Global Scientific JOURNALS

GSJ: Volume 9, Issue 10, October 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

APPRAISEMENT OF WATER QUALITY INDEX FOR MOST PATRONIZED BORE WELLS IN THE THREE WARDS OF ZING METROPOLIS, NIGERIA

S. Munta[1], B. T. Fyinbu[2] and A.B. Istifanus[3]

[1]Department of Civil Engineering, Taraba State University (TSU), Jalingo, Nigeria

[2]Undergraduate student, Department of Civil Engineering, Taraba State University, Jalingo, Nigeria.

[3]Department of Agric. and Bio-Resources Engineering, TSU,

Jalingo, Nigeria

[1]Corresponding Author:
muntjen2000@gmail.com

ABSTRACT

In this study, water samples were collected from bore wells in (A1, A2 and B) wards in Zing metropolis, which were conveyed to Taraba State Water and Sewerage Corporation, Environmental Laboratory, Jalingo, Headquarters Nigeria, for analysis. It was found that only Temperature (A1=34, A2=35 and B=34) were outside the acceptable limit of WHO/NSDWQ. The results of the water parameters were inputted into Microsoft excel, 2016 to determine the water quality index of each of the three locations. The results of the water quality index show that all the sources of the water are rated good. Base line approach method was employed to compare the water parameters for sources of bore well water A1 in terms of percentage differences and it was found that fluoride has the greatest level of influence on the water quality index by 157.46%, while the influence of TDS is 0.

Keywords: Water, Quality, jndex, borewells, parameters, rating, Zing, metropolis

1. INTRODUCTION

Water indeed is an essential component of life [1] The need for water in the day to day activities of man include for cooking, washing, drinking and for industrial activities [2]. For the chemist therefore the quality of water is very important to ensure that it is potable for drinking [3]. Two major sources of water whose quality are assessed by chemists are the surface (streams, rivers, ponds, lakes) and ground waters (wells, boreholes). The reason is that surface waters are prone to contamination because it was reported that surface waters are generally poor in quality [4]. Ground waters on the other hand are more reliable for domestic and agricultural irrigation needs ([4]. [5] and [6]). In fact a study revealed that well waters are the main source of water in Akure, Ondo state [7], an indication of how people generally desire this kind of water source for use in their daily activities especially as surface water is not accessible to some communities. Due to runoff into groundwater, they also tend to experience some level of contamination owing to leaching from waste dumps and industries [8]. Owing to lack of potable water in most rural areas in Nigeria, the people tend to depend on streams and river water for domestic use and other activities

[9], The contamination of these water sources comes from different sources in the environment. They include effluents from industries, abattoir activities and pesticides and from animal faecal discharges into surface and ground waters due to washing by rain falls [10].

[11] stated that the use of water quality index (WQI) in determining the quality of both surface and ground water- bodies have increased tremendously since the initial WQI developed by [12], and improved version by [13]. They also stressed that WQI has the ability to provide a number, simple enough for the public to understand, that states the overall water quality at a certain location and time using the measured values of selected water quality parameters. In most cases, it is used to determine the potability of surface water. Various methods have been employed to determine the water quality index but the one adopted by ([11, 14, 15]); which is the weighted arithmetic mean method of evaluation of water quality index is used in this study

The present study reviewed some of the important water parameters of the three most patronised wells within the three Wards in Zing metropolis. The choice of the water parameters is based on the information presented by [16], that the most important Water Quality Parameters were Temperature, Turbidity, PH and Electrical Conductivity/Salinity. Salinity occurs in groundwater when formation materials dissolved in water hence it is being replaced by Total Dissolved Solids (TDS) in this research. Fluoride was also included based on the research conducted by ([17, 18]) that there exist Fluoride in some groundwater wells in most wards in Zing Local Government Area (LGA), Nigeria, above acceptable limit by World Health Organisation (WHO)/Nigeria Standard of Drinking Water Quality (NSDWQ). [17,18] only conducted their studies on Physico-Chemical water parameters of some wells within some wards in Zing LGA, Nigeria; this research will focus on the determination of WQI of most patronized wells within the three wards of Zing metropolis.

2. MATERIALS AND METHODS

Area Study

Zing lies between longitude 10^0 and 11^0 E and latitude 9^0 and 10^0 N of the equator with land area of 1,030km^2 and estimated population of about 127,363 ([19]. The area falls within the transitional belt of savanna in North eastern Nigeria. It has a temperature range of 25^0 C to 33^0 C in both rainy and dry seasons with good climatic conditions for agricultural activities. The study area is endowed with a lot of natural resources such as mountains, natural grasslands, rocks, peasant and commercial farmers, shallow streams and good weather conditions for habitation. The study area (see Figure 1) covered three wards in Zing metropolis which are Zing A1, Zing A2, and Zing B.

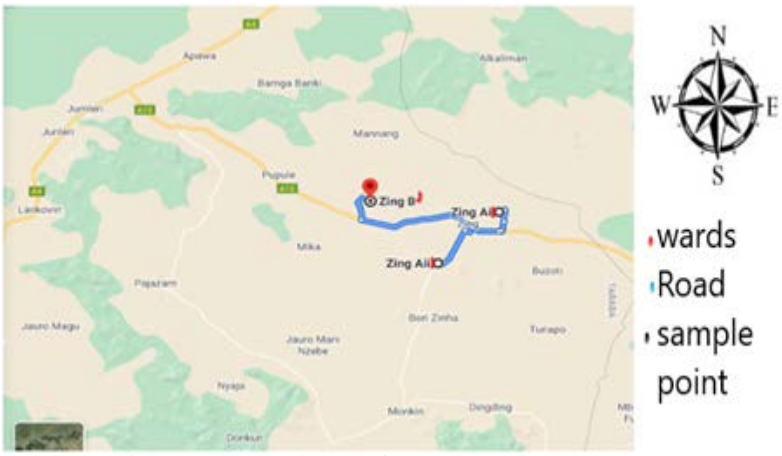

Table 1: Bore wells location

S/N	WARDS	LOCATION	LABEL
1	Zing (A1)	Jidonko	A1
2	Zing (A2)	Angwan Kuka	A2
3	Zing (B)	Sabon-Layi	B

Figure 1: Map of the study area

Physico-Chemical Analysis of Water Sample

well water samples were collected from the most patronized wells in wards of Zing metropolis, as presented in Table 1. The water samples were collected with plastic containers which were initially subjected to pre-treatment by washing with dilute HCL (0.05ml), rinsed using distilled water air-dried in a dust proof environmental condition. At the point of collection, the containers were again rinsed with the appropriate samples thrice. Thereafter, the water samples are introduced into the containers and corked securely. The laboratory analysis of the different physical and chemical parameters of the water sample were done at the Taraba State Water Suppy and Sewarage Corporation (TAWASCO), Environmental Laboratory, Jalingo, Headquarters and according to the methods prescribed in [20, 21]. The physico-chemical parameters examined include: Temperature (Temp, ^{0}C), Turbidity (Turb, NTU), pH, Total Dissolved Solids (TDS, mg/l) and Fluoride (Fluo, mg/l).

Calculation of Water Quality Index

This study made use of five (5) physico-chemical properties of water in the calculation of the WQIThe evaluation of the WQI was made on the basis of the standards of drinking water quality specified by the WHO/NSDWQ as approved by the Standard Organization of Nigeria (SON). The weighted arithmetic mean method of evaluation of water quality index is used in this study [20, 21].

The WQI is given in Equation (Eqn) (1) $WQI = \frac{\Sigma Q_i w_i}{\Sigma w_i}$ ----------(1); The quality rating scale (Q_I) for each parameter will be calculated via Eqn. (2); $Q_i = \left[\frac{v_i - v_0}{s_i - v_0}\right] X100$ ----------(2)

Where, v_i = estimated concentration of the n^{th} parameter in the analyzed water sample; v_0 = Ideal value of analyzed water parameter in pure water sample which is usually zero except PH = 7.0 S_i = recommended standard value of n^{th} parameter which for this study will be WHO/NSDWQ the unit weight (W_i) for each water quality parameter is evaluated using Equation (3); $w_i = \frac{k}{s_i}$ ----------(3); Where, k = proportionality constant and can be evaluated by equation (4): $k = \frac{1}{\Sigma \frac{1}{s_i}}$---------(4) The water quality index rating describes the range with which each of the calculated water quality index falls into. [22] defined the rating as Excellent, Good, poor, very poor and unsuitable/ unfit for drinking, as shown in Table 2. Calculated

WQI of 100 and above indicates that the water is unfit for drinking while low calculated index indicates excellent water fit for drinking.

Table 2: Rating of WQI

WQI	0-25	26-50	51-75	75-100	>100
RATING	excellent	good	poor	very poor	Unfit
GRADE	A	B	C	D	E

Table 3: Water Parameters data

LOCATION	TEMP (^{0}C)	TURB (NTU)	pH	TDS (mg/l)	FLUO(mg/l)
A1	34	2.36	6.6	340	0.62
A2	35	0.13	6.39	167	0.77
B	34	3.08	6.01	406	0.6

3. RESULTS AND DISCUSSION

Physico-Chemical Parameters Data

Results gotten from analysis of the water parameters are presented in Table 3. Results of temperature in all the three locations (A1, A2 and B) are higher than the permissible level for drinking water which is an indication of decrease in oxygen solubility in water; also the results have agreed with those of [20] in all the wards. The values of Turbidity in Table 3 shows that they lies within the acceptable level of drinking water however, values of turbidity in A2 is significantly low which could be attributed to better natural filtrations processes of the water, while passing through the various strata of the soil at that location in order to recharge the ground water. pH values in Table 3, in all the locations are also within the admissible level, however they are slightly acidic which may not be healthy, especially, for individuals who are below five years. TDS in Table 3 shows that the values in all the location are within the acceptable level; however, the values in all the three locations (A1, A2 and B) are high which could be as a result of the dissolved of the formation into the water. The Fluoride values of the three locations (A1, A2 and B) presented in the Table 3 are within the allowable levels of drinking water, however, they do not agree with those of [20] which are higher but still within the acceptable limit.

Water Quality Index Data

Data of water parameters gotten, through the variables in Equation (1 to 4), were inputed into microsoft excel 2016 to determined the water quality index of the three locations, as presented in Table 4. The results show that the water quality index of all the three locations are in the range of 38.30 to 42.08, which indicate that the water in all the three locations are of good quality. Using the base line of 7 as a number and added to each of the water parameters one at a time, it was found that increase on the values of any of the water parameters within the permissible limit will cause a pacentage differences as presented in Table 5.

Table 4: Determined WQI

Table 5: Percentage diff. of WQI after adding 7 to each parameter

LOCATION	WQI	TEMP (oC	TURB (NTU)	PH	TDS(mg/L)	FLUO (mg/L)
A1	40.94	34	2.36	6.6	340	0.62
A2	38.3	35	0.13	6.3	167	0.77
B	42.08	34	3.08	6.01	406	0.6

PARAMETERS	WQI	BASELINE WQI	DIFF	AVE	K	% DIFF
TEMP	40.94	42.03	1.09	41.485	100	2.62
TURB	40.94	68.22	27.28	54.58	100	49.98
PH	40.94	50.38	9.44	45.66	100	20.67
TDS	40.94	40.94	0	40.94	100	0
FLUO	40.94	344.07	303.13	192.505	100	157.46

4. CONCLUSION

Laboratory experiments were conducted on water parameters of wells to determine their qualities. Result gotten were entered into Microsoft excel 2016 to calculate water quality index of the water parameters for each of the three locations, respectively. Base on the finding the following can be deduced:

- All the water parameters in all the three locations are within the permissible limit of WHO/NSDWQ except Temperature.
- Water quality index in all the three locations are of good quality and fit for all purposes.
- When 7 was used as a standard and added to each of the water parameters one at time, it was found that the percentage differences for water quality index at the location A1 for fluoride was 157.46%; which indicate that fluoride above the acceptable level is detrimental to human health as it is being noticed in the stained teeth of some inhabitants.

ACKNOWLEDGEMENT

I thank the management of Taraba State University, Jalingo for its support through payment of my salary to enable me pay for publication charges.

REFERENCES

[1]. Osunkiyesi, A.A. (2012): Physicochemical analysis of Ogun River (water samples) within two locations (Akin- Olugbade and Lafenwa) in Aboekuta, Ogun State. IOSR Journal of Applied Chemistry.1(4):24-27.

[2]. Akpoborie, T., Egbo,S.H.O., Ebenuwa,C.C and Emeshili,E.M (2008): Comparative study of the satchet water in Asaba Metropolis, South-South, Nigeria. Book of proceeding of international conference of the chemical Society of Nigeria held in Effurun,Delta State

[3]. Agbazue,V.E (2008): The chemist and self employment. Book of Proceeding of the international conference of the chemical society of Nigeria Held in Effurun, Delta State.

[4]. Okeola, F.O., Kolawole, O.D. And 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.

[5]. Haruna,A.,Uzaini,A and Harrison, G. F. S (2008): Evaluation of water quality of shallow tube wells of some fadama lands in Zaria City, Nigeria. Book of Proceedings of the international conference of the chemical society of Nigeria held in Effurun, Delta State.

[6]. Shymala, R., Shanthi, M. And Lalitha, P. (2008): Physico-Chemical Analysis Of Borewell Water Samples Of Telungupalayam Area In Coimbatore District, Tamilnadu, India.E- Journal Of Chemistry.5(4):924-929.

[7]. Ogundele, J.O (2010): Physico-chemical and metal analysis of water samples from Akure, Nigeria. Ecoservices international.

[8]. Mahananda,M.R., Mohanty,B.P and Behera,N.R (2010): Physico-chemical analysis of surface and groundwater of Bargarh district ,Orissa, India IJRASS2(3):284-295.

[9]. Shittu,O.B., Olaitan,J.O and Amusa,T (2008): Physico-chemical analysis of water used for drinking and swimming purposes in Abeokuta, Nigeria.African Journal of Biomedical Research.11:285-290.

[10]. Iornumbe, E.N and Onah, J.O (2008): Determination of heavy metal accumulation by1Erchornia Crassipes and Pollutants. Book of Proceeding of the international conference of the chemical society of Nigeria Held in Effurun, Delta State.

[11]. Olayiwola, O. and Olubunmi, F. (2016): The Use of Water Quality Index Method to Determine the Potability of Surface Water and Groundwater in the Vicinity of a Municipal Solid Waste Dumpsite in Nigeria. American Journal of Engineering Research, Volume-5, Issue-10, pp-96-101.

[12]. Horton, R. K. (1965): An Index number system for rating water Quality. J. Water Pollu. Contd. Fed., 37(3), pp 300-305.

[13]. Brown, R. K., McClelland, N. I., Deininger, R. A. and Tozer, R. G. (1970): Water Quality Index-do we care? Water Sewage Works,

117(10), pp 339-343.

[14]. Odia, M. and Nwaogazie, I. L (2017): Multivariate Statistical Approach in Modelling Surface and Groundwater Quality near Municipal Solid Waste Dumpsites in Warri Metropolitan City", Archives of Current Research International, Vol.8, No. 4, pp.1-21.

[15]. Nwaogazie, O. P. Osamudiamen, and O. Bovwe: Modeling Groundwater Quality Index Based On Sensitivity Analysis for Wet and Dry Seasons in Obio/ Akpor Local Government Area, Rivers State, Nigeria. Nigerian Journal of Technology (NIJOTECH), Vol. 37, No. 3, 2018, pp. 799 – 805.

[16]. The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment State Water Resources Control Board (310.doc. 2010).

[17]. Andy N. M and Silas I (2020): Evaluation of Physico-Chemical Properties of Well Water Qualities in Selected Villages in Zing Local Government Area of Taraba State, Nigeria, International Journal of Contemporary Research and Review, IJCRR 11 (03), 20282–20288.

[18]. Gwaha A, M (2017): Dental Fluorosis In A Rural Nigerian Community : Is The Water To Blame? An Undergraduate thesis, American University Of Nigeria, Department Of Natural And Evironmental Science.

[19]. National Population Commission, Census, 2016.

[20]. APHA, (2005): Standard Methods for the Examination of Water and Wastewater, 21st edition, Washington, DC: American Public Health Association.

[21]. WHO, (2014): Guidelines for Drinking Water Quality, Geneva, Switzerland: World Health Organization.

[22]. Chatterrji, C. andRaziuddin, M. (2002): Determination of Water Quality Index of a Degraded River in Asanol industrial area, Raniganj, Burdwan West Bengal. Nature, Environment and pollution technology, 12(2), 181-189.