

Full Length Research Paper

Assessment of Groundwater Quality of Mai'adua Local Government, Katsina State, Nigeria

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The analysis of some physicochemical parameters of well water from various locations at Mai'Adua Local Government Area of Katsina State, Nigeria, was conducted. The aim of the study was to analyze some of the parameters and compare the results with standard values recommended by WHO. The samples taken from six different locations at least 1km apart revealed that the study area has a mean of Turbidity 2.4NTU, Colour 5.8Hazen unit, Temperature 27.7⁰C, PH 6.98, Alkalinity 5.3mg/L, Hardness 39.08mg/L, Biochemical oxygen demand (BOD) 0.13mg/L, Total dissolved solid (TDS) 221.75mg/L, Suspended solids (SS) 12.5mg/L, Conductivity 7.64µs/cm. By observing the results, it was shown that the parameters from the water samples were within WHO permissible limits which satisfies the safety limit for its use for various purposes like domestic, agricultural, industrial and so on.

Keywords: Ground water, Metropolis, Biological oxygen demand, Alkalinity, Pollution.

INTRODUCTION

Rapid urbanization, especially in developing countries like Nigeria, has affected the availability and quality of groundwater due to waste and effluent disposal practice, especially in urban areas. This can be evidenced from African and Asian countries that experience rapid industrial growth, thus, making environmental conservation very difficult (Agarwal and Animesh, 2011). Researchers' workers such as Kalyana *et al.*, (2014), Adefemi and Awokunmi (2010), Ezeribe, Oketunda and Shaato (2011) who studied some physicochemical parameters of ground water from industrial areas of Pydibheemavaram, Vizianagaram and Andhra Pradesh Districts, India have indicated such. Eight ground water samples were taken from boreholes and open wells and were analysed for pH, EC, Chloride, Total Alkalinity, Total Dissolved Solids (TDS) and Total Hardness. The results were compared with WHO standards. Similarly, the study of Murhekar and Gopalkrushna (2010), who carried out, an assessment of physico-chemical status of ground water samples in Akot city also analyzed for

temperature, pH, TDS, dissolved oxygen turbidity, total alkalinity, total hardness, Ca²⁺, Mg²⁺, Na⁺, K⁺, Cl⁻, F⁻, NO₃⁻, SO₄⁻ and PO₄⁻ of open and Bore wells. No hazardous level of contamination was detected in all samples analysed except few sites with little contamination. The physicochemical and bacteriological studies on ground water have also indicated some level of contamination as reflected in the report of Ahmed and Eyaife (2014) who conducted same physicochemical and bacteriological quality of ground water at Abubakar Tatari Ali polytechnic Bauchi, Nigeria. The results revealed that the samples contained some contaminants like bacterial contaminants in excess of the recommended limits set by NSDWQ and WHO.

The correlation between the level of various parameters analysed showed positive correlation as indicated by the study of Chandrakar, (2017), Gabriel, *et al.* (2010), who developed linear regression equations to predict the concentration of water quality among the various parameters analysed. The TDS and EC have perfect correlation coefficients whereas Na⁺ and Cl⁻ were also highly correlated in all the water sources. Furthermore, while Ca²⁺ and HCO₃ are highly correlated in both the shallow and deep groundwater they have relatively lower correlation coefficients in the surface

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water samples. It was equally observed that Mg^{2+} , Ca^{2+} , NO_3^- , Cl^- and Fe are highly correlated with EC in surface water samples. The data also indicated that apart from surface water bodies Ca^{2+} , NO_3^- , Cl^- and HCO_3^- are poorly related with electrical conductivity at 5% level of significance.

MATERIALS AND METHODS

The Study Area

Mai'adua is a Local Government Area in Katsina State, Nigeria, it's situated along Latitude $13^{\circ}11'26''N$, and Longitude $8^{\circ}12'42''E$. Mai'Adua is sharing a border with the Republic of Niger from the North, Zango from East, Daura from South, Mashi and Dutsi from West. Its headquarters are in the town of Mai'Adua on the A2 highway. It has an area of 528 km² and a population of 201,178 as at the 2006 census (NPC, 2006) (Figure 1 and 2).

Sampling

The samples were collected from Mai'Adua Local Government; the sample was collected from six different wells, at least 1km apart. The water was collected in pre-cleaned polythene containers, labeled with place, date and time of collection.

RESULTS

Results of the analysis of water quality parameters are shown in Table 1.

DISCUSSION

Temperature

Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. The average temperatures of water samples obtained from the wells are close to each other as seen in table 1, thus reflecting the average temperature of the environment during the period of sampling. The temperature values are slightly above normal room temperature. It is influenced by solar radiation in the study area.

pH

pH is a term used to express the intensity of the acidic or alkaline condition of a solution. The pH values of water

samples varied between 6.7 to 7.0 and were found to be within the limit of 6.5-8.5 as prescribed by WHO as standard for drinking water.

Colour

The colour of drinking water reflects the presence of suspended matter. Therefore the more suspended matter in the water the more intense the colour. However, in exceptional circumstances, colour may arise naturally from the presence of colloidal Iron/Manganese in water. The values of the 5Hazen unit were recorded for all the well water samples except for the evening sample at Ramin Dauda with 15Hazen unit which is due to the type of soil in the area, that is rich in clay. All the values did not exceed those recommended by the WHO of 15Hazen unit as the standard for drinking water.

Electrical Conductivity

Electrical conductivity (EC) is a measure of water capacity to convey electric current. The water samples collected from the wells have a relatively low EC value which ranges from 3.67 μ S/cm to 18.2 μ S/cm. All the values were within the recommended limits of 1000 μ S/cm set by WHO (Emmanuel and Nuruddeen, 2012).

Total Dissolved Solids

Total dissolved solids refer to materials that are completely dissolved in water. Dissolved minerals, gases and organic constituents may produce aesthetically displeasing colour, taste and odour.

From the results obtained, TDS values ranged from 154mg/L to 277mg/L. the values are lower than the recommended value of 500 mg/L by the national guideline and standards for water quality in Nigeria and the WHO specification limits of 1000mg/L for drinking water (Edimeh et al., 2011).

Alkalinity

The alkalinity of water is its capacity to neutralize acid. The alkalinity values for all the samples analysed were found to be within the range 3.3 to 11mg/L. These values did not exceed the 150mg/L limits prescribed by W.H.O. as standard for drinking water (Ezeribe et al., 2014)

Total Hardness

The total hardness for all the samples analysed is between 15 to 106mg/L. The highest value recorded was

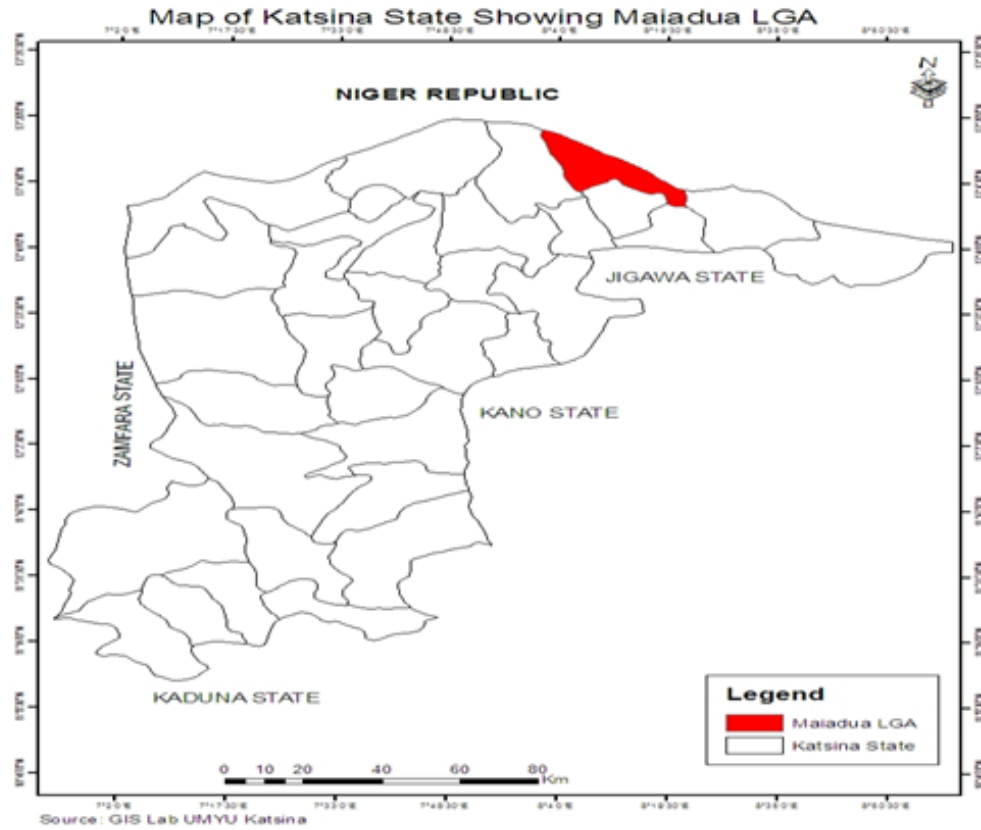


Figure 1. Map of Katsina state, Nigeria

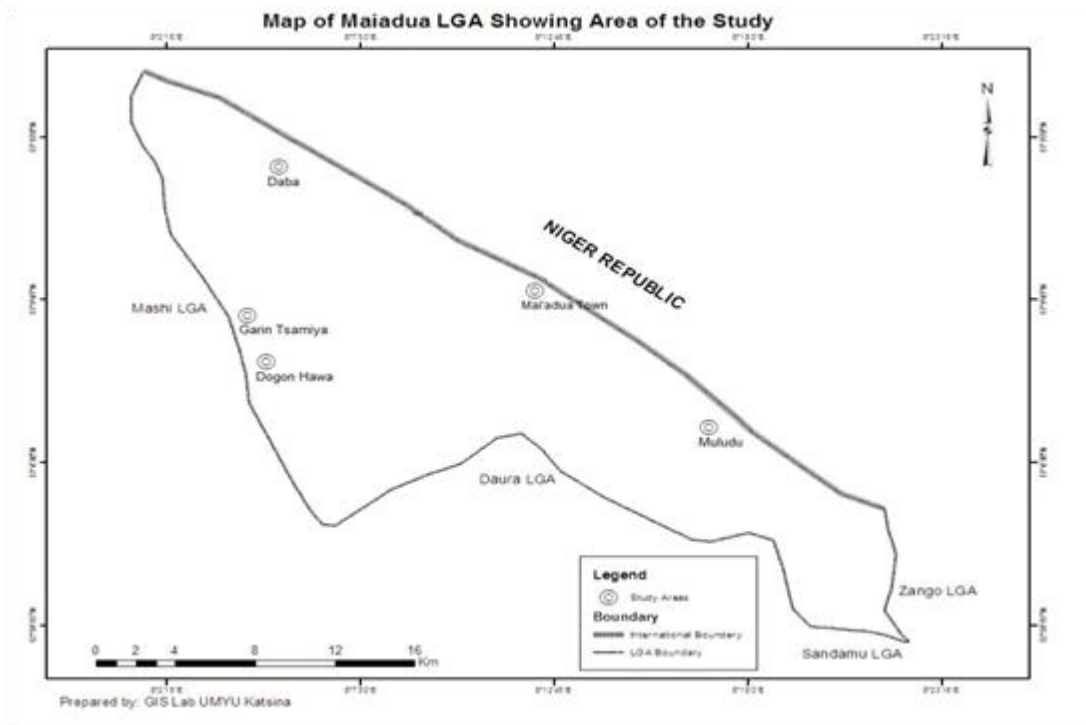


Figure 2. Map of the study area

Table 1. Results of the analysis of water quality parameters

PARAMETERS	Garin Tsamiya	Daba	Garin Kaji	Muludu	D/Hawa	Rafin Dauda	WHO
Temperature ($^{\circ}$ C)	27.6	27.6	27.80	27.70	27.50	27.8	
pH	6.90	7.00	6.80	6.70	7.00	7.50	6.5-8.5
Colour (Hazen)	5.00	5.00	5.00	5.00	5.00	5.00	15
Electrical Conductivity (μ s/cm)	7.00	3.67	8.20	4.07	4.70	18.20	5
Total Dissolved Solids (mg/L)	267	190.50	232.00	211.0	154	277	500
Total Suspended Solids (mg/)	9.00	11.50	3.50	10.00	6.00	33.00	20
Hardness (mg/L)	28.9	15.00	41.50	27.00	17.08	104.50	150
Alkalinity (mg/L)	3.30	4.40	4.25	4.35	5.17	10.50	150
Turbidity (NTU)	3,29	2.90	0.00	3.06		5.12	5
Biological Oxygen Demand (mg/L)	0.05	0.11	0.09	0.19	0.32	0.20	5

in Ramin Dauda well, which is 106mg/L. The high value could be due to contamination from the waste materials deposited around the area. All the values are within 150mg/L limit as prescribed by W.H.O.

Turbidity

Turbidity is the technical term referring to the cloudiness of a solution and it is a qualitative characteristic which is imparted by solid particles obstructing the transmittance of light through a water sample. Turbidity often indicates the presence of dispersed and suspended solids like clay, organic matter, silt, algae and other microorganisms. From the result obtained, the Turbidity values of water samples were within 0.00 to 6.00NTU. Only the results obtained from R/Dauda was above the maximum acceptable limits of 5 NTU recommended by WHO, the high level of turbidity in the area may be due to the nature of the soil.

Biochemical Oxygen Demand (BOD)

Micro-organisms use the atmospheric oxygen dissolved in the water for biochemical oxidation of organic matter, which is their source of carbon. The BOD is used as an approximate measure of the amount of biochemically degradable organic matter present in water.

The biochemical oxygen demand (BOD_5) recorded in the study area was between 0.05mg/L to 0.2mg/L. All the values obtained from the study showed that they are within the 5mg/L limit prescribed by WHO.

CONCLUSION

From the results obtained, it shows that the quality of all the samples analyzed was within the maximum permissible limit prescribed by WHO, except for Turbidity at R/Dauda which was above the permissible limit. It is therefore, concluded that the water in the area under investigation is safe for consumption and other domestic activities.

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