threshold limits (6.5-8.5) except the values obtained in Yaba (6.51±0.01). The relatively low pH recorded could be attributed to anthropogenic activities such as waste disposal, contributing to the presence of humic acids (Adeyemo *et al.,* 2002). Continuous consumption of water with low pH may lead to health issues like acidosis (Beka *et al.,* 2009). The pH values obtained in this study are similar to the values reported in some studies conducted in well water in Nigeria such as, Ezemonye, (2009); Duru *et al*. (2017), Duru *et al.*, (2019) and T. Yahaya *et al*. (2022).

The Electrical Conductivity provides a reliable indication of the amount of substances dissolved in the water as well as the ability of the waterbody to conduct electrical current (Adu *et al.,* 2019). A high EC in a water body indicates higher ion concentrations which could signify higher concentrations of pollutants or naturally occurring minerals. The EC values recorded in this study exceeded the WHO and NSDWQ limits. The relatively Higher EC obtained in this study indicate contamination from leachates or runoff, possibly due to the porous geology in the area (Udeh *et al*., 2025). It can also be attributed to the depth of the well in the area and the porous and permeable nature of the geologic formation of the area which usually makes the groundwater resources of the study area vulnerable to contamination from surficial sources (Eze *et al.,* 2021). The relatively higher EC values recorded in this study are inconsistent with other studies conducted on well water in Nigeria such as; Olubukola *et al.* (2022) and Udeh *et al.* (2025).

Total dissolved solids (TDS) stands as a significant factor in evaluating water quality and consists of inorganic salts, ionized or micro-granular suspended form and various dissolved substances present in waterbody (Bilewu *et al.,* 2022). TDS values recorded in this study were found to be within the acceptable limits by WHO and NSDWQ. These values were similar to those reported by Eze *et al.* (2021) and Duru *et al*. (2019) in their various studies. The low TDS values recorded in this study could be due to the absence of industrial discharge within the study area because higher organic matter contents present in wastewater discharge by industries directly into waterbodies increases the concentration of TDS (Saidu *et al.,* 2020). Consumption of water with high total dissolved solid (TDS) are harmful to the body system of humans (Cosmas *et al*., 2015).

Total hardness is one of the parameters used in assessing water quality and it describes how dissolved minerals especially calcium and magnesium determine whether the water is suitable for domestic and industrial purposes (Okey-wokeh, 2021).The values of the total hardness recorded in this study ranges from 290.5±170.41 to 780.0±466.69 mg/l exceeded the WHO limit of 200 mg/l, indicating high calcium and magnesium concentrations in the water making the water "hard" and less ideal for drinking and domestic use. The high concentration of calcium and magnesium could be due to erosion, weathering of rocks, farming, dust that contains calcium and leaching of rocks among other natural processes (Titilawo *et al.,* 2019). The values obtained in this study compare favourably with previous studies documented by Beka *et al*. (2009), Akubugwo *et al.* (2013) and Eze *et al*. (2021)

Dissolved oxygen (DO) is a good indicator of good water quality. The DO value were within the WHO-recommended limit (>6.5 mg/l), indicating good water quality, which may support aquatic life. The values obtained in this study were relatively higher than the values obtained by Joseph *et al.* (2019), Ibe *et al*. (2020) and Udeh *et al.* (2025) in their respective studies.

Heavy Metals of Well water

The range of lead levels in the well water from several sample locations was 0.003±0.00 mg/l to 0.050±0.07 mg/l. These values fell within the permissible limits of NSDWQ. This observation is in consisted with the values reported by Olubukola *et al*. (2022), Udeh *et al.* (2025) and Hussaini *et al.* (2025) on their respective studies. The presence of coal in the subsurface soil surrounding the study region was identified as the source of lead in the well water samples. Lead is known to have serious, potentially irreversible health impacts if it enters the body, but it has no known biological role. Nearly every major organ system in the body is impacted, including the hematopoietic, renal, neurological, and cardiovascular systems (Kumar *et al.*, 2017; Mohammadi *et al.*, 2019). Lead exposure may cause cancer, vitamin D deficiency, high blood pressure, brain damage, infertility and mental impairment in children (NSDWQ, 2007).

Cadmium (Cd) is a highly toxic heavy metal with no known biological function in humans and chronic exposure can lead to kidney dysfunction, bone demineralization, cardiovascular diseases and cancer (Rasin *et al*., 2025). The range of cadmium concentrations in the well water from several sample locations in this study was 0.001±0.00 mg/l to 0.003±0.00 mg/l which is found to be within the NSDWQ permissible limits. High quantities of cadmium are rarely found in groundwater, such as well water, unless it is contaminated by coal mining or seepage from hazardous waste sites (Beka *et al.,* 2009). The presence of Cd in well water may also be attributed to corroding galvanized pipes or nearby waste dumpsites (Hussain *et al.,* 2025). Several studies such as; Kubier *et al*., 2019; Balaram *et al.*, 2023; Abanyie *et al*., 2023, have reported higher Cd levels in groundwater, particularly in areas with intensive agricultural activities where phosphate fertilizers (which contain Cd as an impurity) contribute to contamination (Grema *et al*., 2022). Renal disorders and kidney damage are caused by cadmium, a well-known human carcinogen (Mohammadi *et al.*, 2019).

chromium (Cr) exists in water primarily as trivalent chromium (Cr^{3+}) and hexavalent chromium (Cr^{6+}) with Cr^{6+} being highly toxic and carcinogenic (Monga *et al.,* 2022). The well water from various sample locations had chromium levels ranging from N.D. to 0.001±0.00 mg/l. The Cr value obtained in this study were found to be within NSDWQ recommended limits. Natural sources of Cr in well water include leaching from underground rock formations containing Cr rich minerals or contamination from nearby anthropogenic activities such as metal plating, tanneries, or improper disposal of industrial waste (Singh *et al*., 2022). It is important to know that Prolonged exposure to high Cr concentrations can lead to serious health problems such headaches, diarrhea, nausea and vomiting (Beka *et al*., 2009; Sharma *et al*., 2012; Kumar *et al*., 2017).

The values of Nickel recorded in this study ranged from (Not detected) N.D – 0.002±0.00 mg/l. This was clearly within the recommended limit set by the NSDWQ. These values are relatively lower than the values obtained by Hussain *et al*. (2025) who reported higher values than the recommended limits by NSDWQ. The presence of Nickel in the well water samples can be attributed to natural sources such as leaching from top soil and rocks (igneous rock). Nickel is a human carcinogen known to cause severe health effects such as nausea, dermatitis, chronic asthma, and coughing (Mohammadi *et al*., 2019; Eze *et al.*, 2021).

The range of cobalt values of cobalt obtained in the well water from several sample locations was not detected (N.D). to 0.001±0.00 mg/l. These values are in consistent with values reported by Tarik *et al*. (2023) and Udeh *et al.* (2025). The presence of cobalt in the well water samples could be attributed to natural sources including leaching from top soil and mafic and ultramafic rocks (Beka *et al.*, 2009). Higher concentrations of Cobalt in well water can have a variety of negative health consequences on people, particularly children, when consumed in excess of the recommended limit (Kumar *et al.*, 2017; Enyoh and Isiuku, 2020; Eze *et al.*, 2021).

CONCLUSION

The systematic evaluation of well water in Ondo West LGA highlights critical concerns regarding the safety of the community's primary domestic water source. While the levels of toxic heavy metals such as Lead and Cadmium currently fall within the permissible limits set by the Nigeria Standard for Drinking Water Quality (NSDWQ), the presence of these elements even in small quantities poses a potential risk due to their ability to bioaccumulate in the food chain. The most significant issues identified were the slightly acidic pH levels and excessive water hardness, which render the water less ideal for drinking and household tasks like laundry. These chemical characteristics are largely driven by local environmental factors, including the porous geology of the region and human activities such as improper waste disposal. To safeguard public health, it is essential for local authorities to implement regular water quality monitoring, improve sanitation infrastructure, and educate the public on the necessity of water treatment before use.

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