Assessment of the Spatial Variation in the Physico-Chemical Parameters of Groundwater across Selected Geologic Formations in Ogun State, Nigeria

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ABSTRACT

Groundwater serves as a crucial source of potable and agricultural Water in Ogun State, Nigeria, where limited access to treated surface water has intensified reliance on subsurface sources. This study examines the spatial variation in physicochemical parameters of groundwater across two contrasting geological formations: the basement complex terrain of Atan/Odosenbora and the sedimentary formation of Sagamu.

Twenty groundwater samples were systematically collected and analyzed for Total Dissolved Solids (TDS), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Iron (Fe), Chloride (Cl^-), Sulphate (SO_4^{2-}), Nitrate (NO_3^-), Fluoride (F^-), Dissolved Oxygen (DO), Total Hardness, and Total Alkalinity using standardized APHA methods. Results showed that Sagamu, underlain by sedimentary rocks, exhibited significantly higher concentrations of Ca^{2+} (mean: 46.5 mg/L), Cl^- (122.04 mg/L), and SO_4^{2-} (22.38 mg/L) compared to Atan, reflecting greater mineral solubility and anthropogenic influence. Conversely, the groundwater at Atan showed higher alkalinity levels, consistent with characteristics of basement complex aquifers. Iron was not detected in any samples.

Most parameters across both formations were within WHO permissible limits, although Sagamu recorded calcium levels exceeding the highest desirable limit in some locations. Statistical regression analysis confirmed a strong relationship (R^2 = 0.947; p= 0.00) between water chemistry and geologic formation, indicating that aquifer lithology significantly governs groundwater quality. Groundwater quality varies significantly between geologic formations in Ogun State, with sedimentary terrains showing higher mineral concentrations than basement complex areas. Routine groundwater monitoring, particularly in high-risk zones, is recommended. Basic treatment techniques, such as boiling, reverse osmosis, or ion exchange, should be employed. Public education campaigns should promote safe water practices and protect groundwater sources from contamination. Additionally, future groundwater development projects should integrate hydrogeological data to ensure a sustainable water supply and safeguard public health.

(Keywords: groundwater quality, physico-chemical parameters, Ogun State, basement complex, sedimentary terrain)

INTRODUCTION

Groundwater is a critical resource that supports domestic, agricultural, and industrial activities worldwide. Its quality is influenced by a range of factors, including the geological composition of aquifers, anthropogenic activities, and climatic conditions. For instance, sandstone aquifers are generally associated with relatively good water quality due to their high permeability and filtration capacity. In contrast, groundwater in limestone regions may exhibit higher hardness due to the dissolution of calcium carbonate (Domenico and Schwartz, 1990). Groundwater from crystalline basement rocks often shows elevated concentrations of iron, manganese, and fluoride due to limited natural filtration and higher water-rock interaction times.

One of humanity's most significant problems is access to a potable water supply. Variations in the physico-chemical parameters of groundwater, such as pH, electrical conductivity (EC), total dissolved solids (TDS), major ions, and heavy metals, have significant implications for human

health and environmental sustainability (Todd and Mays, 2005). Spatial variation in groundwater quality is often a reflection of underlying geological formations, which control the mineralogical composition and geochemical interactions within the aquifer system (Freeze and Cherry, 1979).

The spatial distribution of groundwater quality is intrinsically linked to the nature of the geologic formations in which aquifers are embedded. Despite groundwater being the most reliable and widely used source of freshwater globally, its quality is increasingly threatened by both natural and anthropogenic factors. One of the significant challenges in groundwater resource management is understanding the spatial heterogeneity in water quality, particularly in terms of physicochemical parameters influenced by the underlying geological formations. This spatial variability is often under-researched or generalized across regions, leading to ineffective water management policies and public health risks (Hem, 1985).

Different geologic formations, ranging from sedimentary rocks to crystalline basement complexes, have distinct mineralogical compositions and water-rock interaction mechanisms, resulting in diverse groundwater chemistries (Domenico and Schwartz, 1990). However, in many developing regions, water quality assessments often lack geological specificity, undermining efforts to implement targeted water treatment and protection strategies (Sharma and Patel, 2010). Moreover, the infiltration of pollutants from agricultural runoff, industrial effluents, and urban wastewater further complicates the chemical landscape of groundwater.

These pollutants interact with the geologic matrix, altering the natural chemical composition of groundwater and introducing contaminants such as nitrates, heavy metals, and salinity into aquifers (APHA, 2017). Without detailed spatial assessments, such threats remain undetected or poorly mitigated. Compounding the issue is the lack of comprehensive spatial datasets and geospatial analyses that can accurately map variations in physicochemical parameters across different terrains.

Conventional monitoring approaches often fail to incorporate hydrogeological frameworks, leading to fragmented and non-representative assessments (Freeze and Cherry, 1979). Groundwater is the primary source of potable Water in both urban and rural areas in Ogun State and has assumed such a high proportion.

Against the backdrop of poor, erratic, and undependable public Water by the state government, over 80% of Nigerians depend on groundwater as the primary source of potable Water for drinking and other domestic purposes, as well as for commercial and industrial purposes (Idris-Nda, *et al.,* 2015). Eighty percent of diseases and deaths in developing countries are related to water contamination (UNESCO, 2007; UNDP 1971).

The occurrence and quality of groundwater are primarily influenced by the stratigraphy, origin, and physical properties of the various lithologic frameworks that occur within the crust underlying the landscape of Ogun State. Several studies on groundwater quality have been conducted to assess its suitability for consumption and irrigation, focusing on the influence of pollutants and contaminants on groundwater (Egbinola and Amanambu, 2014).

A comparative analysis of groundwater quality in basement and sedimentary formations in Kastina State was also conducted (Mustapha, *et al.,* 2018). Understanding these variations is essential for informed groundwater management, especially in regions where groundwater is the primary source of potable Water. Given these gaps, there is an urgent need to evaluate the spatial variation in the physicochemical characteristics of groundwater in geological formations. Such assessments will provide valuable insights into the natural geogenic influences and anthropogenic pressures on water quality, thereby facilitating informed groundwater management and policy making.

MATERIALS AND METHODS

Study Area

As shown in Figure 1, Ogun State is bordered by the Benin Republic in the west, Lagos State in the south, Oyo and Osun States in the North, and Ondo State in the East. It occupies a total area of 16,409.26km^2 km² and lies on latitudes 6.2°N and 7.8°N and longitudes 3.0°E and 5.0°E.

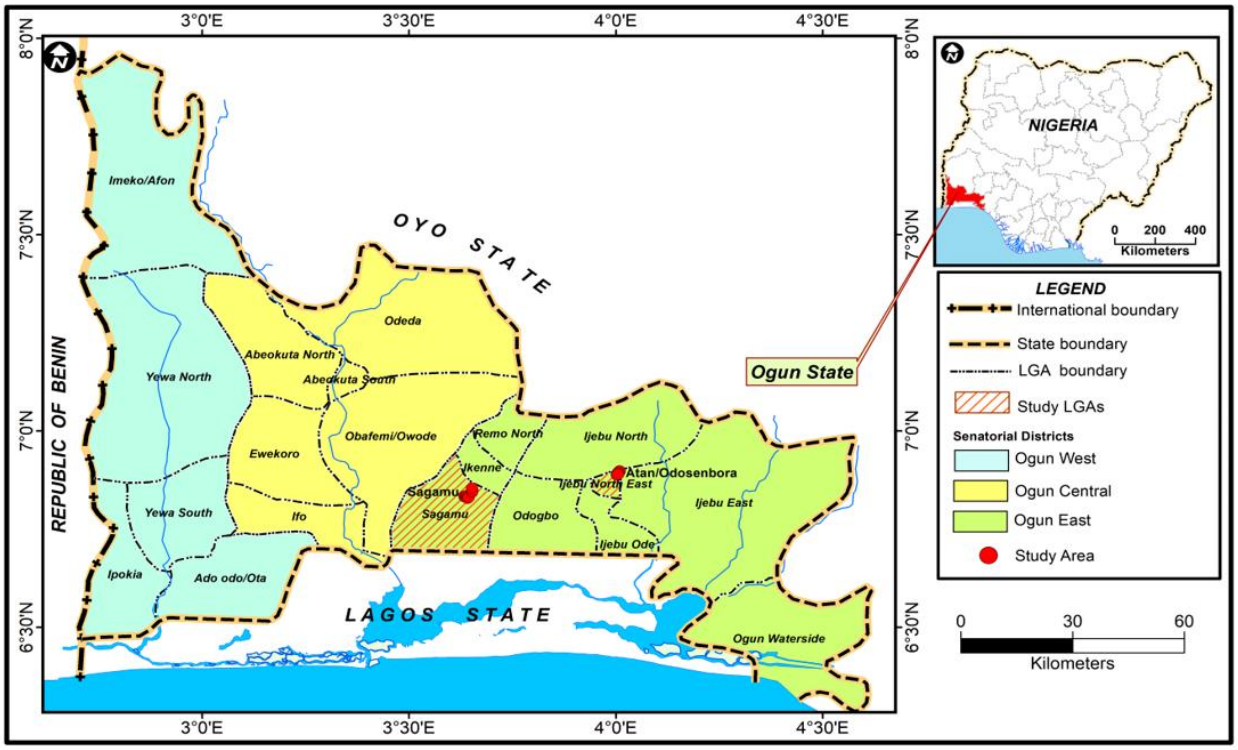

Figure 1: Map of Ogun State showing Sagamu and Atan/Odesenbora Local Government Areas.

The study was conducted in the Atan/Odosenbora and Sagamu in Ogun State. The geology comprises seven formations (Olurin, *et al.,* 2012), namely: the Basement Complex, Abeokuta Formation, Ewekoro Formation, Oshosun Formation, Ilaro Formation, Coastal Plain Sand, and Recent Alluvium.

The geologic units of the State are composed of crystalline rocks of the Basement Complex and sedimentary rocks of the extensive Dahomey Basin. Stratigraphic units of the Nigerian sector of the Dahomey Basin, which are also found in Ogun State, are composed of late Cretaceous, predominantly sandy strata of the Abeokuta Group, the oldest.

The overlying Tertiary strata include limestone of the Ewekoro Formation, shale of the Akinbo Formation, mudstones/shale of the Oshosun Formation, and sandstone of the Ilaro Formation. Other younger strata are the Oligocene to Recent continental sands of the Benin Formation, as well as recent alluvial sediments. (Omatsola and Adegoke, 1981; Adewuyi, 1984; Adediran, *et al.,* 1991; and Nton, *et al.,* 2009).

A substantial part of the study area falls within the area underlain by deposits of the Abeokuta Group. In contrast, a minor part occurs within the transition zone between the crystalline basement rock and sedimentary rocks. The Ewekoro formation belongs to the Tertiary period, having formed during the Paleocene and Eocene epochs. The greater part of the depression is a potential artesian basin, where groundwater can be sourced. Kogbe (1976) and Adegoke, *et al.* (1972) described the stratigraphy and paleography of different sedimentary basins. Adegoke *et al.* (1976) outlined the Alban and younger Paleozoic history of Nigeria, summarizing the nature and extent of transgressive and regressive phases, as well as the nature of the sediment.

The geology of Ogun State consists of intercalations in argillaceous sediment. The rock is soft and friable, but in some places, it is cemented by ferruginous material on siliceous material. It lies uncomfortably in the crystalline basement. The extensive Precambrian rocks are classified into three major groups. In Ogun State, the basement complex rock extends from the

northwestern part to Ijebu-Igbo. They consist of various rock types, including coarse, porphyritic hornblende–biotite granodiorite, biotite granite, gneiss, pegmatite porphyroblastic granite, amphibolite schist, quartzite, quartz, and banded gneiss (Iloeje, 1979).

The sedimentary rock unit of Ogun State consists of the Abeokuta Formation, which lies directly above the basement complex. This is, in turn, overlain by Ewekoro, Oshosun, and Ilaro formations, which are themselves overlain by the coastal plain sands (Benin formation). The floodplains of the major rivers and streams are covered by the alluvial sands (Kehinde, 1992). The area is accessible through secondary roads from Ijebu-Igbo in the North and Ijebu-Ode in the south. The relief shows that the region is an undulating coastal plain with elevation hardly rising above 240m above sea level.

The area is well-drained, with rivers of both perennial and seasonal types, as well as some minor streams that form minor tributaries of the main rivers. The drainage pattern of most rivers has taken advantage of faults in the area and, hence, they are structurally controlled (Ariyo, 2007). Sagamu has experienced both population and economic growth since the 1950s due to its position between the cities of Ibadan and Lagos.

The population in 1995 was 114,300, but estimates for 2007 suggest it may have been as high as 228,382. The study area lies within the tropical region, characterized by distinct wet and dry seasons. The wet season usually occurs from March to October and is dominated by heavy rainfall. The dry season occurs from November to March, when the area is under the influence of north-easterly winds (Badmus and Olatinsu, 2009). The annual rainfall is estimated to be approximately 1,600 mm, while the mean temperature ranges between 25.7 °C and 30.2 °C, with an average of 26°C.

The vegetations are of main types: tropical rainforest and Guinea savanna. The soils vary according to the geographical history and soil formation process. The northern part is characterized by savannah vegetation, while the central and southern parts fall within the rainforest belt, featuring large trees and dense undergrowth.

The drainage density of the State is high and is characterized by numerous large perennial rivers, such as Ogun, Ewekoro, and Berre, which mostly have dendritic drainage patterns (Akanni, 1992).

Data Collection

The data on which this study is based were generated through an intensive fieldwork, which took the researcher to the area under investigation and into personal interactions with the owners of the groundwater sources in the area. Water samples were collected in well-labelled 750ml capacity polythene bottles. Before collecting samples, the containers were thoroughly cleaned by washing with distilled Water. Bottles were rinsed thrice with the sample water before collection.

There are two significant water sources used for sample collection: wells (including ring wells, mud wells, and tube wells) and raw borehole water. Samples were collected from the same source at two different lithologic formations—the pre-treatment of samples involved cooling them to a temperature of 4°C. The samples were then transferred to a cooler containing ice, and the collected samples were analyzed in the Department of Agronomy Laboratory at the University of Ibadan. The well-tightened samples were stored at 4 °C to maintain this temperature. The analysis was completed within three weeks of the sample collection date.

Water Quality Parameters

Water samples were analyzed for key physico-chemical parameters including; Total Dissolved Solid (TDS), Calcium (Ca), Magnesium (Mg), Iron (Fe), Chloride (Cl), Sulphate (SO_4^{2-}), Nitrate (NO_3^{2-}), Fluoride (F^-), Dissolved Oxygen (DO), Total Hardness and Total alkalinity.

The TDS is determined as the residue left after evaporation of a filtered sample of Water in a beaker and is obtained from:

TDS, mg/L = (a-b) x 1000 x 1000 / V

where, a = Final weight of the beaker in g
b = Initial weight of the beaker in g
V = Volume of the filtered water sample evaporated in ml

Calcium is determined by the EDTA titrimetric method using the following equation: Ca mg/L =

(Vx 400.8) / ml of water sample, where V = Volume of EDTA used.

Magnesium is determined indirectly by the EDTA titrimetric method, which involves first determining Ca and Mg together in a water sample and then determining Ca alone in the same Volume of water sample.

The following equation is used to obtain Mg content: Mg, mg/L = $[(V_1-V_2) \times 400.8]$ / ml. of sample x 1.645, Where, V_l = volume of EDTA used in the determination of total calcium and magnesium, V_2 = volume of EDTA is used in the determination of calcium alone for the same Volume of the sample.

Chloride is determined by titration with silver nitrate solution using potassium chromate as the indicator. The endpoint is indicated by the appearance of a permanent reddish tinge (Mohr's method).

$Cl^- + Ag^+ \longleftrightarrow AgCl$

$2Ag^+ + Cr04^{2-} \longrightarrow Ag_2Cr0_4$ (red)

The following expression determines chloride-
C1 in mg/L = (ml x N) of $AgNO_3$ x l000 x 35.5 / ml of sample.

Sulphate is precipitated in an acidic medium with barium chloride to form barium sulphate crystals of uniform size. The light absorbance of the barium sulphate is measured using a spectrophotometer (Hitachi 3210 UV-visible spectrophotometer), and the sulphate concentration is determined by comparing the reading with a standard curve.

Nitrate content in Water is determined using a UV-visible spectrophotometer (Hitachi 3210) at 220 nm and 275nm wavelengths. Fluoride is determined by the SPADNS colorimetric method.

Hardness is determined by complexometric titration using EDTA (Ethylene Diamine Tetraacetic Acid, disodium salt) and Eriochrome Black T as the indicator. Hardness is determined by the formula: hardness, mg $CaCO_3$/L = (ml EDTA used × 1000) / ml water sample.

The alkalinity of Water is its capacity to neutralize a strong acid and is characterized by the presence of hydroxyl ions that can combine with hydrogen ions.

Dissolved oxygen (DO) is a relative measure of the amount of oxygen (O_2) dissolved in Water.

Sampled Locations in Atan/Odesenbora and Sagamu

Table 1: Coordinates of Sample Locations.

S.No.	Latitude	Longitude
SGM 1.	6°52'35"N	3°42'8"E
SGM 2.	6°50'3"N	3°38'13"E
SGM 3.	6°50'3"N	3°38'16"E
SGM 4.	6°49'50"N	3°38'27"E
SGM 5.	6°49'42"N	3°38'30"E
SGM 6.	6°49'51"N	3°38'40"E
SGM 7.	6°50'57"N	3°39'8"E
SGM 8.	6°50'51"N	3°39'8"E
SGM 9.	6°50'50"N	3°39'12"E
SGM 10.	6°51'14"N	3°39'8"E
ATAN 1.	6°53'21"N	4°0'20"E
ATAN 2.	6°53'32"N	4°0'19"E
ATAN 3.	6°53'52"N	4°0'34"E
ATAN 4.	6°53'46"N	4°0'29"E
ATAN 5.	6°53'39"N	4°0'20"E
ATAN 6.	6°53'25"N	4°0'16"E
ATAN 7.	6°53'21"N	4°0'12"E
ATAN 8.	6°53'25"N	4°0'12"E
ATAN 9.	6°53'17"N	4°0'10"E
ATAN 10.	6°53'35"N	4°0'24"E

Source: Researchers Analysis, (2020)

RESULTS AND DISCUSSION

Variation in Water Quality Parameters across the Sampled Locations

Calcium is an important ion in imparting the hardness of Water. Calcium concentration in Atan ranged from 0.95 mg/L to 27.40 mg/L, and 3.94 mg/L to 312.0 mg/L in Sagamu while Magnesium in Atan ranged from 0.232 mg/L to 16.290 mg/L, and 1.47 mg/L to 10.74 mg/L in Sagamu as shown in Figure 2.

Iron (Fe) was non-reactive in the water samples from both geological formations. TDS ranged from 0.90 mg/L to 1.60 mg/L in Atan and 0.85 mg/L to 1.60 mg/L in Sagamu. In sedimentary formations, elevated TDS levels are often associated with natural mineral dissolution, particularly in areas with marine sediments while Chlorine levels varied from 43.20 mg/L to 93.60 mg/L in Atan and 72.0 mg/L to 198.0 mg/L in Sagamu as shown in Figure 3.

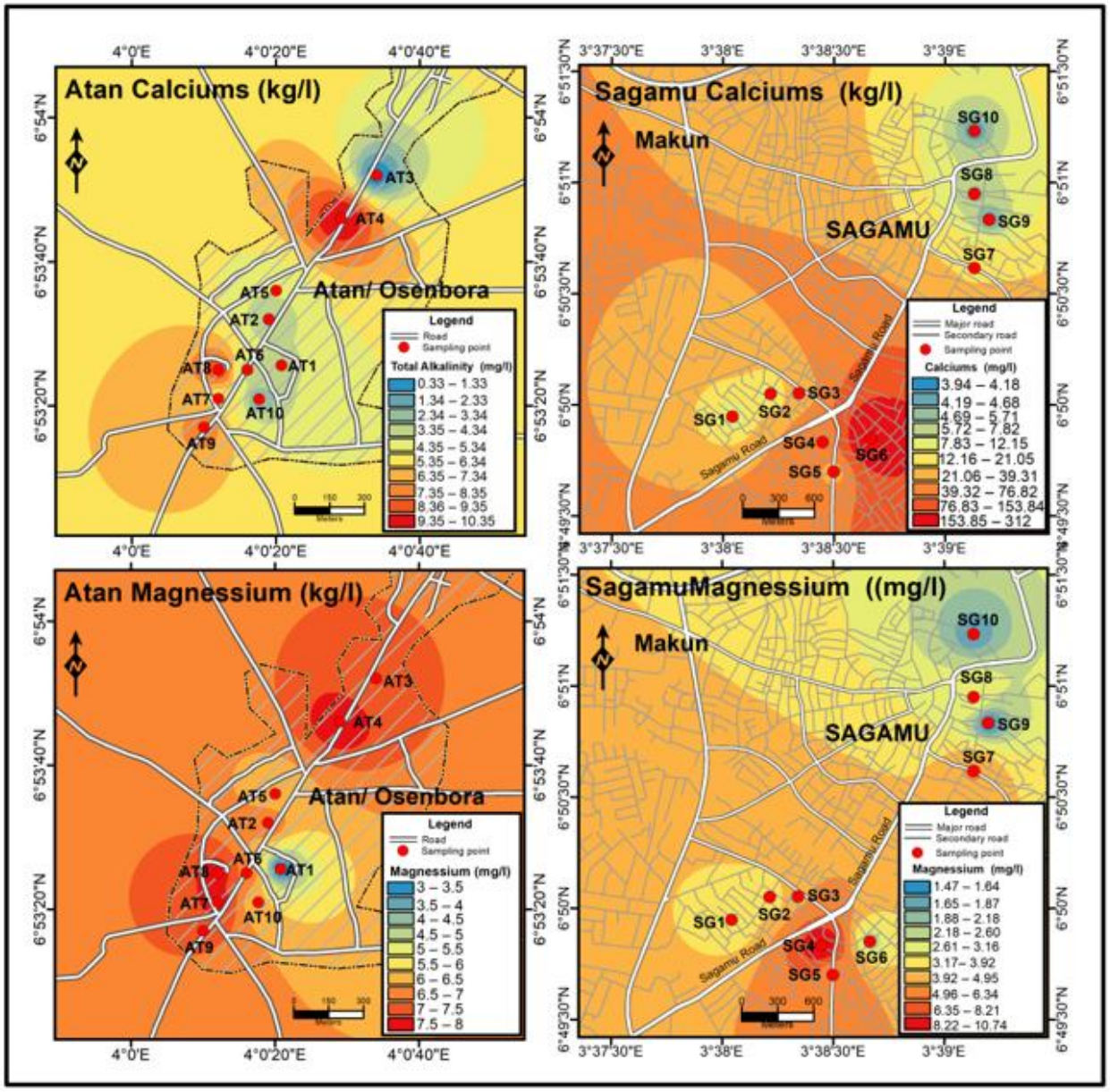

Figure 2: Spatial Distribution of Calcium and Magnessium in Atan/Odesenbora and Sagamu
Source: Researchers Analysis, (2020)

Sodium and chloride were predominant in areas affected by agricultural runoff and domestic sewage, indicating anthropogenic contamination. Nitrate levels vary from 0.70 mg/L to 0.124 mg/L in Atan and 0.118 mg/L to 0.159 mg/L in Sagamu while Sulphate ion ranged from 0.182mg/L to 1.058mg/L in Atan and 0.151mg/L to 219.0mg/L in Sagamu as shown in Figure 4.

Total alkalinity ranged from 10.80 mg/L to 26.40 mg/L in Atan and 2.80 mg/L to 6.0 mg/L in Sagamu while Fluoride ion was below the specified limit of HDL 1.0mg/L and MPL of 1.5mg/L, concentration ranged from 0.05 to 0.30mg/L in Atan and 0.18 to 0.56mg/L in Sagamu as shown in Figure 5.

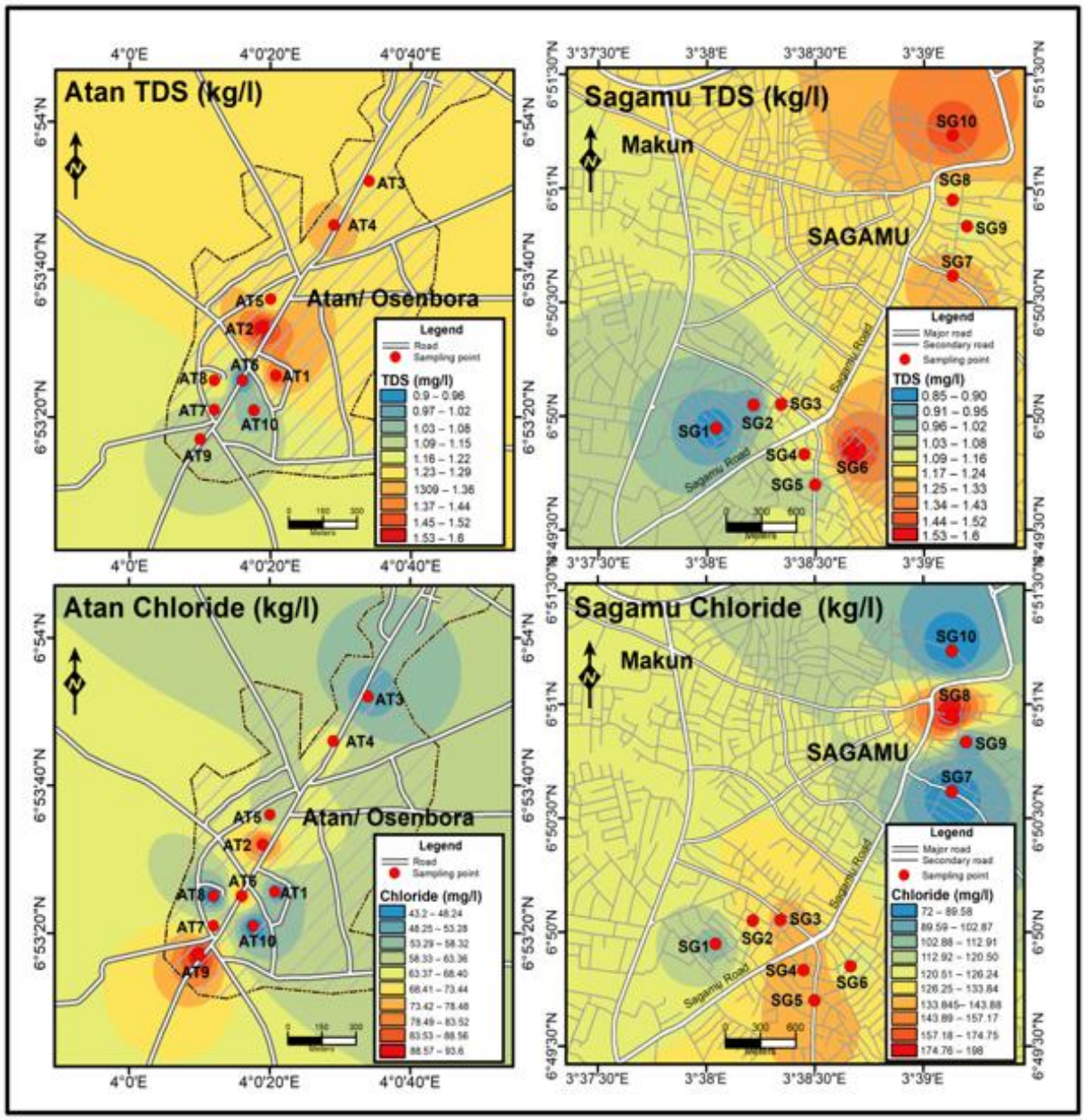

Figure 3: Spatial distribution of TDS and Chloride in Atan/Odesenbora and Sagamu
Source: Researchers Analysis, (2020)

The anions responsible for hardness are bicarbonate, carbonates, sulphate, and chloride. The total hardness of groundwater samples ranged from 0.33 to 10.35 mg/L in Atan and 1.59 to 78.76 mg/L in Sagamu while DO values ranged from 6.0 to 8.0 mg/L in Atan and 6.0 to 9.0 mg/L in Sagamu as shown in Figure 6. The maximum value was observed in Sagamu.

Spatial patterns in groundwater quality corresponded closely with the underlying geologic formations. Sedimentary formations exhibited higher TDS and hardness due to greater mineral content and solubility. Basement complex regions exhibited elevated iron and manganese levels, reflecting longer water-rock contact times and low aquifer buffering capacity.

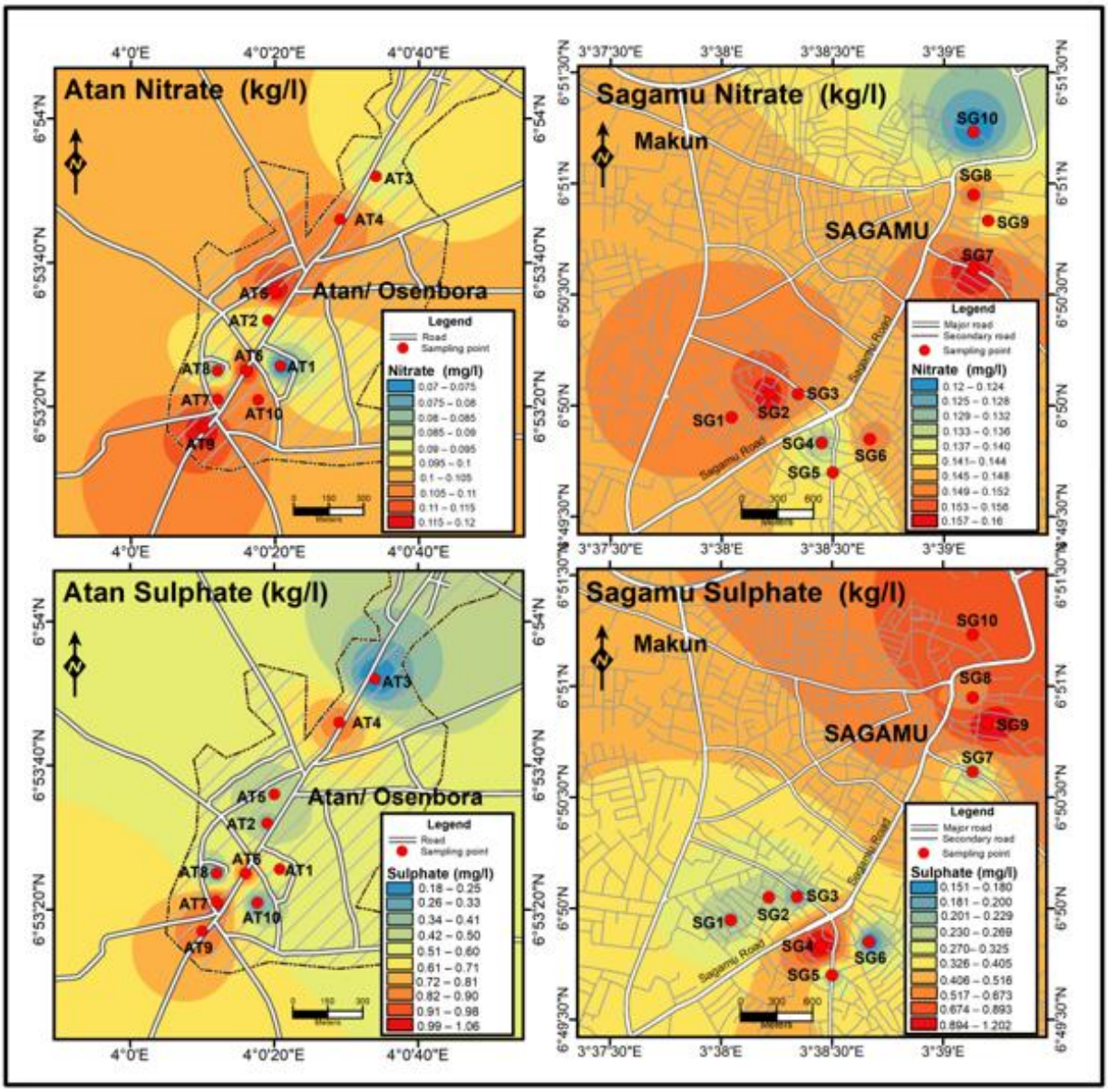

Figure 4: Spatial distribution of Nitrate and Sulphate in Atan/Odesenbora and Sagamu
Source: Researchers Analysis, (2020)

The distribution of ions in groundwater from the Atan/Odosenbora basement complex and Sagamu sedimentary terrain areas indicates comparable concentrations of Cl, Ca, SO_4, and TH, with higher values in the sedimentary area relative to the basement complex. Consistent with this, Groundwater quality from the basement complex of Abeokuta and Kano towns in southwest and north-central Nigeria was assessed by Ufoegbune *et al*. (2009) and Adamu *et al*. (2013), respectively.

Results show that zinc, iron, and lead had elevated concentrations above the WHO-prescribed limit in Abeokuta. In contrast, pH, conductivity, alkalinity, and total dissolved solids were found to be lower in the quartzite area than in the granite, schist, and gneiss areas of Kano town.

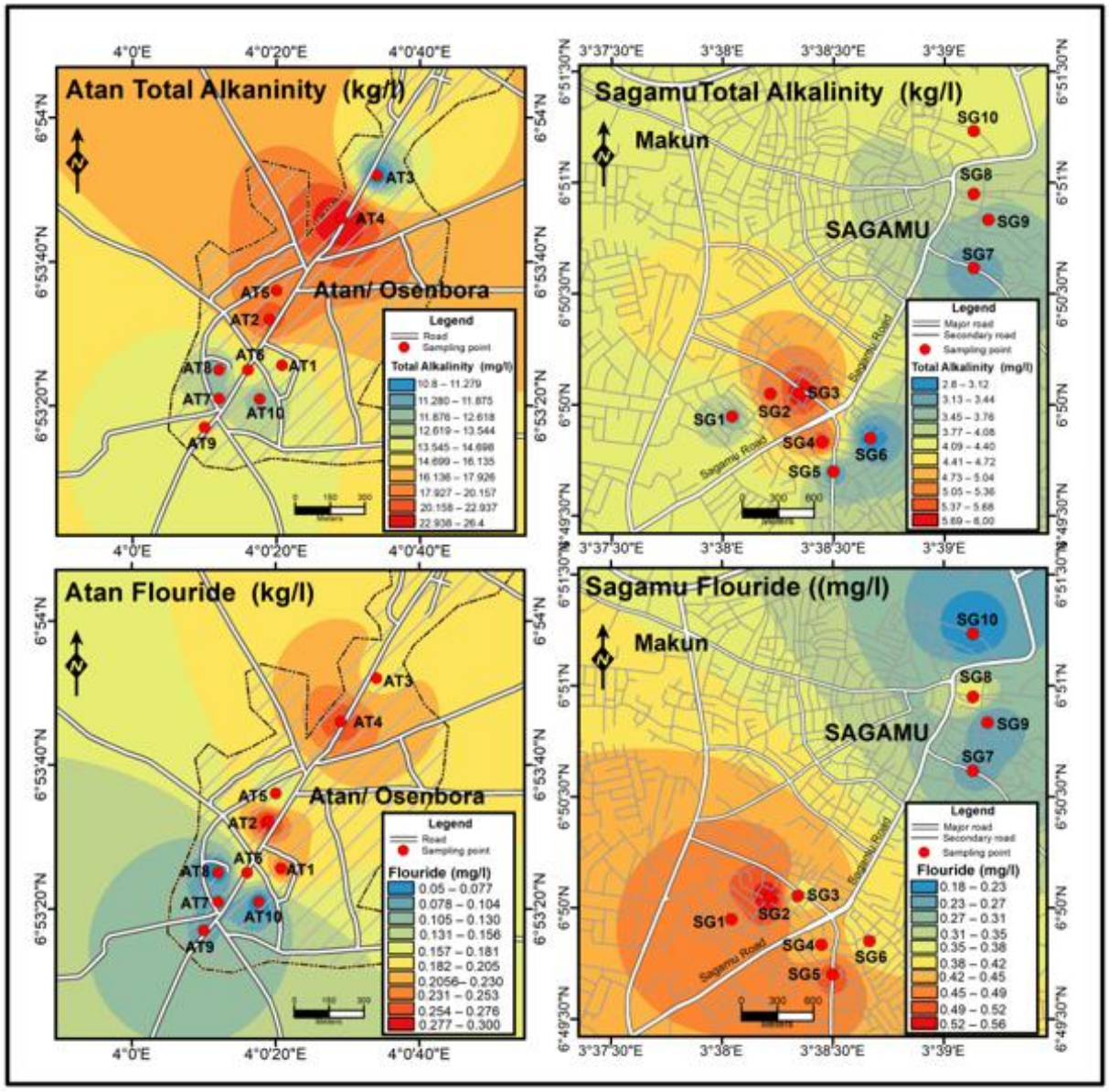

Figure 5: Spatial distribution of Alkalinity and Fluoride in Atan/Odesenbora and Sagamu
Source: Researchers Analysis, (2020)

In the same vein, Nwankwoala and Udom (2011) assessed the hydrogeochemistry of groundwater using pH, EC, Ca, Na, K, Cl, HCO_3, and SO_4 in Port Harcourt town. Ionic order identified was Ca, Mg, K, HCO_3, Cl, SO_4, NO_3. Ca-Mg-HCO_3 and Ca-Mg-SO_4 were found to be the dominant hydrochemical properties. Okoye. *et al*. (2010) investigated the physicochemical quality of groundwater in Calabar and its environs.

They found the Water to be acidic, with elements like iron, magnesium, aluminum, and nickel at lower concentrations.

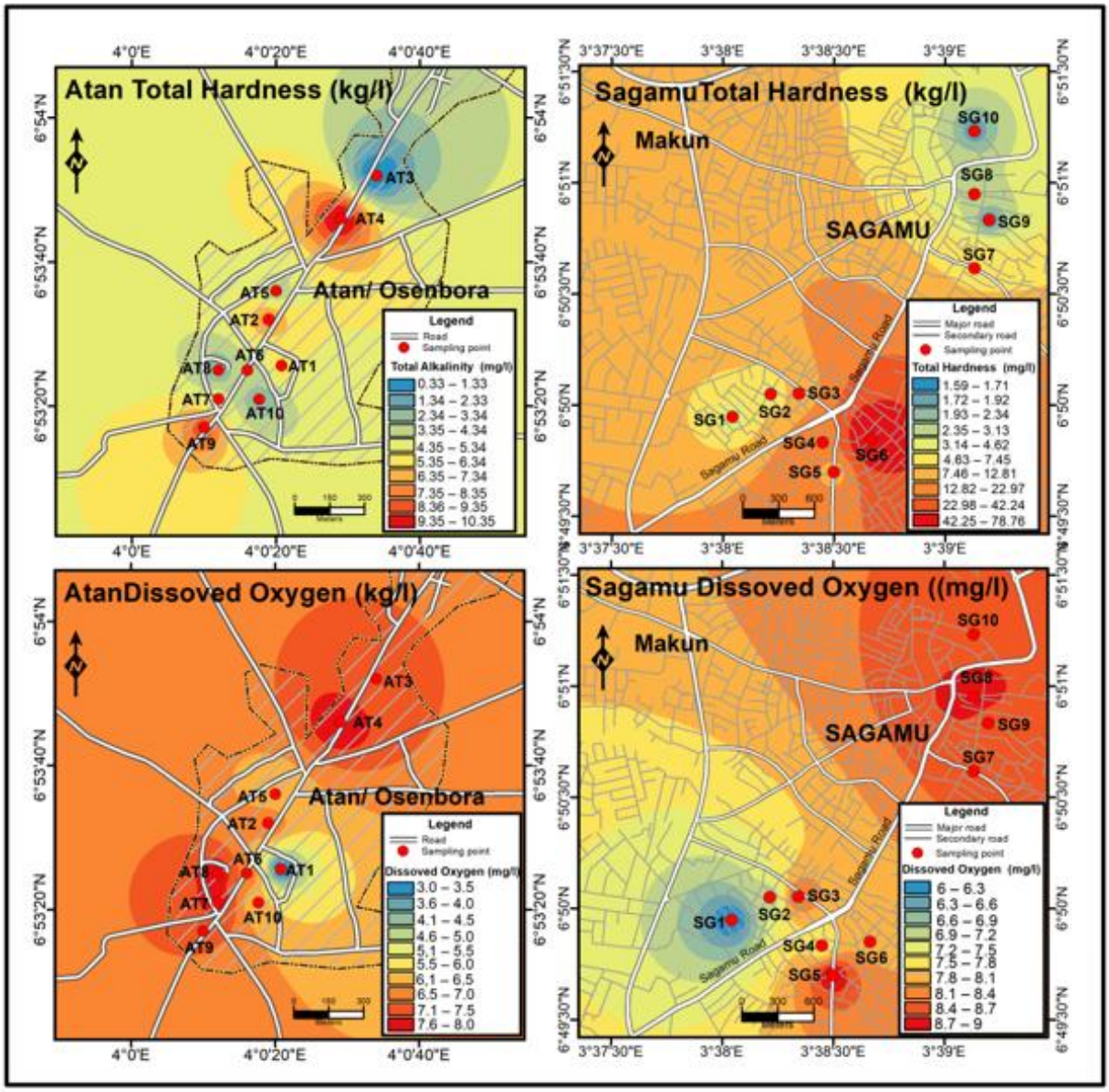

Figure 6: Spatial distribution of Total Hardness and Dissolved Oxygen in Atan/Odesenbora and Sagamu
Source: Researchers Analysis, (2020)

Table 2. Variation in the Physicochemical Qualities of Water in Groundwater and Aquifer Minerals.

Source of variation	Sum of Squares	Df	Mean Square	F-Ratio	P
Regression	4.875	10	.487	34.975	.000[b]
Residual	.125	9	.014		
Total	5.000	19			
R = 0.987; Multiple R = .975; Multiple R^2 (Adjusted) = .947; Stand error estimate = .118					

a. Dependent Variable: Geological formations
b. Predictors: (Constant), Do, Mg, Hardness, Fluoride, Sulphate, Nitrate, Tds, Alkalinity, Chloride, Ca

Table 3: Comparison of Mean Values of Parameters from Atan and Sagamu with the WHO Standards.

Parameters/ Location	Atan		Sagamu		WHO	
	Min	Max	Min	Max	HDL	MPL
CA	.95	27.40	3.94	312.00	75	100
MG	.232	16.290	1.47	10.74	30	50
FE	.00	.00	.00	.00	-	-
TDS	.90	1.60	.85	1.60	500	600
CHLORIDE	43.20	93.60	72.0	198.0	200	600
NITRATE	.70	.124	.118	.159	-	-
SULPHATE	.182	1.058	.151	219.0	200	250
ALKANILITY	10.80	26.40	2.80	6.00	20	
FLUORIDE	.05	.30	.18	.56	1.0	1.5
HARDENESS	.33	10.35	1.59	78.76	200	500
DO	6.0	8.0	6.0	9.0	-	-

Note: All values are expressed in mg/l , HDL- highest desirable limit; MPL- maximum permissible limit

Table 2 results show that the variables *F* (Mean Square Regression/Mean Square Residual) and *Sig.* (Significance) which confirms the relationship between groundwater and aquifer minerals. The results in Table 2. Indicated that water chemistry is being determined by the reaction of groundwater and aquifer minerals ($R = .987$; $R^2 = .975$; Adj. $R^2 = .947$; $F_{(10, 19)} = 34.975$; $p = .000$). This showed that the water chemistry accounted for 94.7% (Adj. $R^2 = .947$) of the variance observed in the groundwater and aquifer minerals. This implies that, to a great extent, water chemistry is being determined by the reaction of groundwater and aquifer minerals.

Table 3 revealed that the Calcium content showed high concentrations in Sagamu compared to Atan, and it ranges even higher than the WHO's highest desirable limit and maximum. Magnesium hardness indicated a slight difference between the two geological locations, with both locations having magnesium hardness lower than the WHO's highest desirable limit. Iron is not detected in any of the sources of the two locations. There is no significant difference in TDS between the two formations.

The chloride levels in all groundwater sources were found to be low. Nitrate content was found to be higher in Sagamu. The sulphate content was found to be higher in Sagamu, with the highest readings being slightly higher than the highest desirable limit.

The groundwater in Atan/Odonsembora had higher levels of total alkalinity compared to Sagamu, with the highest reading exceeding the WHO's highest desirable limit. Fluoride ion concentration was found to be below the WHO's highest desirable limit and maximum permissible limit, and there was no significant variation found in these values.

The total hardness in both formations was found to be below the WHO limits. Dissolved oxygen is almost the same in both formations. Most of the physicochemical parameters examined in the groundwater of Atan/Odosembora and Sagamu indicated that it is suitable for drinking. The Concentrations of Chloride, Calcium, Nitrate, and Total hardness are due to water-rock reactions and the differences in the geology of Atan/Odosembora and Sagamu, which vary from basement complex to sedimentary terrain in nature.

CONCLUSION

Some of the recommendations include reducing the calcium content, which was slightly higher in concentration than the WHO's highest desirable limit in drinking Water, using basic methods such as removing water hardness through boiling or reverse osmosis.

The groundwater samples from Atan and Sagamu are equally suitable for agricultural purposes, such as irrigation. More interventions are needed to provide an adequate supply of drinking water, like boreholes, for the people as part of community development as soon as possible, to guide against unforeseen situations of contamination in order to safeguard the health of the people living in Atan/Odosembora, as the majority of their groundwater sources are wells.

A significant limitation was the difficulty in accessing and collecting water samples in the locations, as the majority of the groundwater sources are wells located within fenced households. The perception of the inhabitants towards the collection was misconstrued for diabolical purposes, rather than the actual intent of the researcher.

The findings underscore the need for geologically-informed water management policies. Regular monitoring and mapping of groundwater quality across geological terrains can help identify areas at risk of contamination or resource degradation.

Water treatment strategies should be tailored to the dominant geochemical characteristics of each region. For example, areas with high iron and manganese may require aeration and filtration systems, while regions with saline or hard Water may need reverse osmosis or ion exchange treatment. Groundwater quality shows significant spatial variation across different geologic formations due to inherent mineralogical and hydrological properties. Understanding these variations is crucial for sustainable groundwater exploitation and public health protection. Integrated hydrogeological, geochemical, and spatial analysis provides a comprehensive framework for practical groundwater quality assessment and management.

APPENDIX

1. Water Quality Parameters in Atan/Odosenbora.

		CA	MG	FE	TDS	Cl	NO_3^{2-}	SO_4^{2-}	ALKY	F^-	TH	DO
N	Valid	10	10	10	10	10	10	10	10	10	10	10
Mean		10.3950	6.83010	.0000	1.2200	63.3600	.10090	.58420	16.5600	.1720	5.7210	7.2000
Median		6.6400	6.02500	.0000	1.2250	61.2000	.10650	.48650	15.2000	.1650	5.2700	7.0000
Std. Deviation		8.89004	5.068569	.00000	.20843	17.89570	.017381	.324836	5.10233	.08257	3.32680	.78881
Range		26.45	16.058	.00	.70	50.40	.054	.876	15.60	.25	10.02	2.00
Minimum		.95	.232	.00	.90	43.20	.070	.182	10.80	.05	.33	6.00
Maximum		27.40	16.290	.00	1.60	93.60	.124	1.058	26.40	.30	10.35	8.00

2. Water Quality Parameters in Sagamu**.**

		CA	**MG**	**FE**	**TDS**	**Cl**	**NO_3^{2-}**	**SO_4^{2-}**	**ALKY**	**F^-**	**TH**	**DO**
N	Valid	10	10	10	10	10	10	10	10	10	10	10
Mean		46.5020	4.06300	.0000	1.1750	122.0400	.14520	22.37560	4.1600	.3790	13.2740	8.0500
Median		14.2250	3.15500	.0000	1.1500	126.0000	.14800	.39700	3.8000	.3900	5.2250	8.5000
Std. Deviation		94.33152	2.707262	.00000	.24181	38.04019	.012408	69.087980	1.10272	.12521	23.44933	.95598
Range		308.06	9.270	.00	.75	126.00	.041	218.849	3.20	.38	77.17	3.00
Minimum		3.94	1.470	.00	.85	72.00	.118	.151	2.80	.18	1.59	6.00
Maximum		312.00	10.740	.00	1.60	198.00	.159	219.000	6.00	.56	78.76	9.00

Note: All values are expressed in mg/l

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