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Research Article

ASSESSMENT OF CHEMICAL PARAMETERS OF BOREHOLE AND WELL WATER FOR DOMESTIC USE IN YOBE STATE, NIGERIA

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ABSTRACT

Life of all living organisms in the environment depends on having access to clean, safe, and sufficient quality water. Since it is linked to a number of health conditions, water quality issues are complicated and varied, demanding immediate worldwide attention and action. This study assessed the quality of chemical components of borehole and well water for domestic use in Yobe State, Nigeria. One Local Government Area headquarter from each senatorial zone of the State was purposively selected, three different sites for sample collection were randomly identified, samples of water from borehole and well were collected and subjected test using 9in1 test strip that measure KH, pH, CO3 GH, NO2, NO3, TCL, CL and H25, However,pH, CO3 GH, NO2, NO3, and CL were reported in this study. The findings of the study revealed that pH in most of the sites for both borehole and well water were below the set standard, Nitrates in some of the site were also above the set limit and also the water collected from the sites were hard. No statistical significant difference was observed between borehole and well water in the concentration of pH, CO3 NO2, NO3, and CL. However, statistical significant difference was observed in the GH between borehole and well water ($P<.05$). Itwas therefore concluded that the concentration and level of pH, Nitrates and GH were not within the permissible limits of National Drinking Water Standard Quality and that of World Health Organisation.

Keywords: Chemical, Components, Borehole, Well, Water, Domestic.

INTRODUCTION

One of the most significant and plentiful components of the environment is water, it is essential for the survival and growth of all living things, as well as for the health of natural ecosystems and the advancement of humanity. Water can be used for many different purposes, including drinking, cooking, industry, agriculture, and leisure. It transports essential nutrients and also helps in dissolving organic substances in human body. Only Earth has 70% water on the globe, however, as a result of the growing human population, industrialization, the use of fertilizers in agriculture, and other human-made activities, it has become very contaminated with numerous dangerous chemicals, which has a detrimental impact on all living things (Baffa, 2022). Due to the enormous rise in population, the quick rate of urbanization, the intensification and extension of agricultural methods, and other factors, man has had a significant influence on the environment during the past 10 years (Olubukola, 2021). The further stressed that this has caused resources to gradually and continuously degrade, notably surface water, which is a key means of disease transmission. Water-borne illnesses cause an estimated 1.8 million deaths annually in underdeveloped nations, especially among children.

Specific physical, chemical, and biological aspects of water and how they affect the survival, reproduction, growth, and management of aquatic life serve as the basis for defining its features and quality (Aduwo and Adeniyi, 2019). When water has a lot of minerals, it becomes hard. Magnesium and calcium ions may enter water from rock and soil, and their presence in water is the major source of hardness. Groundwater often has a higher hardness level than surface water which can be assessed with a colorimeter or test strip (Sensorex, 2021). Water can be contaminated by various chemical which very detrimental health of human as revealed by the study of Aduwo and Adeniyi (2019) where it was reported that the water from all the locations of the study was contaminated with various chemical above the permissible level of World Health Organisation therefore, deemed dangerous for consumption. The study ofAndong*et al.,* (2019), reported that the factors examined were water temperature, pH, dissolved oxygen (DO), chemical and biological oxygen demand (COD, BOD), potassium, magnesium, sodium, calcium, phosphate, nitrate, chloride, and sulphate. The findings revealed that the majority of the anions (phosphate, nitrate, chloride, and sulphate), cations (calcium, magnesium, and sodium), water temperature, and BOD and DO were below the quality standard levels.Basic chemistry and temporal fluctuations may have been primarily influenced by natural elements such geology, terrain, weather, hydrology, water levels, and biological activity.

The following parameters were examined in a research by Baffa (2022) on the physico-chemical examination of water: pH, Electric Conductivity, Turbidity, TDS, Sulphate, Total Chlorine, Nitrate, Nitrite, Magnesium, Manganese, Molybdenum, Chromium, Iron, Copper, Lead, Nickel, and Cadmium. The result revealed that the water was potable and that it could be used for household, agricultural, and industrial purposes as it was found not contaminated by physical and chemical pollutants.

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On the examination of chemical, physical and biological pollutants from dams in Saudi Arabia, the study of Albaggar*et al.,* (2021) revealed that nearly three-fourths (75%) of the water samples taken from dams had levels of Mn, NO3, and TDS that were over Saudi limits for acceptable levels. The study further revealed that the average concentrations of Fe, Mn, SO_4, NO_3, and NO_2 were 3065.00, 0.10, 0.89, 68.25, 17.91, and 0.016 mg/L, respectively, for total dissolved solids. However, the finding showed that the average pH of the water samples was, nonetheless, 7.95 +/- 0.66, which is still within the permitted range established by national and international norms. Additionally, the finding of the study of Albaggar*et al.,* (2021) further showed that the total dissolved solids for irrigation water quality surpassed the usual Food and Agriculture Organization limits. Without any discernible geographical variations across dams and sites as a whole, coliform bacteria were found in 37.5% of dams. There are correlations between turbidity, pH, SO4 and NO3, CO2 levels, and coliform bacteria. The study suggested that agricultural practice as well as animal and human wastes deposited into dams via rainfall and flash floods may be responsible for the elevated concentrations of measured parameters in dams.

Study was conducted on quality of water in build reservoirs by Arora and Arora (2020) where it was revealed that the quality of water stored for domestic use stored in built-in reservoirs is subjected to a number of factors, including toxic substances and microbial contaminants from rainfalls, air, dead plants, animals, soil, and household wastes. Similarly, the study of Dagim*et al.,* (2017) reported that means plots were utilized for further structure detection while single component analysis of variance (t test) was employed to identify potential differences between borehole and spring water. The majority of the samples out of the total samples analysed meet the water quality standards set by the Ethiopian Limit, WHO, and USEPA. to have a pH that was somewhat acidic and over the set limit. The three boreholes contained high concentrations of Fe and Mn that exceeded the limit established by the WHO. It was discovered that spring water sources were superior to borehole water sources for drinking.

MATERIALS

Samples of water were collected using universal containers through the use composite location method, where samples were collected from different locations at the same time. 9in1 water quality test strip was used to analyse the samples of water collected from the area of the study. The test strip used for the analysis measures nine parameters of water that predict water quality, these are KH, pH, CO_3 GH, NO_2, NO_3, TCL, CL and H_{25}.

METHODS

All the Local Government Areas (LGA) in the three senatorial zones in Yobe State were clustered into Cluster A-C, One LGA headquarter was purposely selected from each senatorial zone, three different locations were randomly selected for sample collection, three replications were also made. The samples were collected from borehole and well water, and were analysed through the use of 9in1 water quality test strip. The chemical parameters reported in this study were pH, Co_3, GH, NO_3, NO_2 and CL. The results obtained were compared with the National Standard of Drinking Water Quality (NSDWQ) and World Health Organisation (WHO) standard to assess the Drinking Water Standard Quality (DWQS) in the study area.

RESULT AND DISCUSSION

The findings of the study are presented in a tabular form as follows:

Table 1: Well Water Quality Parameters in Yobe State, Nigeria

	GASHUA			POTISKUM			DAMATURU			DWSQ	
	Site A	Site B	Site C	Site A	Site B	Site C	Site A	Site B	Site C	NSDWQ	WHO
pH	7.2	6.2	6.1	6.2	6.8	7.0	7.6	6.2	6.8	6.5-8.5	6.5-8.5
CO_3(mg/l)	40	20	0	0	20	40	20	0	20		
GH	250	250	250	250	425	425	250	250	250	150	100
NO_3(mg/l)	0	0	0	10	10	25	0	0	0	10	50
NO_2(mg/l)	1	0	1	1	0	1	0	0	1	.2	
Cl(mg/l)	2	0.5	0	0	0	0.5	0.5	0.5	1	100	250

Fieldwork, 2023

Table 2: Borehole Water Quality Parameters in Yobe State, Nigeria

	GASHUA			POTISKUM			DAMATURU			DWQS	
	Site A	Site A	Site C	Site A	Site B	Site C	Site A	Site B	Site C	NSDWQ	WHO
pH	6.2	6.8	6.1	6.2	6.2	6.8	6.2	7.6	6.2	6.5-8.5	6.5-8.5
CO_3(mg/l)	0	0	10	0	0	20	20	20	10		
GH	250	250	250	250	425	425	250	250	250	150	100
NO_3(mg/l)	10	0	0	10	10	10	0	10	0	10	10
NO_2(mg/l)	0	0	1	1	1	1	1	0	0	.2	
Cl(mg/l)	0.5	0	0.5	0	0	0	1	1	1	100	250

Fieldwork, 2023

Table 3: Difference in Observed Water Quality between Borehole and Well Water

S/N	Parameter	Water Source	Sites	Mean	SD	t-cal	Sig.
1.	pH	Borehole Water	9	6.5111	.48074	.828	.420
		Well Water	9	6.7222	.59535		
2.	CO_3(mg/l)	Borehole Water	9	8.8889	9.27961	-1.467	.162
		Well Water	9	17.7778	15.63472		
3.	GH	Borehole Water	9	208.3333	62.50000	-2.434	.027
		Well Water	9	288.8889	77.16775		
4.	NO_3(mg/l)	Borehole Water	9	8.8889	13.64225	.722	.481
		Well Water	9	5.0000	8.66025		
5.	NO_2(mg/l)	Borehole Water	9	.5556	.52705	.000	1.000
		Well Water	9	.5556	.52705		
6.	Cl(mg/l)	Borehole Water	9	.4444	.46398	-.424	.677
		Well Water	9	.5556	.63465		

Alpha level 0.05

Table 1 and 2 revealed the DWQP in Yobe State, the table shows that pH in site B, C, Site A and site C for well water and sites A, C; A, B; A and C for Borehole water in Gashuwa, Potiskum and Damatururespectively were below the standard set by National Standard of Drinking Water Quality in Nigeria (NSDWQ) and the one set by World Health Organisation which indicates that the water in the said location is acidic it was also indicated the more the pH is low the corrosive the water is. The table also revealed that the water in all the sites of the study were hard as it is above the standard of 150 and 100 set by NSDWQ and WHO even though there is no serious health consequences associated with water that is hard, it is reported that it is beneficial health from aesthetic viewpoint, however it was reported that exposure to hard water may exacerbate Eczema and increased soap absorption in hard water leaves metals, soap and salt residues on the skin and can skin irritation (Netsol Water, 2023). Only site C in Potiskum LGA that shows the nitrate above the standard set by both NSDWQ and WHO of 10mg/l for well water, however, for borehole water none is above the standard. When nitrate is above the acceptable limit, it is linked with health risk of methemoglobinamia, a disease which interferes with oxygen transport in the blood; it also indicates that contaminants are present in the water (Netsol Water, 2023).The tables further revealed that Nitrite (NO_2)was above the limit set by NSDWQ of .2 in five out of the 9 sites of the study; it is also associated with Cyanosis and Asphyxia (blue baby in Infant under 3months. The table also show that Chloride in all the sites were not above the standard set by NSDWQ and WHO as all were below 50 and 250.

The findings contradicts that of Baffa (2022) were it was reported that the tested water was suitable for domestic, agricultural and industrial activities. So also that of Kadmiel (2021) where the findings indicated that all the parameters examined were within the permissible level. However, the findings were in line with the finding of the study of Adong (2019) where it was reported that some parameters were below while others were above the permissible limits which suggest pollution. In the same vein, the findings were also supported by that of Olusola*et al.,* (2017); Tawati*et al.,* (2018) were it was reported that some of the parameters examined were below or above the permissible levels which indicates a certain level of pollution.

Table 3 revealed the summary of independent sample t-test on the difference between drinking water from borehole and well, the table shows that no significant difference was observed between the sources of drinking. The only significant difference that was observed between the sources of water was from General Hardness (GH) with the calculated P-value of .027 less than the alpha value of .05.

CONCLUSION

The study concluded that concentration and level of some chemical components of drinking water in the study area were above the set standard by NSDWQ and WHO. Nitrates were above the acceptable limit, pH was also below the neutral level so also the GH. The study further suggested that both well and borehole water were the same in the level and concentration of chemical, the only observed difference was in GH level.

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