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SHORT COMMUNICATION

Assessment of the water quality from hand dug wells and boreholes water in Rogo Local Government Kano State, Nigeria

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ABSTRACT

Water quality analysis was conducted using physico chemical and biological parameters on water samples collected from boreholes (B1, B2, B3 and B4) and hand dug wells (W1, W2, W3 and W4) eight wards Rogo Town, Kano Sate, Nigeria in order to determine its suitability for drinking in enriched in WHO standards for drinking water. Fourteen (14) water quality parameters, namely pH, temperature, total alkalanity, total acidicity, dissolved oxygen (DO), 5-day biochemical oxygen demand (BOD_5), total coliform, odour, taste, color, clarity, total hardness calcium (Ca),and magnesium (Mg). Results obtained showed that the mean pH readings ranges from 6.2 – 6.6 and temperature of the sample ranges from 24 °C – 27 °C. Total alkalinity ranges from 63-80mg/l, total acidity showed a great variation between the hand dug wells and borehole samples. DO concentrations of hand dug wells were less than that of boreholes and did not meet the WHO unit (5 -14 mg/l). The BOD_5 of both boreholes and hand dug wells water sample were within the WHO standard (2 – 4 mg/l) for drinking, except borehole water sample from B4 with BOD value of 1.9. The water samples from both sources were odorless, colorless, tasteless and clear for consumption.

***Keywords*:** Dissolved Oxygen, total acidity, total hardness, water quality, water pollution

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1. INTRODUCTION

Water is an indispensable material for a multitude of domestic and industrial purpose and naturally exists in three main sources, rain water, ground water, ground water and surface water (Kushreshtha, 1998). As it percolates into the earth it is subjected to some purification actions by the numerous chains of pervious and impervious strata or layers. Some level of purity is achieved on turbidity, color, odour and taste where it reaches the surface through wells, shafts, springs, borehole (Bashiru, 2004). Clean and fresh drinking water is essential for human and other life forms and access to it is important to every community (Adeyemi 2007). According to the World Health Organisation (WHO 2006), about 1.1 billion people lack access to drinking water supply. In most cities, town and villages in Nigeria, valuable man-powers are spent on seeking and fetching water, often of doubt quality from distance (Hafiz et al., 2009). Ground water serves a cheaper source of domestic water supply that includes natural springs, wells and boreholes. Reports that in many arid and semi-arid areas of Africa boreholes water is a mean of coping with water deficiencies in areas where rainfall is scarce or highly seasonal and surface water is extremely limited. Borehole water is a ground water available in an aquifer obtained by installing pumps to draw the water to the consumers. The major problems of boreholes is the chemical content of the ground water, which must be analyzed to ascertain if these dissolved products are within the permissible limits for consumption. Adeyemi (2007) reports high level of ions in ground water from developing countries.

Hand-dug wells provide a cheap and low-tech solution and are excavation of the ground digging to reach the water table. Since shallow aquifers are exploited, Mustapha and Nabegu (2014) revealed that the well may be susceptible to possible contamination from surface water including sewage and leachate. Kushreshtha (1998) stressed that the quality of ground water resources depend on the management of human waste, as well as the natural physico-chemical characteristics of the catchment areas. Colour, odour, taste, pH, total hardness, total coliforms and other dissolved ions have been reported as indices of water contamination (Bashiru, 2004). The significance of maintaining proper water quality to human health has been reported by Hafiz et al., (2009) contamination was considerably for both open and rope- pump shallow wells. 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, according to WHO (2006), depletion of dissolved oxygen in water supply can encourage the microbial reduction of nitrate to nitrite and sulfate to sulfide. Alkalinity and calcium management also contribute to the stability of water and control its aggressiveness of pipe and appliance. Stated that organism that can live in the presence of oxygen (or without it) are known as facultative anaerobes. In contrast obligate anaerobes are organisms which do not like oxygen. A principal microbiological concern in underground water is the health hazard posed by faecal contamination of the four types pathogens (virus, bacteria, protozoa, and parasite) contain in human excreta.

Rogo Town is densely populated; poor sanitation habit and lack of enforcement of environmental sanitation laws have contributed immensely to the pollution of water sources. Thus this investigation into the better supply source of water for use is essential to inform public of the safest source. This research was aimed at water quality analysis of sample obtained from four randomly selected hand dugs wells and boreholes. This study aim at assessing the suitability of hand dug and boreholes water for drinking purpose.

2. MATERIALS AND METHODS

2. 1. Study area and sites

Rogo Town is located at the western part of the Kano State. It has an estimate land area of about 802 km^2 with an estimate population of 227,742 (NPC, 2006). It is situated within coordinates 11°34′ N, 7°50′ E /11°, 56 N 72, 8°33′. Two distinct seasons i.e the rainy season (May – October) and dry seasons (November to April) prevailed the study area. The study locations were selected from spatially which include Gimba (W1), Unguwar Bilya (W2), Ashiru Gabas (W3) and Unguwar Ado (W4) for hand dug wells water sample and boreholes water sample from Jatau (B1), Mato (B2), Tsakiyar Gida(B3) and Zamfarawa (B4). These sites were chosen to reflect human activity like schools, motor parks grazing areas etc.

2. 2. Sample collection and analysis

Water samples for physicochemical analysis and coli form count were collected using dry clean plastic bottles according to standard procedures. Samples from wells were labeled as W1, W2, W3 and W4 while those from boreholes as (B_1), (B_2), (B_3), and (B_4). Temperature and pH were recorded as described by APHA (2005). Both Dissolved oxygen and biochemical oxygen demand were estimated using standardized sodium thiosulphate as described by APHA (2005). Total hardness pinch Erich Rome black T indicator was used, determination of calcium and magnesium (moroxide indicator) were titrimetrically done with EDTA until colour change. Microbial analysis for bacterial count was done using the double strength broth with treated and untreated water to show acid and gas production.

3. RESULTS ANALYSIS

There were no pronounced temperature variations between the sites of water sampling. However, highest temperature recording of 27 °C was at Well W1 and Borehole B3 while Borehole B1 and Well W4 recorded the least temperature value with 24 °C (Table 1). Highest pH of 6.6 was recorded at W1 and least pH of 6.2 at W4 and B2. The highest DO was recorded at B1 and least at B3, B4 and W4 and the highest value of BOD_5 concentrations was recorded at W3 with lowest concentration at B4 with insignificant differences between the sites. Data from total alkalinity, acidity and total hardness shows little effect of samples sources on the measurements. All other physicochemical parameters of colour, taste, clarity and odour were uniform for all sites and there were no records of total coli forms from any of the samples. The cations Ca^{2+} and Mg^{2+} were also recorded evenly from the sites. The taste, colour, clarity and odour of both well and borehole waters were within the acceptable limit by various standard for drinking purpose.

The physicochemical relationship was investigated using contour mapping to reveal the influencing parameters under study. The relationship between temperature and pH as presented in Figure 1 reveals temperature affect the concentration of pH. Temperature increases to 27 °C, the pH value of 6.6 was recorded. The pH of a solution is the concentration of hydrogen ions, expressed as a negative logarithm. It reflects the acidicity or alkalinity of a solution. Water with a pH of 7 is neutral, lower pH levels indicate increasing acidicity, while pH level higher than 7 reveal increasingly alkaline solution (Mustapha 2017).

Table 1. Physicochemical parameters under study.

Parameters	(B1)	(B2)	(B3)	(B4)	(W1)	(W2)	(W3)	(W4)
pH	6.4	6.2	6.3	6.4	6.6	6.4	6.3	6.2
Temp °C	24	25	27	26	27	26	25	24
Total alk. mg/l	70	66	63	68	60	63	80	76
Total acid.	3	4	5	5	6	7	2	3
DO	4.4	4.0	3.0	3.0	3.4	4.1	4.3	3.0
BOD_5	2.3	2.1	2.0	1.9	2.2	2.3	3.0	2.0
Odour	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Taste	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Colour	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Clarity	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Total hard	70	69	70	68	69	71	68	70
Ca^{2+}	60	59	60	58	59	61	58	60
Mg^{2+}	3.21	3.0	3.20	3.1	3.0	3.21	3.1	3.21
TCC	ND	ND	ND	ND	ND	ND	ND	ND

TCC = Total Coli form, ND = Not Detected

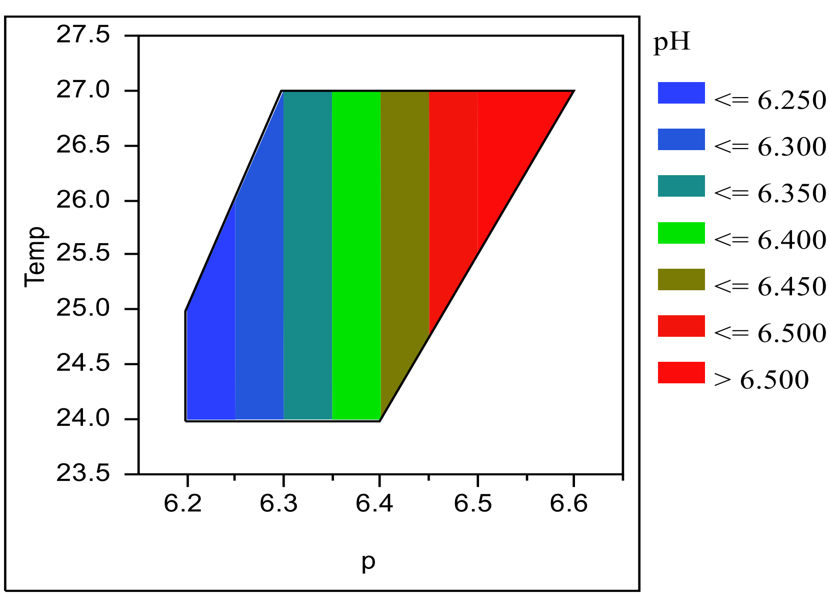

Fig. 1. XY Relationship between temperature and pH

Moreover, temperature affects the DO and BOD_5 as presented in Fig 2. Rapid population growth and associated urban development have also led to the release of enteric human pathogens in to well and borehole waters which increases the concentration of BOD_5 and reduce the available DO in both well and borehole waters. Human activities have negatively influenced water quality and aquatic ecosystem functions (Mustapha and Aris 2012).

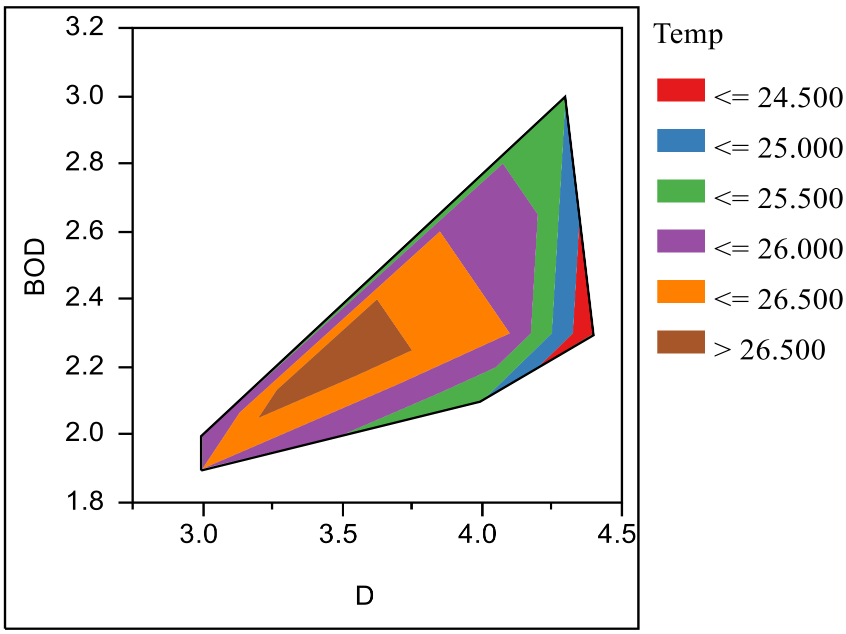

Fig. 2. XYZ Relationship between temperature, DO and BOD_5

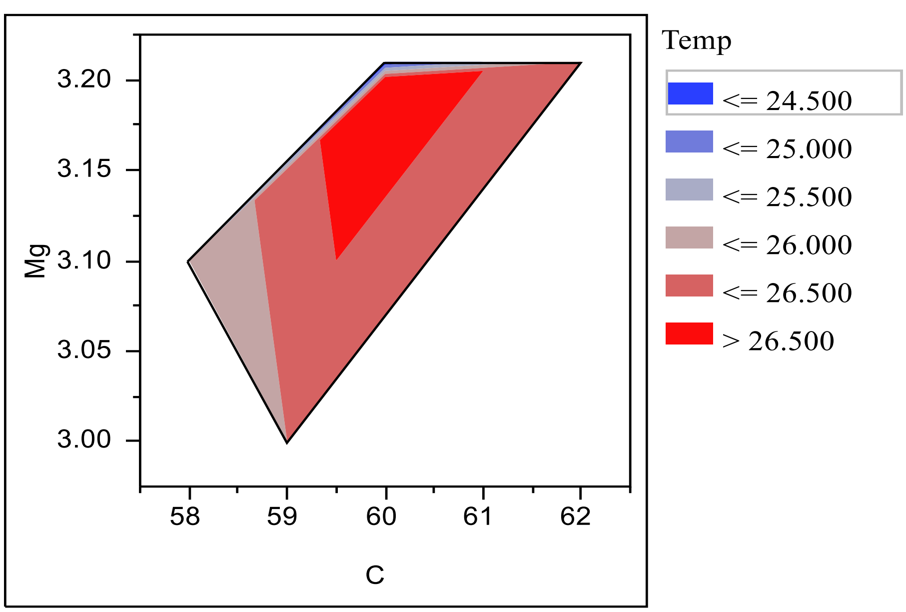

Fig. 3. XYZ Relationship between temperature, Mg and Ca.

Moreover, The XYZ relationship between temperature, Ca and Mg was investigated to identify the inter-relationship between these parameters. Figure 3 show that temperature has a profound effect on the concentration of Ca and Mg. The release of Ca and Mg ions into well and borehole water could have been the result of weathering products of younger granitic outcrop and silicate minerals most probably from feldspar mineral associated with basement complex rock and weathering of catchment which is a function of both geology of the catchment region and precipitation (Salihu et al. 2016; Ibiam, 2017; Gubter, 2009; Rüdiger, 2012). Independent sample t test was conducted to test the null hypothesis that there are no significant differences between the well water and borehole water. As depicted from Table 3 pH F (1.929, $p > 0.05$), Temperature F (0.000, $p > 0.05$), TK F (0.577, $p > 0.05$), TA F (0.852, $p > 0.05$), DO F (0.838, $p > 0.05$), BOD_5 F (0.246, $p > 0.05$), TH F (0.766, $p > 0.05$), Ca F (0.973, $p > 0.05$). The result revealed that there are no significant differences between the well water and borehole water in Rogo Local Government Area of Kano State, Nigeria.

Table 2. Descriptive statistics of parameters used in independent sample t'test

	Types of Water	Mean	Std. Dev.	Std. Error Mean
pH	Well Water	6.3	0.08165	0.04082
	Borehole Water	6.375	0.17078	0.08539
Temp	Well Water	25.5	1.29099	0.6455
	Borehole Water	25.5	1.29099	0.6455
TK	Well Water	66.75	2.98608	1.49304
	Borehole Water	69.75	9.74252	4.87126
TA	Well Water	4.25	0.95743	0.47871
	Borehole Water	4.5	2.38048	1.19024
DO	Well Water	3.6	0.71181	0.3559
	Borehole Water	3.7	0.60553	0.30277
BOD_5	Well Water	2.075	0.17078	0.08539
	Borehole Water	2.375	0.43493	0.21747
TH	Well Water	69.25	0.95743	0.47871
	Borehole Water	69.5	1.29099	0.6455
Ca	Well Water	59.25	0.95743	0.47871
	Borehole Water	59.75	1.70783	0.85391
Mg	Well Water	3.1275	0.09845	0.04922
	Borehole Water	3.13	0.101	0.0505

Table 3. Parameters of water.

Parameters	F	t	df	Sig. (2-tailed)
pH	1.929	-0.792	6	0.458
Temp	0.000	0.000	6	1.000
TK	22.74	-0.589	6	0.577
TA	12.50	-0.195	6	0.852
DO	0.667	-0.214	6	0.838
BOD_5	2.090	-1.284	6	0.246
TH	0.500	-0.311	6	0.766
Ca	1.000	-0.511	6	0.628
Mg	0.007	-0.035	6	0.973

4. CONCLUSIONS AND RECOMMENDATIONS

The results from this research showed that the water samples were odorless with normal taste and color. All samples were clear with no sediment. pH range of the samples (6.2 – 6.6) was within the world health organization recommended limits of 6.5 - 8.5 WHO (2006). The values for the temperature (24 °C to 27 °C) are fair enough for drinking water. The total alkalinity of the water samples showed that hand dug well water sample from W_3 comply with WHO (80 mg/l to 120 mg/l), while the total alkalinities of all the other samples do not comply with WHO (2006). Neither of the samples from these sources met the WHO limits of 5 – 14mg/l for Dissolved oxygen. However, Five day BOD readings were within the limits for drinking water WHO (2006). An exception is seen in the B4 borehole where the 1.9 mg/l BOD were not met. Hardness range from 68-71 mg/l with sample from W2 being harder than other samples with highest value of 71 mg/l. Values for Ca analyzed from both sample sources range from 58-60 mg/l which did not comply with WHO (2006) standard of 75 mg/l. The WHO acceptable limit for Total Coliform count in any drinking water is 0.00 mg/L (WHO, 2006). All the samples were within the WHO standard because the TCC were not detected from all the samples. It can be generalized that given the findings on the tested water quality parameters, there are minimal health risks that can be associated with the samples. This is true as the absence of total coliforms and fair conditions in other parameters with no serious extremes. There were no significant differences in water quality from well water and borehole water in Rogo town irrespective of location. However, water from borehole could be better for use as it is a closed system compared to the well (from deep aquifers). Well water on the other hand is harder. It is therefore recommended that standard measure be taken by the appropriate authorities to ensure proper treatment of the waters to safeguard the health of the innocent consumers. Hygienically approved method for waste disposal (both solid and liquid) should be explored and adopted to check the possibilities of indiscriminate land dumping of potentially hazardous waste materials. Water users should also be on watch and to report every high level of any physical or chemical properties to the appropriate authorities in water to sustained water quality for consumption.

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