



Comparative Analysis of Some Water Quality Indices in Dutsin-Ma Town, Dutsin-Ma Local Government Area of Katsina State, Nigeria

David, Davida, Akut, Y. B.
Department of Science Education,
Ahmadu Bello University, Zaria
Department of Geography,
Federal College of Education, Zaria

ABSTRACT

The study comparatively analyzed water quality in Dutsin-ma town, Katsina State. Some selected parameters which are indicators of water quality examined are pH, conductivity, Total Dissolved Solutes and nitrate ions. The data required for the study comprises of sampled water from wells, pipe borne (tap), water vendors, dam, and borehole respectively. World Health Organization (WHO) and Standard Organization of Nigeria (SON) water quality values were used to compare the results of the selected elements and samples that were analyzed. The samples were collected in the dry season on the 25th of February, 2018 in the afternoon. A total of ten (10) samples were collected, two for each water source: wells, pipe-borne (tap), water vendors, dam, and borehole respectively. Both descriptive and inferential statistics were used for the analysis of the data generated. The descriptive statistical tool was used to summarize the laboratory results of the analyzed samples through the use of frequency tables. Results indicate that only tap water is acidic (4.61) and fall short of WHO standards. For conductivity, borehole in Dutsin-ma has the highest electrical conductivity of 774.50 μ /cm while water from the dam has the lowest electrical conductivity of 50.25 μ /cm. tap water has the lowest amount of nitrate ions among the other sources of sample collected which is 0.70mg/l. All the other sources of water have nitrate levels lower than the WHO recommendations.

ARTICLE INFO

Article History

Received: August, 2019

Received in revised form: September, 2019

Accepted: December, 2019

Published online: December, 2019

KEYWORDS

Water, Quality, Indices, Dutsin-Ma, Katsina.

INTRODUCTION

Water is very essential and indispensable for the sustainability, wellbeing and growth of any community. Human beings can continue for days without food but absence of water for few days may lead to death (Yusuf & Shuaibu, 2012). The essential nature of water to man's daily survival and activities in terms of quantity and quality from time to time has been on the increase (Jidauna et al, 2014). Unfortunately, the quality of drink water in developing countries like Nigeria is susceptible to toxins as a result of effluents and pollutants (Dabi and Jidauna, 2010; Odoh and Jidauna, 2013).

The demand for quality potable water which is essential to human life and the health of the environment is growing all over the world, so also is the risk of water contamination. Two major classifications of water sources whose quality are assessed by chemist are surface water (Dam, Stream, River, Ponds, Lakes,) and groundwater (Wells and Borehole). The reason is that surface

water is prone to contamination and is generally reported to have poor quality. Groundwater on the other hand is more reliable for domestic uses and agricultural (irrigation) needs (Okeola et al, 2010).

Water resources available in Nigeria can be broadly classified into fresh water and marine water resources. The former constitute the fraction that should ideally be accessible to all communities. They comprise of water from lakes, hand dug wells, taps, boreholes streams, rivers and their plains wetlands and those available in underground reservoirs. Fresh water represents the main sources of safe water for household, agricultural and even industrial applications. They are required for drinking, cooking, recreational activities farming, fishing etc., making them unavoidable for the evolution of society and civilization (Orubu, 2006). However, today the fresh water sources available to the local inhabitants are either unsafe or difficult to obtain and are severely stressed by poor management, this makes access to clean water a serious problem, in some instance

women and children need to walk for hours to fetch drinking water. Survey conducted between 2007 and 2010 (Dabi & Jidauna) indicates that, there are many villages in Dutsin-ma Local Gov't that have never seen the so called treated tap water" in their place.

Similarly, Oki and Akana (2016) accessed the quality of groundwater in Yenegoa and observed variations in the chemistry of water samples drawn from various boreholes which may be attributed to various processes both natural and artificial, e.g., the chemistry of the aquifer material, the rate of groundwater flow, permeability of the aquifer, land use for irrigation and waste disposal. Analysis showed that all parameters from all the borehole samples were within the WHO limits for potable water except pH and magnesium. pH in all BH samples showed water was slightly acidic, also magnesium was above the stipulated limit in all BH samples when compared with WHO (2006). Also, the quality of open well water for domestic use was assessed by Ugya, Umar and Yusuf (2015) in Kaduna metropolis and concluded that all water samples analyzed were polluted with respect to Iron (Fe +2) and Magnesium (Mg +2) while sample R3 was polluted with respect to Chloride, the pH of sample R1 was slightly too acidic.

Dutsin-ma is one of the local governments in Katsina state which is confronted with the challenge of poor quality of water both for domestic and other uses. The town depends on both surface and groundwater to satisfy the need of the population for water. The people get water from

wells, rivers, dams, boreholes and streams. But it has been observed that indiscriminate waste disposal coupled with bad land practices are common scenes that constantly pollute surface water and consequently lead to the degrading of water quality in the area. Therefore, the need for reliable, safe, high quality water for drinking and other domestic uses by the people have made this study necessary. This study therefore, seeks to find out the quality of groundwater for domestic consumption in Dutsin-ma.

The Study Area

Dutsin-ma local government is situated at the central part of Katsina state, with an estimated area of 552.323km² and is bounded from the north by Kurfi, Charanchi and Kankia local government. Matazu from the southeast, Safana and Dan-Musa from the west, Dutsin-ma LGA lies on the latitude 12°26'N and longitude 07°29'E (Abaje, Ati, & Iguisi, 2012).

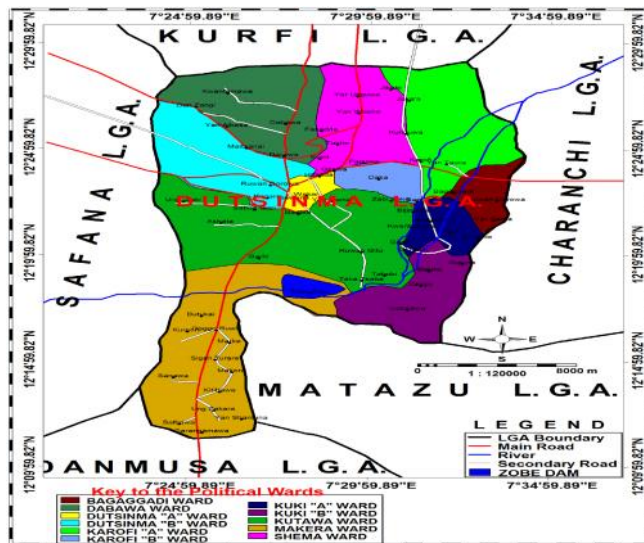


Fig.1. Map showing Dutsin-ma Local Government

Historically, Dutsin-ma town is reported to have originated from a settlement founded by a migrant hunter called MA. Who decided to make MA Granite a place of abode, the term Dutsi means rock in Hausa, and is a possessive maker while MA is the name of the founder. Therefore, Dutsin-ma simply means rock. Granite has a modifying effect on local groundwater conditions. Large well pointed granite masses are capable of storing considerable quantities of rainwater through percolation.

Source: Geography Department, federal College of Education, Zaria

The economic activities of the people are predominantly farming, rearing of animals, trading, and hunting. According to the 2006 population census Dutsin-ma has a population of about 169 829 people as at 2006 national population census.

MATERIALS AND METHODS

The major data source for the study was largely drawn from primary sources, which comprises of the field samples that were collected from the different water sources such as wells, pipe borne (tap), water vendors, dam, and boreholes. Eventually, the samples were taken and analyzed in the laboratory and the results discussed.

The secondary sources are from the different published works: World Health Organization (WHO) and Standard Organization of Nigeria (SON) water quality values were used to compare the results of the selected elements and samples that were analyzed. For the assessment of water quality in Dutsin-ma LGA, the World Health Organization (WHO), and Standard Organization of Nigeria (SON) respectively were considered.

Table1: Selected chemical parameters and standards for water quality

S/No.	Parameters	Unit	WHO standards	SON standards
1.	pH	-	6.5 – 8.5	6.5 – 8.5
2.	Conductivity	u/cm	1500	1000
3.	Calcium (Ca)	mg/l	75	75
4.	TDS	mg/l	500	500
5.	Chloride ion (CL)	mg/l	50	50
6.	Nitrate ion (NO3)	mg/l	400	250

Source: Authors' Field Survey, 2018

Method of data collection

The method of data collection for this research is the empirical survey which involves both primary source (water samples) and secondary sources.

Water Sampling Procedure

Most geographic field research problems are sample studies in the sense that it is not possible to obtain information for the spectrum of a given area, usually only certain phenomena are selected for the study from a range of hundreds of possibilities (Wunbury&Aldried, 1986 as cited by Jidauna et al., 2014).

The samples that were taken from the study area (Dutsin-ma town) covered only the dry season, and the water samples were taken on the 25th of February, 2018 in the afternoon. A total of ten (10) samples were collected, and two for each sampled identify. Two samples were randomly taken from each of the water sources: wells, pipe-born (tap), water vendors, dam, and borehole respectively. Samples from wells were taken within the urban area around Hayin-gada and Yan Daka; Pipe-born from Abuja road; Water vendors around Angwan

Katangaru and FUDMA campus; dam from the upper and lower courses of the stream/ river; and borehole from Angwan Kuddu and Angwan Katangaru respectively. All the samples were taken in the dry season.

The traditional grab sampling method involving the spot collection of water samples were used and water collected stored in clean plastic bottles. Sterilized plastic bottles were used for the collection of water samples and the covers of the bottles were aseptically removed. The bottles were then filled with water, leaving small air space and simultaneously covering back with the cap.

The materials used for the procedure include the following: -

Glassware/Apparatus/Equipment

Burette

Pipette

Retort stand

Beakers 500ml

Conical flask

Water bath

Hot plate

Test tube

pH, conductivity, temperature meter (Suntex TS-2).

Measurement of Water Quality

The complexity of quality as a subject is reflected in the many types of measurements of water quality indicators. Some of the simple measurements can be made on-site as temperature, pH, dissolved oxygen, and conductivity, in direct contact with the water source in question. More complex measurements are made in a laboratory setting which requires water samples to be collected, preserved, and analyzed at another location. For the purpose of this study, only some

elements were examined. These include: pH, chloride, turbidity, nitrogen, calcium, calcium, hardness.

Method of Data Analysis

Both descriptive and inferential statistics were used for the analysis of the data generated. The descriptive statistical tool was used to summarize the laboratory results of the analyzed samples through the use of frequency tables.

RESULTS AND DISCUSSION

Table 2: Concentration of selected elements found in water

Water Sources	pH		Conductivity		TDS		Nitrate ions		Chloride ions	
	WHO	Average	WHO	Average	WHO	Average	WHO	Average	WHO	Average
Tap	6.5 - 8.6	4.61	1500	93.95	500	56.15	50	0.70	400	39.05
Bore Hole	6.5 - 8.6	6.95	1500	774.50	500	474	50	1.05	400	163.3
Vendor	6.5 - 8.6	7.29	1500	126.25	500	75.45	50	1.05	400	37.275
Well	6.5 - 8.6	7.19	1500	683.15	500	413.1	50	1.05	400	150.875
Dam	6.5 - 8.6	7.19	1500	50.25	500	30.2	50	1.05	400	31.95
TOTAL		33.23		1728.10		1048.9		4.90		422.45

Source: Fieldwork, 2018

The Results of pH from Water Sources

From the table, samples collected from borehole, dam, water vendors and wells have an average pH value 6.9 to 7.2, meaning the water is neutral, except for the tap water which is acidic (4.61), falling short of the WHO standards. This may not be unconnected with the use of chlorine for treatment before distribution to consumers. pH is the measure of the active hydrogen ion (H⁺) concentration in water, and it represents the relative alkalinity or acidity of water. The pH scale lies between 0 and 14. On a typical pH scale, the medium is increasingly more acidic from pH of 0 to 7, and more alkaline from pH of 7 to 14. At pH of 7, the medium is neutral. The normal range for pH for surface water is 6.5 to 8.5. Water with acidity less than 6.5 could be considered acidic, soft and corrosive, while water with pH of more than 7 is alkaline.

Electrical Conductivity from Water Sources

Conductivity of a substance is defined as the ability or power to conduct or transmit heat, electricity, or sound. Its units are Siemens per meter (S/m). In water and ionic materials or fluids, a net motion of charged ions can occur. This phenomenon produces an electric current and is called ionic

conduction. Results of samples collected shows that borehole in Dutsin-ma town has the highest electrical conductivity of 774.50μ/cm while water from the dam in Dutsin-ma town has the lowest electrical conductivity of 50.25 μ/cm. Both, however, are within the WHO limits.

Total Dissolve Solute from Water Sources

Total dissolved solutes in water originate from natural sources, sewage, industrial waste water, urban run-off, and chemicals used in water treatment processes. Total dissolved solutes are a combination of organic salts and little quantity of organic matter that are dissolved in water. Sample tested for borehole and well has the highest concentration of TDS 474mg/l and 413.1while dam has the lowest concentration 56.15mg/l. it is worthy of note that the underground water sources (borehole and well) have the highest concentration of TDS, probably from natural sources such as dissolved salts and minerals.

The Results of Nitrate Ions from Water Sources

The results of the analyzed sample collected in the study area shows that tap water has the lowest amount of nitrate ions among the other sources of sample collected which is 0.70mg/l. All

the other sources of water have nitrate levels lower than the WHO recommendations.

The Results of Chloride ions from Water Sources

From the field work and the result from the sample, borehole water in Dutsin-ma town has the highest amount of chloride ions compared to other sources which is 163.30mg/l, while sample collected from Dam has the low concentration of chloride ions which is 31.95mg/l.

Chloride is an acid-base balance, water balance, component of stomach acid (hydrochloric acid). One of three powerful electrolytes required by the body (the other two being sodium and potassium), chloride performs a number of important functions within the body. It makes up about 0.15 percent of our body weight. It stimulates the production of hydrochloric acid, adjusts metabolic alkalosis resulting from disease or chronic use of diuretic agents. It stimulates the liver to act as a filter to separate waste and then eliminate it from the body. A deficiency in chloride would result in an imbalance in the normal acid-base balance, which in extreme cases could be characterized by nausea, vomiting, diarrhea, and perspiration.

CONCLUSION

The study focuses on quality assessment of groundwater for domestic consumption in Dutsin-Ma town. The results reveal that most water sources used for domestic purposes are below the recommended standard values by WHO and SON. However, possible causes of contamination and pollution of water sources within Dutsin-Ma urban area can be attributed to urbanization, poor waste management system, farming close to water sources (dam), uncovered wells, and dumping of refuse on drainage channels (e.g. gutters and river). Though, the findings from the study show that most of the concentrations of the elements are within tolerable limits of WHO and SON, water from wells and taps show high lead ions concentration which is higher than what is recommended by WHO and SON.

RECOMMENDATIONS

1. The Dutsin-ma water board should improve on their techniques for water purification and treatment particularly for lead ions.
2. Domestic water use (drinking) in Dutsinma should be done with caution, as some of the elements are above recommended standards (WHO and SON).

3. Frequent monitoring of water quality from other sources should also be considered in order detecting early signs of hazards as the result of accumulation in the body.

REFERENCES

- Abaje, I. B., Ati, O. F. and Iguisi, E. O. (2012). Recent Trends and Fluctuations of Annual rainfall in the Sudano-Sahelian Ecological Zone of Nigeria: Risks and Opportunities. *Journal of Sustainable Society*, 1(2); 44-51.
- Dabi, D. D. & Jidauna, G. G. (2010). Climate change and local perception in selected settlement in the Sudano-Sahelian region of Nigeria. *Journal of Environmental Sciences and Resources Management*, 2.
- Jidauna, G. G., Dabi, D. D., Saidu, B. J., Ndabula, C., & Abaje, I. B. (2014). Chemical Water Quality Assessment in selected Location in Jos, Plateau State, Nigeria. *Research Journal of Environmental and Earth Sciences*, 6(5): 284-291.
- Odoh, R., & Jidauna, G. G. (2013). The Spatial Effect of Rusty Roof on Water Quality in Otukpo Local Government Area of Benue State, Nigeria. *International Journal of Marine, Atmosphere, & Earth Science*, 1(1)
- Oki, A.O, Akana, T.S. (2016). Quality Assessment of Groundwater in Yenagoa, Niger Delta, Nigeria. *Geosciences*, 6(1): 1-12
- Okeola, F. O., Kolawole, O. D., & Ameen, O.M. (2010). Comparative study of physic chemical parameters of water from a River and its surrounding wells for possible interactive effect. *Advances in environmental Biology* 4(3): 336-344.
- Orubu, C. (2006). Water Resources, Environment and Sustainable Development in Nigeria. *Journal of Human Ecology*. 19(3): pp 161-181
- Ugya, A.Y., Umar, S.A. and Yusuf, A.S. (2015). Assessment of Well Water Quality: A Case Study of Kaduna South Local Government Area, Kaduna State Nigeria. *Merit Research Journals*. Vol. 3(3) pp.039-043.
- World Health Organization (2006). Guidelines for drinking water quality. 3rd Edition, WHO Geneva
- Yusuf, Y.O., & M. I. Shuaib (2012). The Effect of Wastes Discharge on the Quality of Samaru Stream, Zaria, Nigeria, Ecological Water Quality - Water Treatment & Reuse, Dr Voudouris (Ed.), Effect of wastes dischargge on the quality of Samaru stream in Zaria, Nigeria.