Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 21 Issue 2 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Comparative Analysis of Quality of Sources of Drinking Water used by Scavengers in Gosa Area of FCT-Abuja, Nigeria

By Iliyasu M. Anzaku & Garba Umar

Bayero University, Kano

Abstract- The study assessed the quality of sources of drinking water used by scavengers in Gosa Area of the FCT. The study adopted the experimental research design. The study adopted the purposive sampling technique. Similarly, Sample used in the study were three sources of drinking water in the study area, namely from boreholes and shallow wells. Water samples collected was prevented from being exposed to sunlight. Samples were packed in plastic cooler containing ice for preservation and analysed within 24hours from the time of sample collection to avoid errors that may be introduced due to environmental factors. The samples collected were comparatively analyzed based on their physical and chemical properties, within the premise of drinking water quality as approved by the Standard Organisation of Nigeria (SON), the National Agency for Food, Drug Administrative Control (NAFDACT). The results of the study revealed that all the sampled water sourced in the study were odourless and in line with the requirement of NAFDAC and SON.

Keywords: comparative, water, quality, scavengers, used.

GJSFR-H Classification: FOR Code: 059999p

COMPARATIVEANALYSISOFQUALITYOFSOURCESOFDRINKINGWATERUSEDBYSCAVENGERSINGOSAAREAOFFCTABUJANIGERIA

Strictly as per the compliance and regulations of:

© 2021. Iliyasu M. Anzaku & Garba Umar. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Comparative Analysis of Quality of Sources of Drinking Water used by Scavengers in Gosa Area of FCT-Abuja, Nigeria

Iliyasu M. Anzaku [α] & Garba Umar [σ]

Abstract- The study assessed the quality of sources of drinking water used by scavengers in Gosa Area of the FCT. The study adopted the experimental research design. The study adopted the purposive sampling technique. Similarly, Sample used in the study were three sources of drinking water in the study area, namely from boreholes and shallow wells. Water samples collected was prevented from being exposed to sunlight. Samples were packed in plastic cooler containing ice for preservation and analysed within 24hours from the time of sample collection to avoid errors that may be introduced due to environmental factors. The samples collected were comparatively analyzed based on their physical and chemical properties, within the premise of drinking water quality as approved by the Standard Organisation of Nigeria (SON), the National Agency for Food, Drug Administrative Control (NAFDACT). The results of the study revealed that all the sampled water sourced in the study were odourless and in line with the requirement of NAFDAC and SON. With respect to taste, all the sampled water sources in the study area had test, which is against NAFDAC and SON guideline for safe drinking water. The results revealed that all the sample of the study fall within NAFDAC, SON, and WHO guideline for safe drinking water, ranging from a pH value of 5.00-6.69. All the sampled water sources in the study area had levels of TDS content which met the WHO guideline standard value of 1000mg/l as well as NAFDAC and SON guideline standard. The study found that well water source was the most polluted source of water, as a result of exposure to different materials making it prone to high concentration of physical, chemical and microbiological properties. By way of qualitative description, well water has the highest concentration of physical and microbiological properties of water. The study concluded that with NAFDAC and SON permissible guidelines for potable water not adhered by people; it is therefore the collective responsibility of both private and public sectors for ensuring effective management of water sources for greater sustainability. Furthermore, the research has provided explanatory information on the quality status (Physical, Chemical and Microbiological) parameters of three common sources of drinking water in Gosa, FCT, Abuja.

Keywords: comparative, water, quality, scavengers, used.

Author α: Department of Sciences, School of Continuing Education Bayero University, Kano, Nigeria.
Author σ: Department of Geography, Faculty of Environmental science Nasarawa State University, Keffi.
e-mail: iliyasumammananzaku@gmail.com

I. Introduction

Water is vital to the existence of all living organisms, but this valued resource is increasing being threatened as human populations grow and demand for more water of high quality for drinking purposes and economic activities increases. The Greek philosopher Pindar described water as the "best of all things". Indeed, nothing could be further from this view is not surprising since the need for water, throughout human history, has always been appreciated. Water is present everywhere without which life will simply cease to exist. It is constantly in motion, passing from one state to another and from one location to another. Irrespective of its movement as rivers or streams or stationary as it is in lakes, it invariably contains extraneous materials, due to natural causes and human activities (Biswas, 2008). Almost all of the planet's water (97%) occurs as salt water in the oceans (Bouwer, 1978). Of the remaining 3%, two-thirds occur as snow and ice in polar and mountainous regions, and only about 1% of the global water as freshwater (Bouwer, 2000).

Generally, water is obtained from two principal natural sources; Surface water such as fresh water lakes, rivers, streams, and Ground water such as borehole water and well water (McMurry & Fay, 2004; Mendie, 2005). It is a chemical substance with the chemical formula H_2O. Its molecule contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is a liquid at ambient conditions, but it often co-exists on Earth with its solid, ice, and gaseous state. Groundwater is subsurface water that fills voids and permeable geological formations. It accounts for about 97% (excluding permanently frozen water) of the Earth's useable freshwater resource (Canter *et al.*. 1987).

Groundwater does not exist in isolation, but is an integral component of the hydrological cycle: the endless circulation of water between oceans, atmosphere and land. Groundwater aquifers are periodically replenished by precipitation and by surface water percolating down through the soils. Water stored in aquifers is usually in motion, flowing slowly under the influence uf gravity, until it discharges into a spring, stream, lake, wetland or the ocean or is taken up by plants or is extracted by wells. Hydrologic studies on the

© 2021 Global Journals

water mass balance are usually conducted within a watershed, since the earth's water cycle is too large to be studied easily. The physical hydrologic processes of precipitation, infiltration, surface runoff, subsurface flow and stream flow play an important role in the propagations of contaminants generated by human activities in a particular watershed. However, depending on the particular climatic, geologic, topographic and vegetative characteristics of the watershed in question, some of these processes might be negligible (Sergio. 1997).

In many developing countries over the years, ground water remains one of the dependable sources of usable water in fast growing towns and villages where the supply of potable water is not consistent. Water abstraction for drinking use agricultural production, mining, industrial introduction power generation, and forestry practices can lead to deterioration in water quality and quantity that impact not only the aquatic ecosystem, but also the availability of safe water for human consumption. Due to vast anthropogenic activities, water quality is being lost causing extremely bad health problems to consumers of it as well as deteriorating the quality of soil, plants and other living organism that depends on water (WHO, 2002).This research examined the physicochemical as well as biological characteristics of drinking water in Gosa.

II. Materials and Methods

a) *Research Design*

Because a research design is a time-based plan that guides the selection of sources and types of information all based on the research questions (Cooper & Schindler, 2014), the most suitable research design for a study is one that minimizes bias, maximizes the reliability of data collected and in line with the purpose of the study. Hence, this study adopted the experimental research design.

b) *The Study Area*

The land of Abuja was the south-western part of the ancient kingdom of Zazzau (Zaria). The name "Abuja" was derived from Abu Ja, a brother to Muhammadu Makau, the Hausa ruler of Zaria. Makau had left Zaria after being defeated by the Fulani people and settled in the area now known as Abuja. The study area, Abuja, the Federal Capital Territory of Nigeria is situated within the geographic coordinates of Latitude: 09 10′ 00″ N and Longitude: 007 11′ 00″ E (UKEssays, 2016). The area is centrally located and had few existing residents, as such it was chosen to be the Federal Capital Territory. Plans for Abuja were first announced by decree in 1976. Most of the construction for city began in the 1980's. Today, it is Africa's only purpose-built capital city. Abuja became the capital city of Nigeria since December 12th 1991, when it replaced the previous capital Lagos. However, Abuja was planned and mainly built in the 1980s.The Federal Capital Territory is bordered by four states. Kaduna to the north, Kogi to the south, Nasarawa to the east and Niger to the west. For administrative purposes the FCT is divided into six area councils namely; Abaji, Abuja Municipal, Gwagwalada, Kuje, Bwari and Kwali Area Councils. Within the Area Councils there are locations designated as Satellite Towns, which receive priority attention with regards to infrastructural development. For the purpose of Infrastructural development, the Satellite Towns are under the Department of Satellite Towns Infrastructure (DSTI) of the Federal Capital Development Authority (FCDA).

© 2021 Global Journals

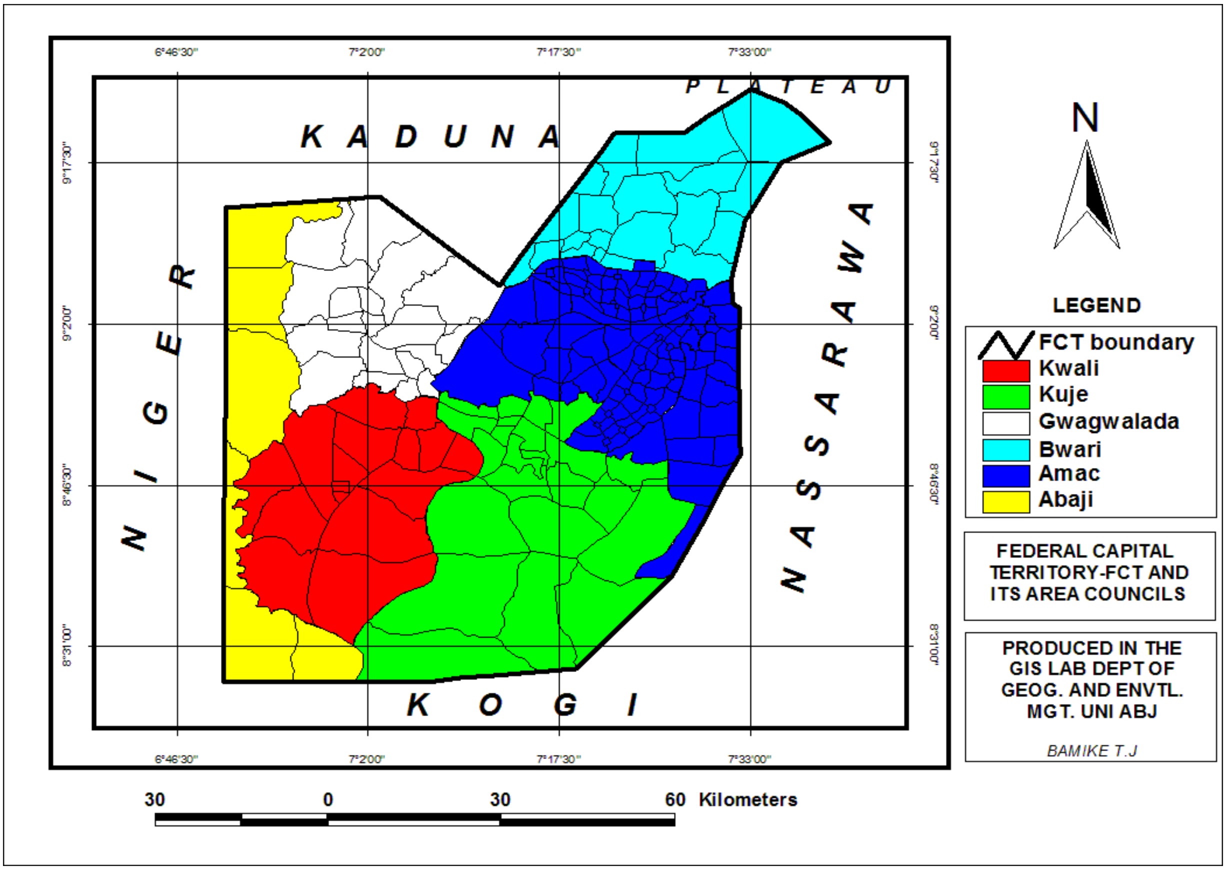


Figure 1: Map of Abuja highlighting all six Area Councils

c) Field Work

The filed exercise shall include the followings;

d) Water Samples

3 sample points were used (location of the water sources namely well, borehole and estate borehole). A total of 3 sample of water were collected from each of the water sources (well, borehole and estate borehole) in the Gosa dumpsite, making a total of 3 water samples. These were collected weekly over a period of 1 month. The essence of this is to ensure quality control during the analysis of chloride and nitrate i.e. test for other parameters except nitrate will be done from sample containers that is treated with HNOs while test for all other parameters except chloride will be done from sample containers that is treated with Hcl.

e) Sampling Technique

The sampling technique employed in the study by the research was the purposive sampling technique.

f) Sample Collected

For water sample from boreholes & shallow wells, GPS positions were given of the site where samples were collected. Water samples were collected from the study area in clean 2litres plastic jar with screw caps. The bottles were labelled using appropriate codes. Samples were collected from the study area in July, 2019.

g) Sample Storage

Water samples collected was prevented from being exposed to sunlight. Samples were packed in plastic cooler containing ice for preservation and analysed within 24hours from the time of sample collection to avoid errors that may be introduced due to environmental factors (Todd & Mays, 2005). The laboratory analysis was carried out at Abuja Environmental Protection Board (AEPB) Laboratory, located in WUPA Waste Treatment Plan in Idu.

© 2021 Global Journals

III. Results and Discussion

Table 1: Results of Parameters of Sampled Source of Drinking Water in the Study Area

S/No.	PARAMETERS	RESULTS			Nigeria Drinking Water Limits *(NAFDAC & SON)*
		Sample 1: *Well*	Sample 2: *Public Borehole*	Sample 3: *Estate Bore Hole*	
1	Odour	Odourless	Odourless	Odourless	Odourless
2	Taste	Taste	Taste	Taste	Tasteless
3	Colour	Colourless	Colourless	Colourless	Colourless
4	Ph	5.00	6.69	6.53	6.5-8.5
5	Temperature (°c)	26.1	26.4	26.4	31
5	Conductivity *(µS/cm)*	119.2	112.7	103	100
7	Turbidity*(NTU)*	13.8	1.3	1.3	5
8	T. Hardness *($mgCaCo_3/l$)*	82	105	85	100
9	Total Dissolved Solid *(TDS mg/l)*	60.6	50.7	50.3	500
10	Total Suspended Solids *(TSS mg/l)*	14.0	2.0	2.0	10
11	Chloride *(mg/l)*	45.0	23.5	19.9	250
12	Sulphate *(mg/l)*	35.7	29.0	26.7	250
13	Dissolved Oxygen *(mg/l)*	6.9	7.1	6.8	250
14	BOD *(mg/l)*	6.9	7.1	6.8	No standard
15	COD *(mg/l)*	13.5	8.0	7.8	< 10
16	T. Coliform (CFU/100mL)	100	200	10	< 10
17	E. coli (CFU/100mL)	10	3	0	Nil
18	Salmonella (CFU/100mL)	2	2	0	Nil

Source: Lab analysis of result of raw water sample from the study area (WUPA WWTP Laboratory), 2019.

The data presented in Table 1 depicts the parameters of water quality (with respect to the scope of the study) from the sampled source of water in the study area, laboratory results on the concentration of these parameters of fresh water from the sampled sources water in the study area, as well as the acceptable limit of drinking water in Nigeria as approved by National Agency for Food and Drug Administration and Control (NAFDAC) and Standard Organisation of Nigeria (SON). The data presented in Table 2 represents the concentration of physical parameters of water quality in the study area.

Table 2: Concentration of Physical Parameters of Water Quality in the Study Area

S/No.	PARAMETER	RESULTS			Nigeria Drinking Water Limits *(NAFDAC & SON)*
		Sample 1: *Well*	Sample 2: *Public Bore Hole*	Sample 3: *Estate Bore Hole*	
1	Odour	Odourless	Odourless	Odourless	Odourless
2	Taste	Taste	Taste	Taste	Tasteless
3	Colour	Colourless	Colourless	Colourless	Colourless
4	Temperature (°C)	26.1	26.4	26.4	31
5	Turbidity*(NTU)*	13.8	1.3	1.3	5

Source: Laboratory analysis, 2019.

a) *Odour and Taste*

Taste and odour are human perceptions of water quality. Human perception of taste includes sour (hydrochloric acid), salty (sodium chloride), sweet (sucrose) and bitter (caffeine). Relatively simple compounds produce sour and salty tastes. However, sweet and bitter tastes are produced by more complex organic compounds. Odour is produced by gas production due to the decomposition of organic matter or by substances added to the wastewater. Odour is measured by special instruments such as the Portable H2S meter which is used for measuring the concentration of hydrogen sulfide. The result depicted in Table 2 shows that all the sampled water sourced in the

© 2021 Global Journals

study were odourless and in line with the requirement of NAFDAC and SON. With respect to taste, all the sampled water sources in the study area had test, which is against NAFDAC and SON guideline for safe drinking water.

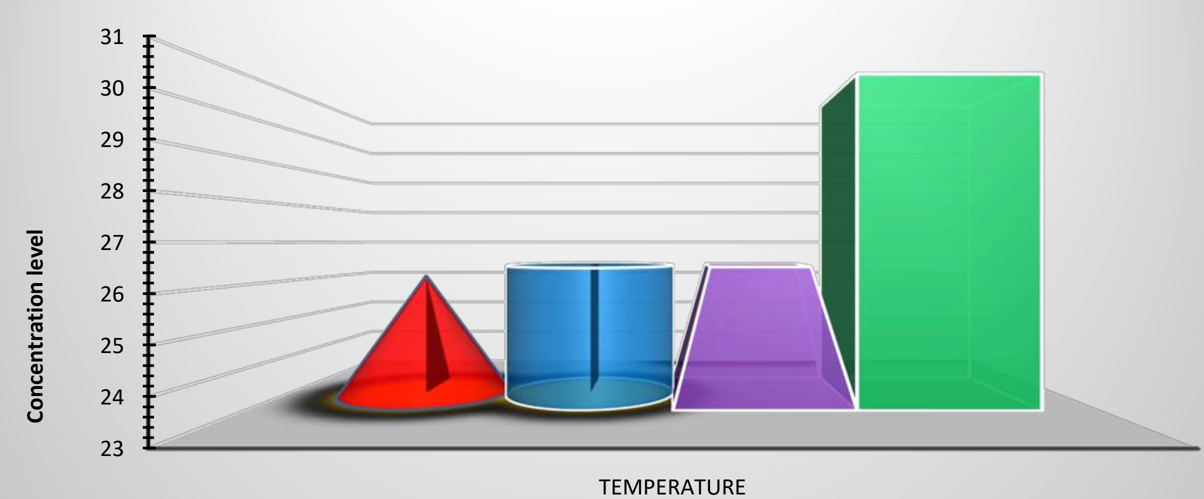
b) Colour

Colour in water is primarily a concern of water quality for aesthetic reason. Coloured water gives the appearance of being unfit to drink, even though the water may be perfectly safe for public use. Colour of the water body can indicate the presence of organic substances, such as algae or humic compounds. In recent times, colour has been used as a quantitative assessment of the presence of potentially hazardous or toxic organic materials in water. Colour is vital as most water users, be it drinking or industrial, usually prefer colourless water. The result presented in Table 4.2 shows that all the sampled sources of water in the study area were colourless and within NAFDAC and SON safety guideline for safe quality of drinking water.

c) Temperature (°C)

Temperature is a measure of the average energy (kinetic) of water molecules. It is measured on a linear scale of degrees Celsius or degrees Fahrenheit. Temperature is a basic water quality variable. It determines the suitability of water for various forms of aquatic life. Depending on the geographic location the mean annual temperature varies in the range of 10 to 21°C with an average of 16°C. Temperature affects a number of water quality parameters such as dissolved oxygen which is a chemical characteristic. Oxygen solubility is less in warm water than cold water. Temperature also affects the aquatic life, for example, trout and salmon require cool temperature for survival and reproduction whereas bass and sunfish do better at warmer temperatures. Temperature in water bodies generally follows mean daily air temperature. It influences: amount of oxygen that can be dissolved in water, rate of photosynthesis by algae and other aquatic plants, metabolic rates of organisms, sensitivity of organisms to toxic wastes, parasites and diseases, and timing of reproduction, migration, and aestivation of aquatic organisms. The above results depicted in Table 2 reveals the temperature of the various sample sources of water in the study area. From the result revealed an average temperature of 26.1°C and 26.4°C, all which fall within the approved 31°C of NAFDAC and SON safety guideline for quality drinking water.

Figure 1: Concentration of Temperature



	Temperature
Sample 1 (Well)	26.1
Sample 2 (Public Bore Hole)	26.4

Source: Author's computation, 2019.

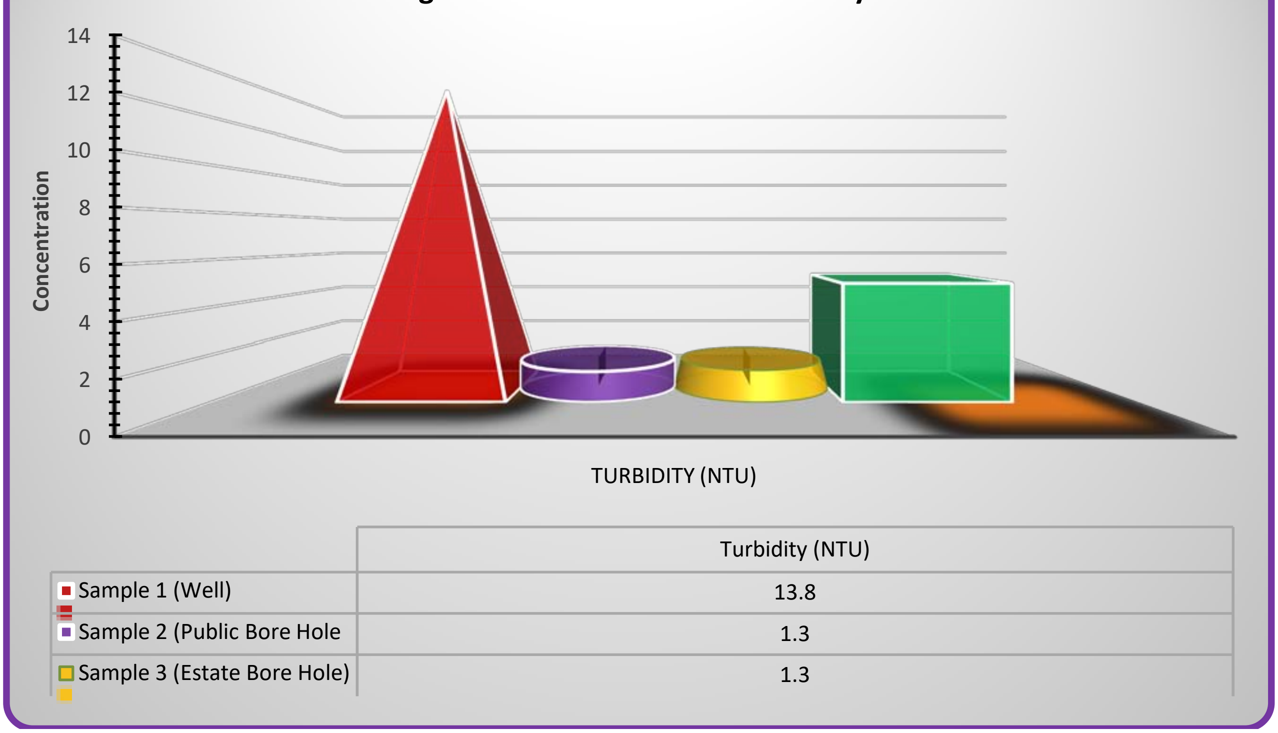
d) Turbidity (NTU)

Turbidity is a measure of the light-transmitting properties of water and is comprised of suspended and colloidal material. It is important for health and aesthetic reasons. Transparency of natural water bodies is affected by human activity, decaying plant matter, algal blooms, suspended sediments, and plant nutrients. Turbidity provides an inexpensive estimate of total suspended solids (TSS) concentration. It has little meaning except in relatively clear waters but is useful in defining drinking-water quality in water treatment.

© 2021 Global Journals

From Table 2, only two out of the 3 sampled sources, namely 2 (Borehole) and 3(estate borehole) had their levels of turbidity within the limit of acceptable standard of drinking water of NAFDAC and SON of 5. The levels of turbidity were 1.3 respectively for both sources. The highest level was obtained from 1(well) with a turbidity level of 13.8.

Figure 2: Concentration of Turbidity



Source: Author's computation, 2019.

e) The Concentrations of Chemical Parameters of Water Quality in the Study Area

The data presented in Table 3 represents the concentration of physical parameters of sampled water quality in the study area, measured and compared against the allowable limit by NAFDAC, SON, and WHO for drinking water quality.

Table 3: Concentration of Chemical Parameters of Water Quality in the Study Area

S/No.	Parameter	Results			Nigeria Drinking Water Limits (NAFDAC & SON)
		Sample 1: Well	Sample 2: Public Bore Hole	Sample 3: Estate Bore Hole	
1	pH	5.00	6.69	6.53	6.5-8.5
2	Conductivity (*µS/cm*)	119.2	112.7	103	100
3	Total. Hardness ($mgCaCo_3/l$)	82	105	85	100
4	Total Dissolved Solid (*mg/l*)	60.6	50.7	50.3	500
5	Total Suspended Solid (*mg/l*)	14.0	2.0	2.0	10
6	Chloride (*mg/l*)	45.0	23.5	19.9	250
7	Sulphate (*mg/l*)	35.7	29.0	26.7	250
8	Dissolved Oxygen (DO *mg/l*)	6.9	7.1	6.8	250
9	Biological Oxygen Demand(BOD*mg/l*)	6.9	7.1	6.8	No standard
10	Chemical Oxygen Demand (CO*mg/l*)	13.5	8.0	7.8	< 10

Source: Laboratory analysis, 2019.

f) pH

pH is classed as one of the most important water quality parameters, as it measures how acidic or basic (alkaline) water is. It is defined as the negative log of the hydrogen ion concentration. The pH scale is logarithmic and ranges from 0 (very acidic) to 14 (very alkaline). For each whole number increase (i.e. 1 to 2) the hydrogen ion concentration decreases tenfold and

© 2021 Global Journals

the water becomes less acidic. The range of natural pH in fresh waters extends from around 4.5, for acid, peaty upland waters, to over 10.0 in waters where there is intense photosynthetic activity by algae. Changes in pH may alter the concentrations of other substances in water to a more toxic form. Ammonia toxicity, chlorine disinfection efficiency, and metal solubility are all subjective to changes in pH value. However, the most frequently encountered range is 6.5-8.0.WHO (2011), NAFDAC and SON guidelines for acceptable limit for quality drinking water are between6.5 and 8.5. The results presented in Table 3 revealed the various pH levels of the sample sources of water in the study area. From the results, it can be observed that all the sample of the study fall within NAFDAC, SON, and WHO guideline for safe drinking water, ranging from a pH value of 5.00-6.69.

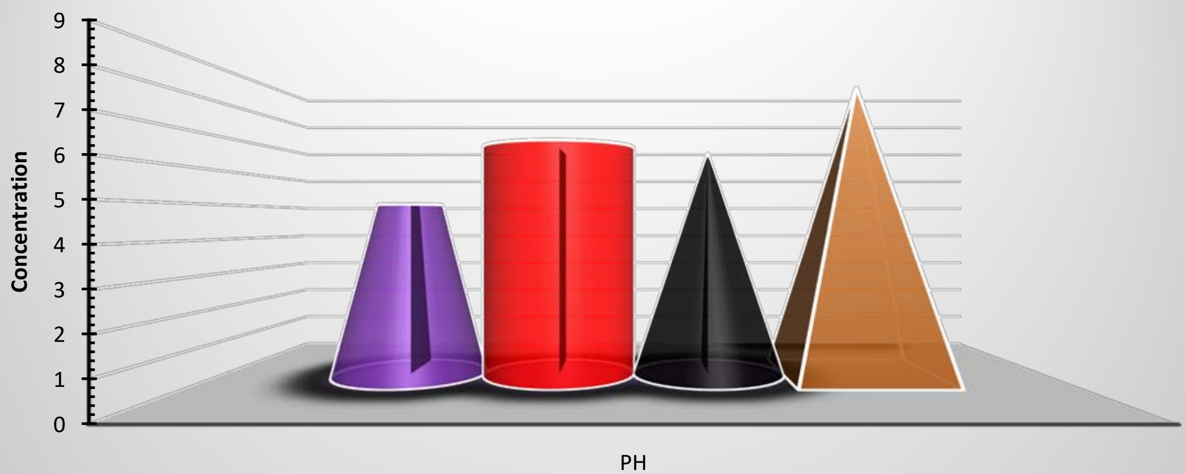


Figure 3: pH Concentration

	pH
Sample 1 (Well)	5
Sample 2 (Public Bore Hole)	6.69
Sample 3: (Estate Bore Hole)	6.53
NAFDAC & SON Limit	8.5

Source: Laboratory analysis, 2019.

g) Conductivity (µS/cm)

Electrical conductivity is the ability of any medium; water in this case, to carry an electric current. The presence of dissolved solids such as calcium, chloride, and magnesium in water samples carries the electric current through water. According to NAFDAC and SON, the maximum allowable (limit) of conductivity is 100*µS/cm.* The results show that the measured conductivity of all water samples ranges from103*µS/cm* to119.2*µS/cm* (Table 3). From the results it can be observed that all the sample sources had conductivity above the NAFDAC and SON approved limit for drinking water in the study area.

The variation in conductivity usually can be explained as the reverse osmosis treatment technique is used to remove dissolved solids, turbidity, colloidal matters, and others, and thus it gives lowest conductivity value. Similarly, it is expected to find high mineral contents in mineral water, which resulted in higher conductivity value Scatena (2000) explained the differences based on various factors such as agricultural and industrial activities and land use, which affect the mineral contents and thus the electric conductivity of the water. Conductivity does not have direct impact on human health. It is determined for several purposes such as determination of mineralization rate (existence of minerals such as potassium, calcium, and sodium) and estimating the number of chemical reagents used to treat this water (Kavcar, Sofuoglu, & Sofuoglu, 2009; Cidu, Frau, & Tore, 2011; Muhammad, Shah, & Khan, 2011; Khan, Shahnaz, Jehan, Rehman, Shah, & Din, 2013).

High conductivity may lead to lowering the aesthetic value of the water by giving mineral taste to the water. For the industrial and agricultural activity, conductivity of water is critical to monitor. Water with high conductivity may cause corrosion of metal surface of equipment such as boiler. It is also applicable to home appliances such as water heater system and faucets. Food-plant and habitat-forming plant species

© 2021 Global Journals

are also eliminated by excessive conductivity (Jia, Qin, & Liu, 2010; Katsoyiannis & Zouboulis, 2013; Tuzen & Soylak, 2006; Heydari & Bidgoli, 2012; Pillay, Hoo, & Chu, 2001).

h) Total Hardness (mgCaCo$_3$/l)

Generally, the total hardness is function of the geology of the area with which the surface water is associated. Hardness has no known adverse influences health; nevertheless, some evidence has been given to point out its impact on heart diseases (Wright, 2010). From the result depicted in Table 4.3, sample 1 and 3falls within the approved water quality limit of NAFDAC and SON, with total hardness ranging from 82 to 85*mgCaCo$_3$/l*. The result from sample 2 had a hardness of 105*mgCaCo$_3$/l,* which is above the approved limit of 100*mgCaCo$_3$/l* by NAFDAC and SON.

i) Total Dissolved Solid [TDS] (mg/l)

Usually, high total dissolved solid [TDS] concentration is attributed to presence extreme anthropogenic activities along the water course and runoff with high suspended matter (WHO, UNESCO & UNEP, 2001). All the sampled water sources in the study area had levels of TDS content which met the WHO guideline standard value of 1000 *mg/l* as well as NAFDAC and SON guideline standard. The TDS content values ranged from 50.3 to 60.6*mg/l.* Sample 1 had a TDS level of 60.6*mg/l,* while sample 2 had a TSD level of 50.7*mg/l.* sample 3 had a TDS concentration of 50.3*mg/l.*

j) Total Suspended Solid [TSS] (mg/l)

Normally, soil erosion considers the source for suspended solids that comes from the surrounding area caused by human activities. For example, rainy season stations recorded the highest value of TSS due to the rainy days which stimulated serious erosion on the two sides of the riverbanks along the river (Al-Badaii, Shuhaimi-Othman, & Barzani, 2013).TSS content levels of the samples ranged from 2.0 to 14.0*mg/l.* The least level was recorded in sample 2 and 2 respectively (2.0*mg/l*). The highest level was obtained at sample 3 (14.0*mg/l*) which above 10*mg/l* allowable NAFDAC and SON limit for drinking water quality.

k) Chloride Ions, [Cl$^-$](mg/l)

The presence of Cl$^-$ in the waters is generally due to the nature of lands traversed. They are found in almost all-natural waters (Degbey, Makoutode, Agueh, *et al.,* 2011).WHO guideline values recommend the range of values from 0.5*mg/l*and 2*mg/l* for free residual chlorine in drinking water, while NAFDAC and SON recommend the concentration value of not above 250*mg/l*. A maximum value of 45.0*mg/l* was measured in sample 1, while sample 2 measured a value of 23.5*mg/l*, while a minimum value of 19.9 was measured in sample 3. These results fall within the acceptable limit for drinking water quality by NAFDAC and SON, but above the recommended values by WHO guideline value.

l) Sulphate (SO$_4$mg/l)

According to Hem (1985), the major sources of sulphate in rivers are rock weathering, volcanoes, and human activities such asmining, waste discharge, and fossil fuel combustion process. The presence of sulphate in drinking water can cause noticeable taste, and very high levels might cause a laxative effect in unaccustomed consumers (WHO, 2004). According to WHO (2008) guideline values recommend sulphate concentration of 250*mg/l*. Similarly, NAFDAC and SON recommended the same concentration value (250*mg/l*) limit for drinking water quality. From the results presented in Table 4.3, all sampled water falls within this limit, with a maximum value of 35.7*mg/l* measured in sample 1, 29.0*mg/l* in sample 2, and a minimum value of 19.9*mg/l* measured in sample 3 respectively.

m) Dissolved Oxygen [DO] (O$_2$ mg/l)

Dissolved oxygen refers to the level of free, non-compound oxygen present in water (Horne & Goldman, 1994; Makwe & Chup, 2013). The dissolved oxygen content of water is influenced by the source, raw water temperature, treatment and chemical or biological processes taking place in the distribution system. Healthy water should generally have dissolved oxygen concentration of above 6.5*mg/l* and 8*mg/l* (Horne & Goldman, 1994). There is no health-based guideline value recommended for dissolvable oxygen in drinking water, however, low dissolvable oxygen can encourage microbial reduction of nitrate to nitrite and sulphate to sulphide, giving rise to anaerobic condition, putrefaction and development of foul odour while very high levels of dissolvable oxygen may exacerbate corrosion of metal pipes (WHO, 2012; Makwe & Chup, 2013). In the case of allowable limit, there is none recommended by NAFDAC and SON. The results obtained from all sampled water were within the recommendations made by Horne and Goldman (1994). From the results of the samples of water (Table 4.3), it can be observed that sample 1 had a dissolvable oxygen measure of 6.9*mg/l*, while sample 2 recorded dissolvable oxygen of 7.1. Sample 3 recorded a measure of dissolvable oxygen of 6.8*mg/l* respectively.

n) Biological Oxygen Demand (BOD mg/l)

According to Gasim, Ismail, Wan, Muhammad, and Marlia, (2005), the concentrations of biological oxygen demand varied from 2.4 to 19.8mg/L which are considered high if compared to this study, given the results obtained from the sampled water and the allowable limits by NAFDAC and SON (5*mg/l*). The results revealed a maximum biological oxygen demand measure in sample (7*mg/l*), which is above NAFDAC and SON allowable limit. However, the measure of biological oxygen demand from sample 2 and 3 fall

© 2021 Global Journals

within the allowable limits of NAFDAC and SON (5*mg/l* respectively).Usually, biological oxygen demand concentration continuously increases because of natural plant decaying process and other contributors that increase the total nutrient in water bodies such as fertilizer, construction effluent, animal farm, and septic system (Al-Sabahi, 2007).Biological oxygen demand concentration is directly associated with dissolvable oxygen concentrations. High value of biological oxygen demand shows decline in dissolvable oxygen. This phenomenon is common as identified in many previous researches (Rosli, Gandaseca, Ismail, & Jailan, 2010).

o) Chemical Oxygen Demand (CO mg/l)

The chemical oxygen demand (COD) concentrations of water samples were fluctuating between minimum of 7.8*mg/l* (sample 3), and 8.2*mg/l* (sample 2) and a maximum of 13.5*mg/l* (Sample 1). It is important to note here that sample 2 and 3 are within the standard allowable limit of NAFDAC and SON (<10*mg/l*), while sample 1 was above the allowable limit (13.5*mg/l*> 10*mg/l*). Generally, the lower chemical oxygen demand level indicates a low level of pollution, while the high level of chemical oxygen demand points out the high level of pollution of water in the study area (HACH, 2003). Moreover, a wide usage of chemical and organic fertilizer and discharge of sewage affect chemical oxygen demand level, while the high chemical oxygen demand pointing to a deterioration of the water quality is attributed to the discharge of municipal effluent (Eisakhani, & Malakahmad, 2009).

IV. Conclusion

Water quality in simple terms pertains to the physical, chemical and microbiological characteristics of water relative to its specific use. The study found that well water source was the most polluted source of water, as a result of exposure to different materials making it prone to high concentration of physical, chemical and microbiological properties. By way of qualitative description, well water has the highest concentration of physical and microbiological properties of water. With NAFDAC and SON permissible guidelines for potable water not adhered to be people, it is therefore the collective responsibility of both private and public sectors for ensuring effective management of water sources for greater sustainability. Furthermore, the research has provided explanatory information on the quality status (Physical, Chemical and Microbiological) parameters of three common sources of drinking water in Gosa, FCT, Abuja.

References Références Referencias

1. UN-Water (2013). An increasing demand, facts and figures, UN-Water, coordinated by UNESCO in collaboration with UNECE and UNDESA. Retrieved from http://www.unwater.org/water-cooperation-2013/en/.
2. World Health Organization [WHO] (2011). Guidelines for Drinking-Water Quality, WHO Press, Geneva, Switzerland, 4th Ed.
3. Dissmeyer, G. E. (2000). Drinking water from Forests and Grasslands, South Research Station, USDA Forest Service, Ashville, NC, USA.
4. International Agency for the Research on Cancer, [IARC], (1993). Ber yllium, Cadmium, Mercury, and Exposures in the Glass Manufacturing Industry, vol. 58 of IARC Monographs on the Evaluation of Carcinogenic Risk to Humans, IARC, Lyon, France.
5. Jia, W., Li, C., Qin, K., & Liu, L. (2010). Testing and analysis of drinking water quality in the rural area of High-tech District in Tai'an City." *Journal of Agricultural Science, vol. 2, no. 3, pp. 155–157.*
6. Katsoyiannis, I. A., & Zouboulis, A. I. (2013). Removal of uranium from contaminated drinking water: a mini review of available treatment methods. *Desalination and Water Treatment, vol. 51, no. 13–15, pp. 2915–2925.*
7. Tuzen, M., & Soylak, M. (2006). Evaluation of metal levels of drinking waters from the Tokat-black sea region of Turkey. *Polish Journal of Environmental Studies, vol. 15, no. 6, pp. 915–919.*
8. Nollet, L. M. L. (2000). *Handbook of Water Analysis,* Marcel Dekker, New York, NY, USA.
9. Dissmeyer, G. E. (2000). *Drinking water from Forests and Grasslands.* South Research Station, USDA Forest Service, Ashville, NC, USA.
10. Heydari, M. M., & Bidgoli, H. N. (2012). Chemical analysis of drinking water of Kashan District, Central Iran," World Applied Sciences Journal, vol. 16, no. 6, pp. 799–805.
11. HACH, DR/500 (2003). *Spectrophotometer Procedure Manual.* Hach Company, Loveland, Colo, USA.
12. Eisakhani, M., & Malakahmad, A. (2009). Water quality assessment of bertam river and its tributaries in Cameron Highlands, Malaysia. *World Applied Sciences Journal, vol. 7, pp. 769–776.*
13. Gasim, M. B., Ismail, B. S., Wan, N. A., Muhammad, I. Y., & Marlia, M. H. (2005). Water quality assessment of the Semenyih River basin langor, Malaysia. *Journal Biosains, vol. 16, no. 1, p. 95.*
14. Al-Sabahi, E. M. (2007). *A Study of Surface Water and Ground water Pollution in Ibb City, Yemen [Ph.D. thesis],* Universiti Kebangsaan Malaysia, Selangor, Malaysia.
15. Rosli, N., Gandaseca, S., Ismail, J., & Jailan, M. I. (2010). Comparative study of water quality at different peat swamp forest of Batang Igan, Sibu Sarawak, *American Journal of Environmental Sciences, vol. 6, no. 5, pp. 416–421.*
16. Hem, J. D. (1985). Study and interpretation of the chemical characteristics of natural water. *US Geological Survey Water-Supply Paper, vol. 2254.*

Global Journal of Science Frontier Research (H) Volume XXI Issue II Version I Year 2021

© 2021 Global Journals

17. World Health Organization [WHO] (2004). *Sulphate in Drinking-Water*. Background Document for Development of WHO Guidelines for Drinking-water Quality.
18. World Health Organization [WHO] (2008). *Guidelines for Drinking Water Quality, 3rd Ed. Vol 1.* Incorporating the First and Second Addenda, WHO, Geneva: ISBN 978 92 4 154761.
19. World Health Organization [WHO] (2012). *Guidelines for Drinking Water. (2nd Ed) Vol. 2. Health Criteria and other Supporting Information.* Geneva, Switzerland, pp. 940-949.
20. Makwe, E. & Chup, C. D. (2013.) Seasonal Variation in Physio-Chemical Properties of Groundwater around Karu Abattoir. *Ethiopian Journal of Environmental Studies and Management Vol. 6(5) 489-497.*
21. Horne, A. J., & Goldman, C. R. (1994). Limnology, 2nd edition. McGraw-Hill, Inc. 576 pp.
22. Degbey C., Makoutode M., Agueh V., et al. (2011). French studies and research papers/health-factors associated with well water quality and prevalence of waterborne diseases in the Municipality of Abomey-Calavi (Benin). *Health 21(1):47-55.*
23. World Health Organization [WHO] (2011). *Guidelines for Drinking Water Quality, 4th edition.* WHO Press, Geneva, Switzerland
24. Scatena, F. N. (2000). *Drinking water quality, in Drinking Water from Forests and Grasslands: A Synthesis of the Scientific Literature,* G. E. Dissmeyer, Ed., General Technical Report SRS-39, p. 246, Department of Agriculture, Southern Research Station, Asheville, NC, USA.
25. Kavcar, P., Sofuoglu, A., & Sofuoglu, S. C. (2009). A health risk assessment for exposure to trace metals via drinking water ingestion pathway," *International Journal of Hygiene and Environmental Health, vol. 212, no. 2, pp. 216–227*.
26. Cidu, R., Frau, F., &Tore, P. (2011). Drinking water quality: comparing inorganic components in bottled water and Italian tap water. *Journal of Food Composition and Analysis, vol. 24, no. 2, pp. 184–193*.
27. Muhammad, S., Shah, M. T., & Khan, S. (2011). Health risk assessment of heavy metals and their source apportionment in drinking water of Kohistan region, Northern Pakistan. *Micro chemical Journal, vol. 98, no. 2, pp. 334–343, 2011.*
28. Khan, S., Shahnaz, M., Jehan, N., Rehman, S., Shah, M. T., & Din, I. (2013). Drinking water quality and human health risk in Charsadda district, Pakistan. *Journal of Cleaner Production, vol. 60, pp. 93–101*.
29. Jia, W. C.,Qin, L. K., & Liu, L. (2010). Testing and analysis of drinking water quality in the rural area of High-tech District in Tai'an City. *Journal of Agricultural Science, vol. 2, no. 3, pp. 155–157.*
30. KatsoyiannisI. A., & Zouboulis, A. I. (2013). Removal of uranium from contaminated drinking water: a mini review of available treatment methods. *Desalination and Water Treatment, vol. 51, no. 13–15, pp. 2915–2925*.
31. Tuzen M., & Soylak, M. (2006). Evaluation of metal levels of drinking waters from the Tokat-black sea region of Turkey. *Polish Journal of Environmental Studies, vol. 15, no. 6, pp. 915–919*.
32. HeydariM. M., & Bidgoli, H. N. (2012). Chemical analysis of drinking water of Kashan District, Central Iran .*World Applied Sciences Journal, vol. 16, no. 6, pp. 799–805.*
33. Pillay, M., Hoo, T., & Chu, K. K. (2001). *Drinking water quality surveillance and safety in Malaysia for WHO workshop on drinking water quality, surveillance and safety.* Country Report, Engineering Services Division, Ministry of Health, Kuala Lumpur, Malaysia.

© 2021 Global Journals