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Research Article

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Physico-chemical analysis of ground water samples from Nasarawa LGA, Kano State-Nigeria

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ABSTRACT

This study was carried out to access some physico-chemical quality of borehole water used for drinking and domestic purposes in Nasarawa Local Government Area of Kano Metropolis. Twenty water samples were randomly collected from different sampling sites and were analyzed for their levels in pH, Alkalinity, Conductivity, Total dissolved solids (TDS), Total hardness, Permanent hardness, temporary hardness, Calcium hardness and Magnesium hardness, using standard methods of analysis. The results obtained indicated that the mean pH level was 7.76±0.277, mean alkalinity level was 714.70±336.701mg/L, the mean conductivity level was found to be 1057.40±669.092µScm^{-1}: Total dissolved solid (TDS) had mean value of 708.46±448.286mg/L Total Hardness had mean level of 652.35±311.241 mg/L: Permanent hardness had mean level of 400.20±253.767mg/L. The mean value of Temporary hardness was found to be 252.15 ± 181.915mg/L while mean calcium level was 237.80±139.259mg/L; and finally the mean magnesium level was found to be 414.10±254.057mg/L. The results of this analysis indicated that pH, conductivity and total dissolved solids were within the acceptable range recommended by World Health Organization. (W.H.O), while Alkalinity, Total hardness, Permanent hardness, Temporary hardness, Calcium hardness and Magnesium hardness were all above the safe limit recommended by World Health Organization.

Keywords: Physico-chemical parameters, borehole, permanent hardness, water samples.

INTRODUCTION

Ground water is the major source of water for drinking, agricultural and industrial desires. The availability of water determines the location and activities of humans in an area, and our growing population is placing great demand upon natural fresh water resources. (Oladipo, et al., 2011) . The physico-chemical contaminants that adversely affected the quality of ground water is likely to arise from a variety of sources, including land application of agricultural chemicals, infiltration of effluent from sewage treatment plants, municipal waste , ponds etc, (Rajappa et al., 2011).

(FAO, 1997) defined water as one of the most valuable natural resources and is essential for the maintenance of all forms of life. Surface (rivers, lakes and dams), and ground i.e. (wells and boreholes) water are the principal sources of water; In recent years, because of rapid urbanization, Industrialization and growing population, the rate of discharge of pollutants into the environment which ultimately finds their way into these water bodies is higher than the rate of purification. (Rizwan Reza and Singh 2009). It is believed that surface water are generally more polluted than ground water, hence the use of ground water such as borehole water as the major source of drinking water in many urban and rural areas is the only alternative, (Chukwu, 2008); unfortunately, ground water can also be contaminated through various ways such as seepage from effluent waters, fertilizer from agricultural and mining activities, vehicle maintenance, sewage disposal and domestic waste. (Adekunle, 2009).

(Ademorati, 1996) reported that the importance of water in our daily lives is what makes it imperative for thorough analysis to be conducted. The analysis is the concern of the chemist to ensure that supply of water is maintained suitable for all purposes and to ensure that only water with good qualities is used for both domestic and industrial purposes.

The aim of this work is to determine some physico-chemical parameters in ground water samples in one of most densely populated areas of Kano city, Kano state Nigeria .

EXPERIMENTAL SECTION

Sampling
Twenty water samples were collected from different boreholes situated within the study area. The sample collection was done randomly from twenty different areas in Nasarawa Local Government Area of Kano metropolis using clean polythene plastic container.

Determination of physic chemical parameter pH measurement;
This was measured using a digital pH meter (Meteler Toledo Model). The meter was switched on and was allowed to warm for 15 minutes, this was done after it was standardized with three buffer reference solutions of pH 4.0, 6.8, and 9.18. The electrode that was attached to the meter was quickly introduced into the water sample and measurement was taken after a stable reading was obtained. The electrode was then rinsed with deionized water before taking another measurement. (APHA, 1992).

Determination of Alkalinity:
100cm^3 of water sample was poured into a conical flask, 3 drops of methyl orange indicator was added and titrated with 0.1M HCl until the colour changed from yellow to pink.

The volume of HCl was recorded three more times, and the average titre value was finally recorded. (Ademorati, 1996).

Conductivity Measurement
Conductivities of the water samples were measured using a digital conductivity meter (4010 JENWAY Model). The meter was switched on and allowed to warm for about 15 minutes, this was then standardized with 0.0IM KCl, and conductivity reading of 1413 micro seimen per centimeter was obtained. The electrode was then inmmersed into the water samples and conductivity reading of each water sample was recorded. (APHA, 1992).

Determination of total dissolved soli.
The programmed menu of conductivity meter was switched to total dissolved solid. 100cm^3 of the sample was measured into a breaker and the electrode was then inserted into the sample. After this conductivity meter was set on; care was taken not to allow the electrode to come into contact with the sides and the bottom of the beaker during measurement. The results of total dissolved solids was displayed and reading from the screen was recorded (APHA, 1992).

Determination of Total Hardness:
10cm^3 of water sample was pipetted into a conical flask. 1cm^3 of buffer solution (NH_4cl) of pH = 10 and 3 drops of erichrome black T indicator were added to the flask. The mixture was then titrated with 0.0IM EDTA until the colour changed from wine red to blue.

The procedure was repeated two more times to obtain the average titre value (Ademorati, 1996).

Determination of permanent Hardness:
50 cm^3 of water samples was boiled for about 20 minutes, and the sample was filtered after cooling at room temperature. 2cm^3 of buffer solution of pH = 10 and 3 drops of Eriochrome black T indicator was added. The

mixture was titrated against 0.02M EDTA until the colour changed from red to blue. This procedure was repeated two more times to obtain the average titre value. (Ademorati, 1996).

Determination of Temporary Hardness
This is determined through calculations using the following relation.

Temporary hardness = (Total - permanent) hardness

Determination of calcium hardness
50cm^3 of water sample was pipetted into a conical flask, 50cm^3 of buffer solution (NH_4Cl) of pH = 12 and 3 drops of Eriochrome black T indicator was added and the solution was titrated with 0.02M EDTA until the colour changed from red to blue. This experimental procedure was repeated two more times to obtain the average titre value (Ademorati, 1996).

Determination of Magnesium Hardness

This is obtained through the following relation:

Magnesium hardness = (Total - calcium) hardness (Ademorati, 1996).

RESULTS AND DISCUSSION

The results of some physico - chemical parameters analyzed in borehole drinking water samples from some sampling sites across Nasarawa L.G.A. of Kano metropolis is presented in table 1 below:

Table 3.1 THE PARAMETERS, SAMPLING SITES AND RESULTS OBTAINED FROM CALCULATIONS MADE

S/N	Sampling Sites	pH	Conductivity (μScm^{-1})	Total Dissolved solid (mgL^{-1})	Total Hardness (mgL^{-1})	Permanent Hardness (mgL^{-1})	Temporary Hardness (mgL^{-1})	Alkalinity (mgL^{-1})	Calcium Hardness (mgL^{-1})	Magnesium Hardness (mgL^{-1})
1	Badawa	8.10	352	235.84	282	192	90	700	126	156
2	Brigade	7.57	1423	953.41	885	430	455	560	208	677
3	Dawakin Dakata	8.00	356	238.52	282	96	186	860	95	187
4	Farawa	7.50	1907	1277.62	1232	598	634	1440	450	782
5	Gama	7.45	2540	1701.80	678	340	338	1460	482	196
6	Gawuna	7.63	1630	1092.10	893	804	89	560	274	619
7	Gwarzo	7.37	1625	1088.75	1115	1042	73	480	437	678
8	Gwagwarwa	7.77	858	574.86	454	332	122	700	332	132
9	Giginyu	7.52	1254	840.18	760	561	199	660	177	583
10	Hotoro	7.78	816	546.76	402	380	22	320	176	226
11	Kawo	8.11	307	205.69	202	100	102	560	98	191
12	Kwanar Tudun-wada	7.38	1754	1175.18	1040	517	523	714	271	769
13	Rakad	7.58	753	504.51	1000	484	516	450	116	884
14	Sauna	8.34	305	204.35	466	148	318	1120	79	387
15	Tudun Murtala	7.54	1173	785.91	592	492	100	574	330	162
16	Tudun Nufawa	7.67	1192	798.64	692	360	332	680	208	484
17	Tudun Wada	7.82	1745	1169.15	862	664	198	1200	495	361
18	Tishama	7.96	540	361.80	244	180	64	350	183	61
29	Yan Kaba	8.05	113	75.71	420	176	244	406	94	326
20	Zango	7.96	505	338.35	546	108	438	500	125	421
	Mean	7.755	1057.40	708.46	652.35	400.20	252.15	714.70	237.80	414.10
	Standard deviation (±)	0.277	669.092	448.286	311.241	253.767	181.915	336.701	139.259	254.057

DISCUSSION

The pH levels in the various water samples are presented in fig 1. From, the graph it can be seen all the sampling sites had pH level falling with the W.H.O recommended range value of 6.5 – 8.5 (W.H.O, 2005).

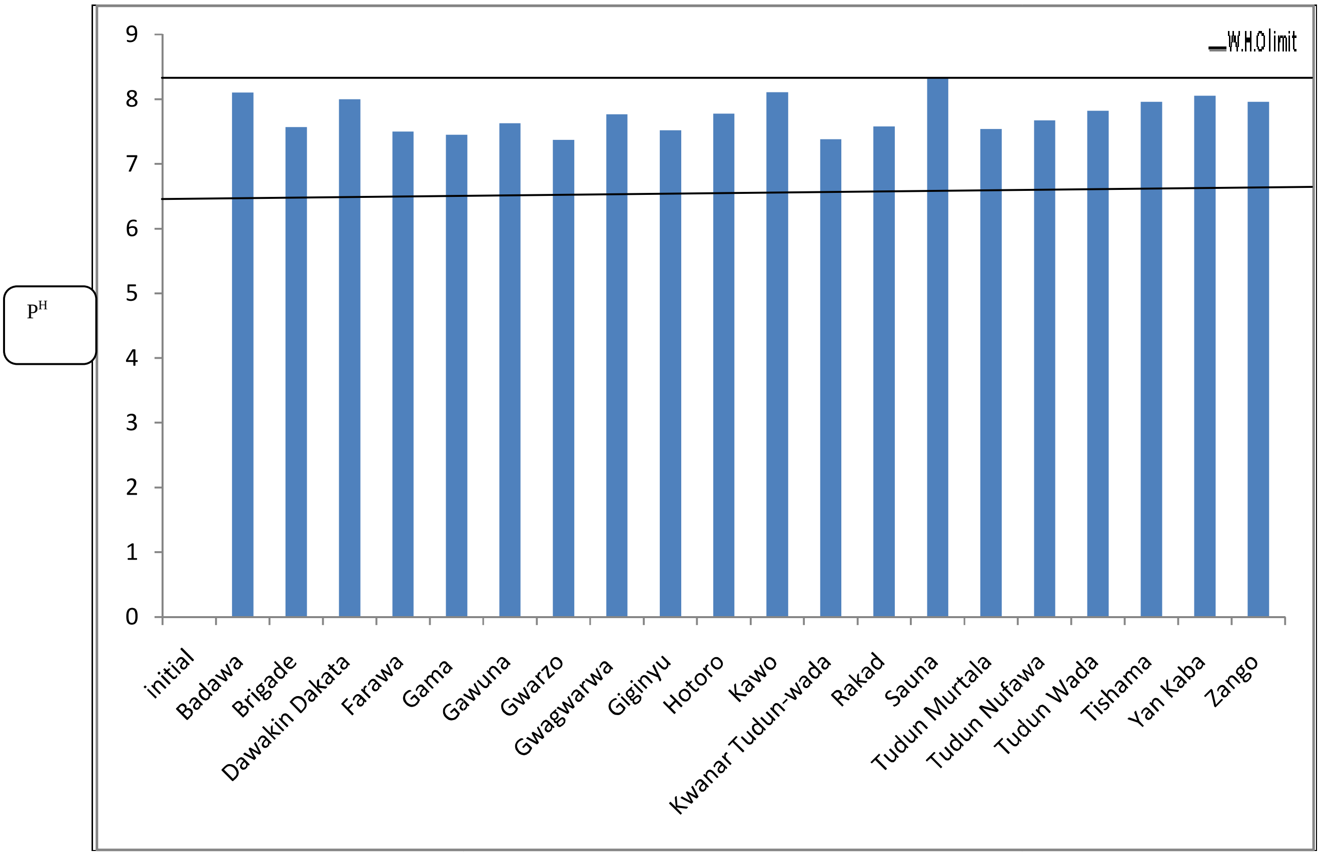

Fig 1:PH level in drinking water samples from the boreholes

Conductivity measurements were conducted in the water samples and the results revealed that some sites such as Farawa. Gama, Gawuna, Ginginyu and Kwanar Tudun wada had conductivity level above W.H.O maximum contaminant level of 1200 µscm^{-1}. (W.H.O, 2005).While the remaining sites such as Badawa, Kawo, Yan Kaba etc. had conductivity level below the W.H.O. maximum contaminant level of 1200 µscm^{-1}. However the high conductivity level at the sites indicated could be linked to sewage materials, leaching at in organic contaminants as observed by Harison, (1992).

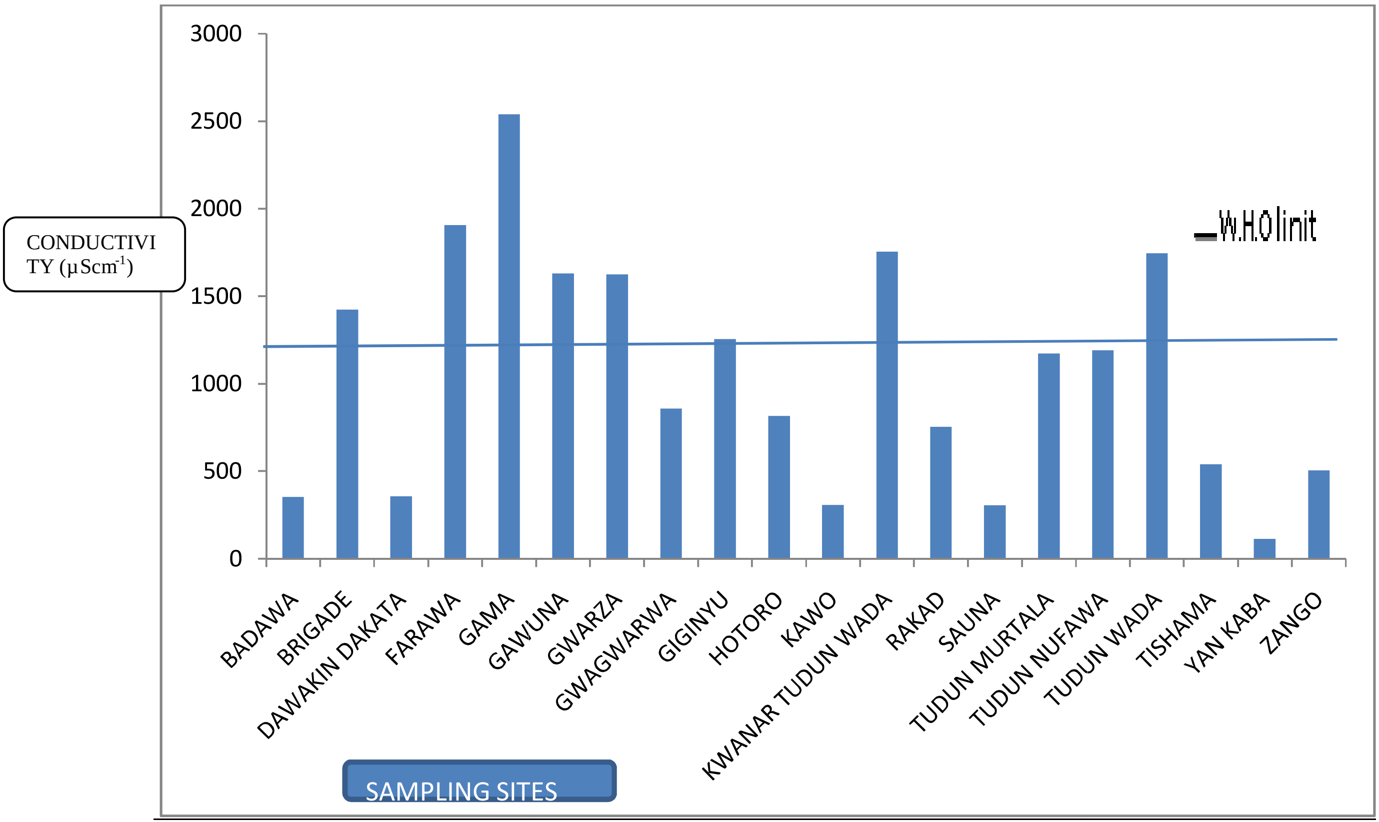

Fig 2: Conductivity level in drinking water samples from the boreholes

Total Dissolved solid was also analyzed and from the results. It can be observed that some sites such as Farawa, Gama, Gawuna etc. had TDS level above the W.H.O. maximum contaminants level of 1000mg clm^{-3}. While majority of the sampling sites had TDS level. Below the WHO maximum contaminant level. (W.H.O, 1998).

The high concentrations of total dissolved solids will reduce water clarity, which could contribute to the decrease in photosynthetic activity and may lead to an increase in water temperature as by (Okonko et al., 2007).

Egereonu, 2003, reported that high TDS concentrations could add laxative effect to the water and this will make the water to have unpleasant taste and as a consequence there could result to an acute and carcinogenic effect.

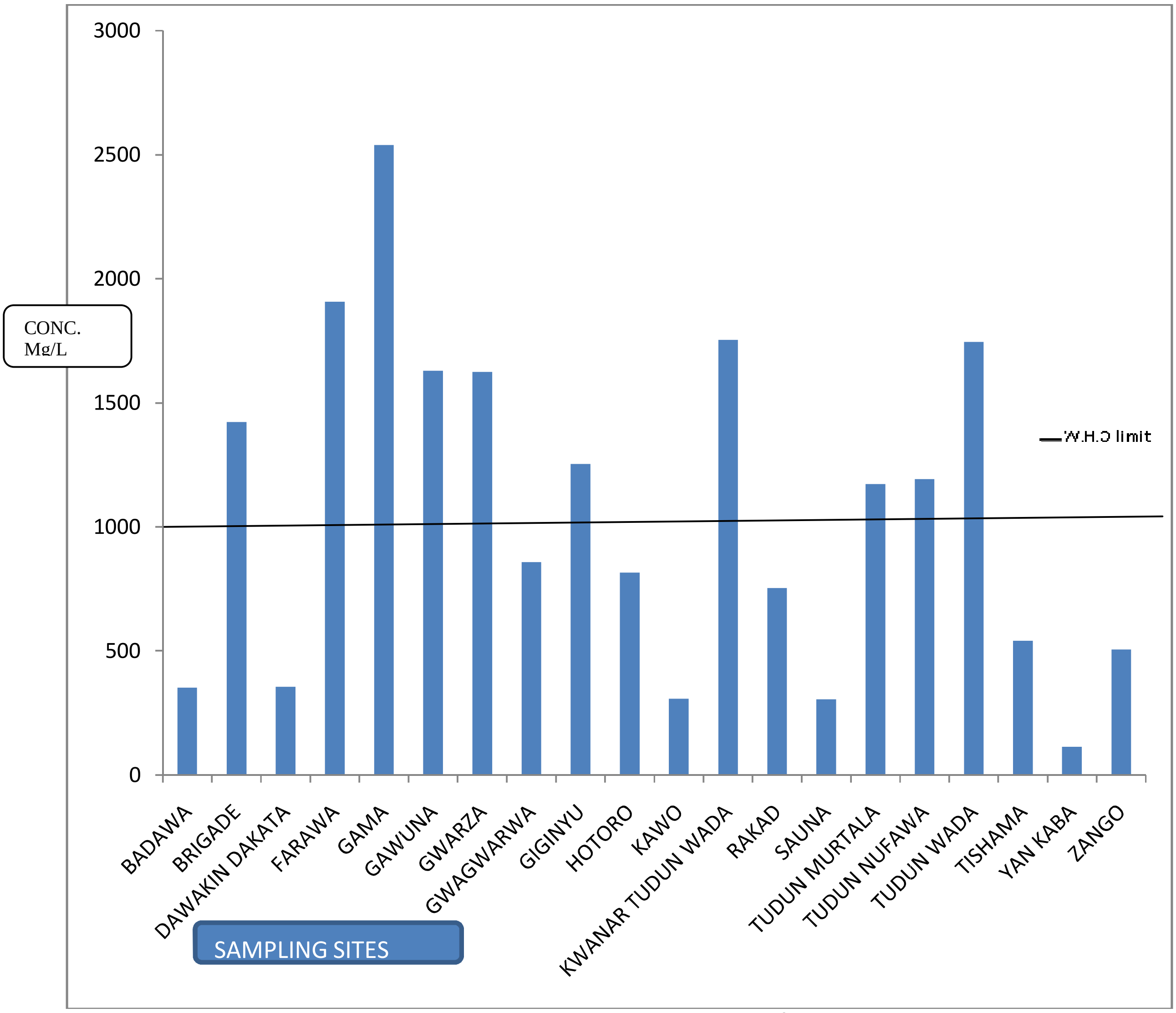

Fig 3: Total dissolved solid level in drinking water samples from the boreholes

The hardness levels were presented in fig. 4,5,6,8 and 9, and according to classification of water conducted by Tyson and Harrison, 1990, in terms of softness and hardness can be made, while considering the following order in terms of Mg/L. 0-60 soft, 60 – 120 moderately soft, 121 – 180 moderately hard and above 180 is hard.Thus using this classification, then it can be deduced that almost all the water samples analyzed are hard and thus not be safe for drinking and other domestic purposes.

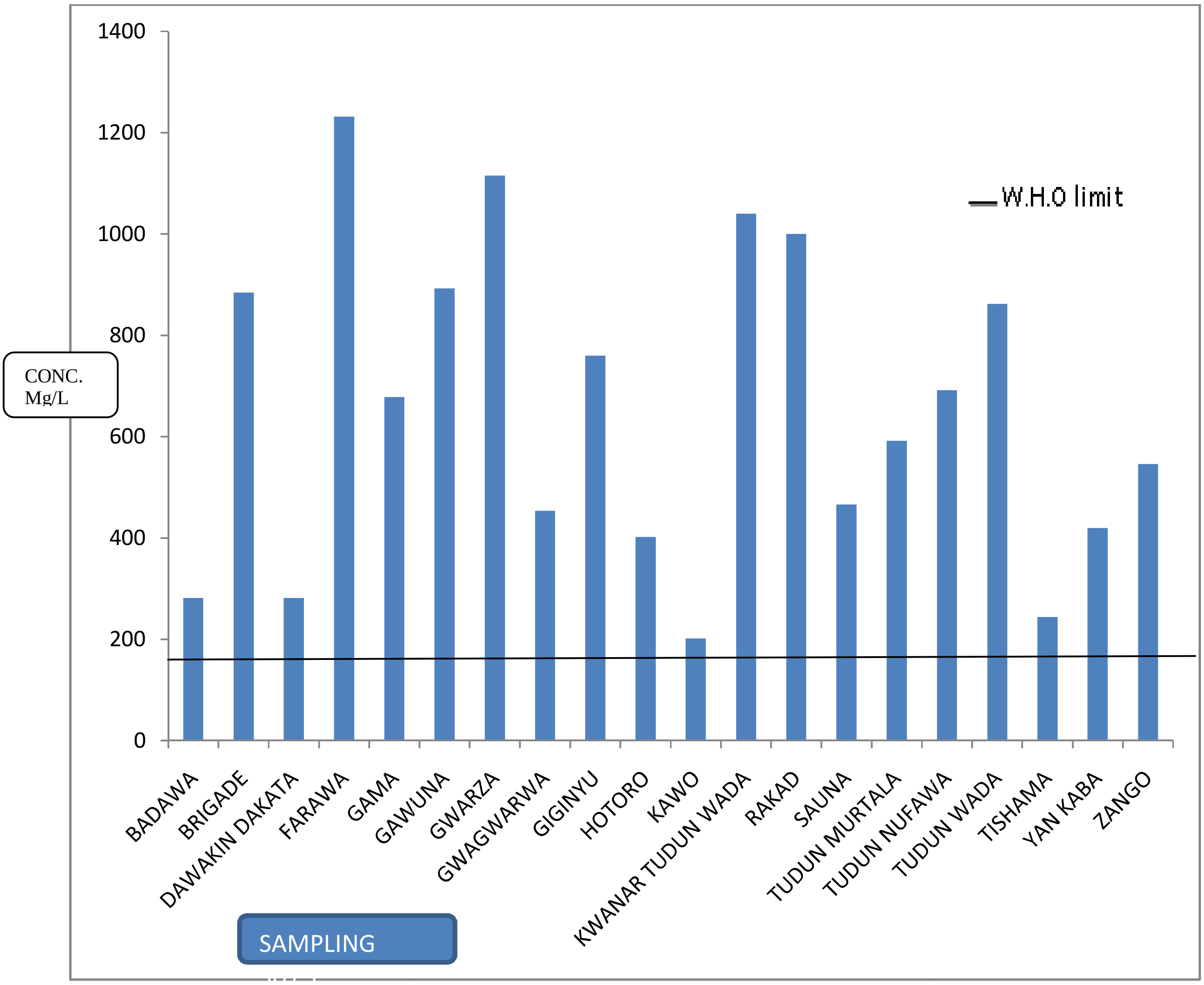

Fig 4: Total Hardness level in drinking water samples from the boreholes

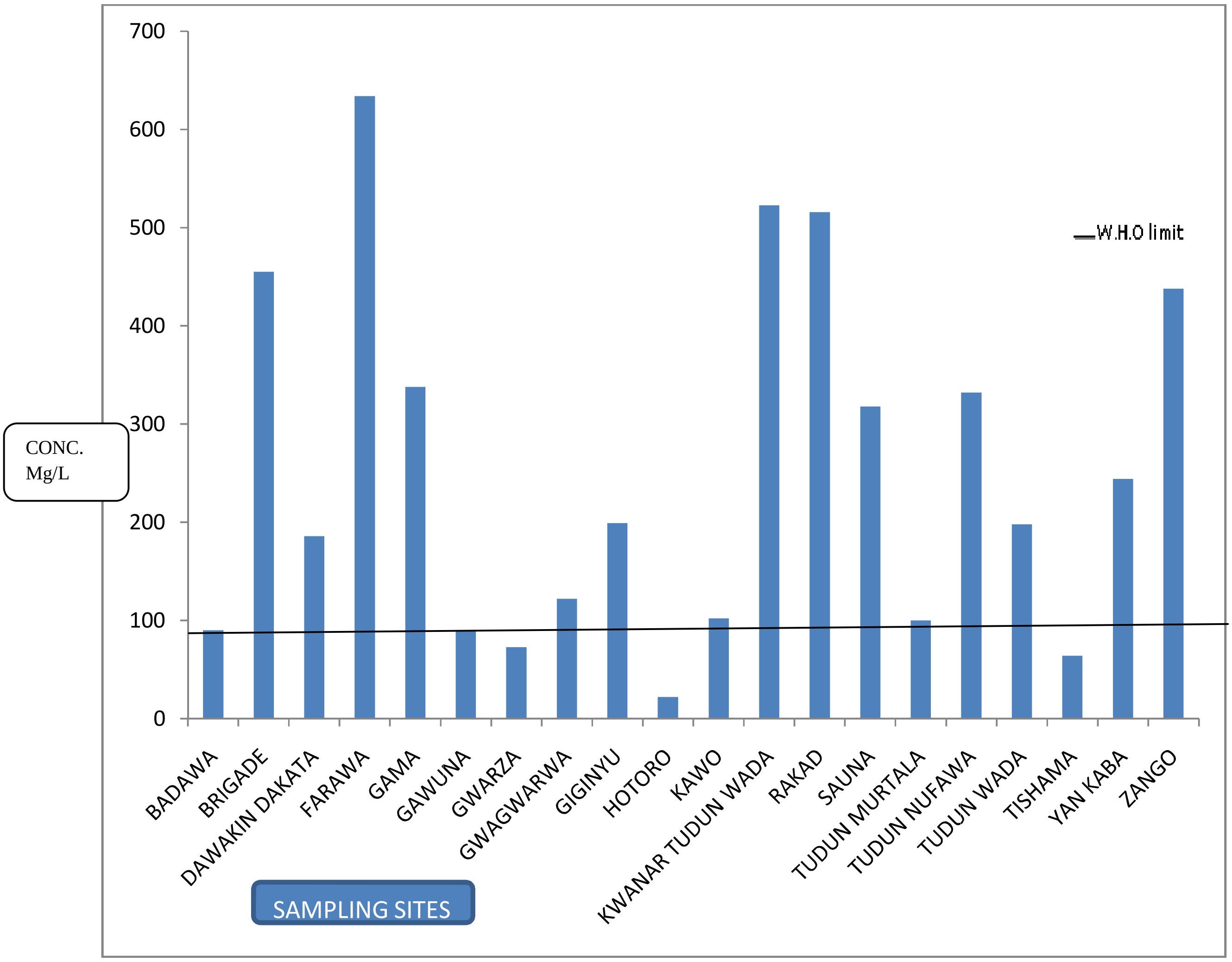

Fig 5: Temporary Hardness level in drinking water samples from the boreholes

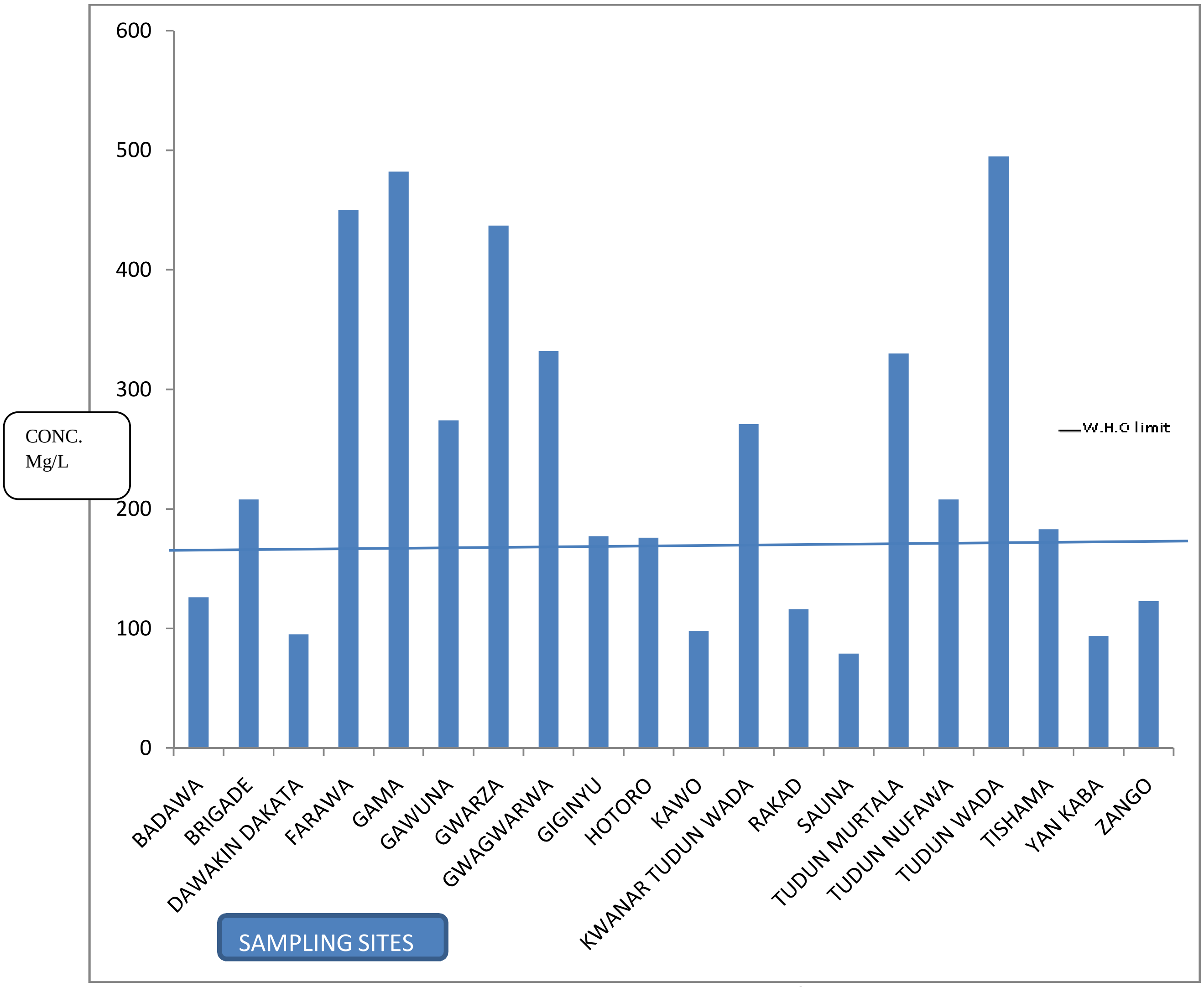

Fig 6: Calcium Hardness level in drinking water samples from the boreholes

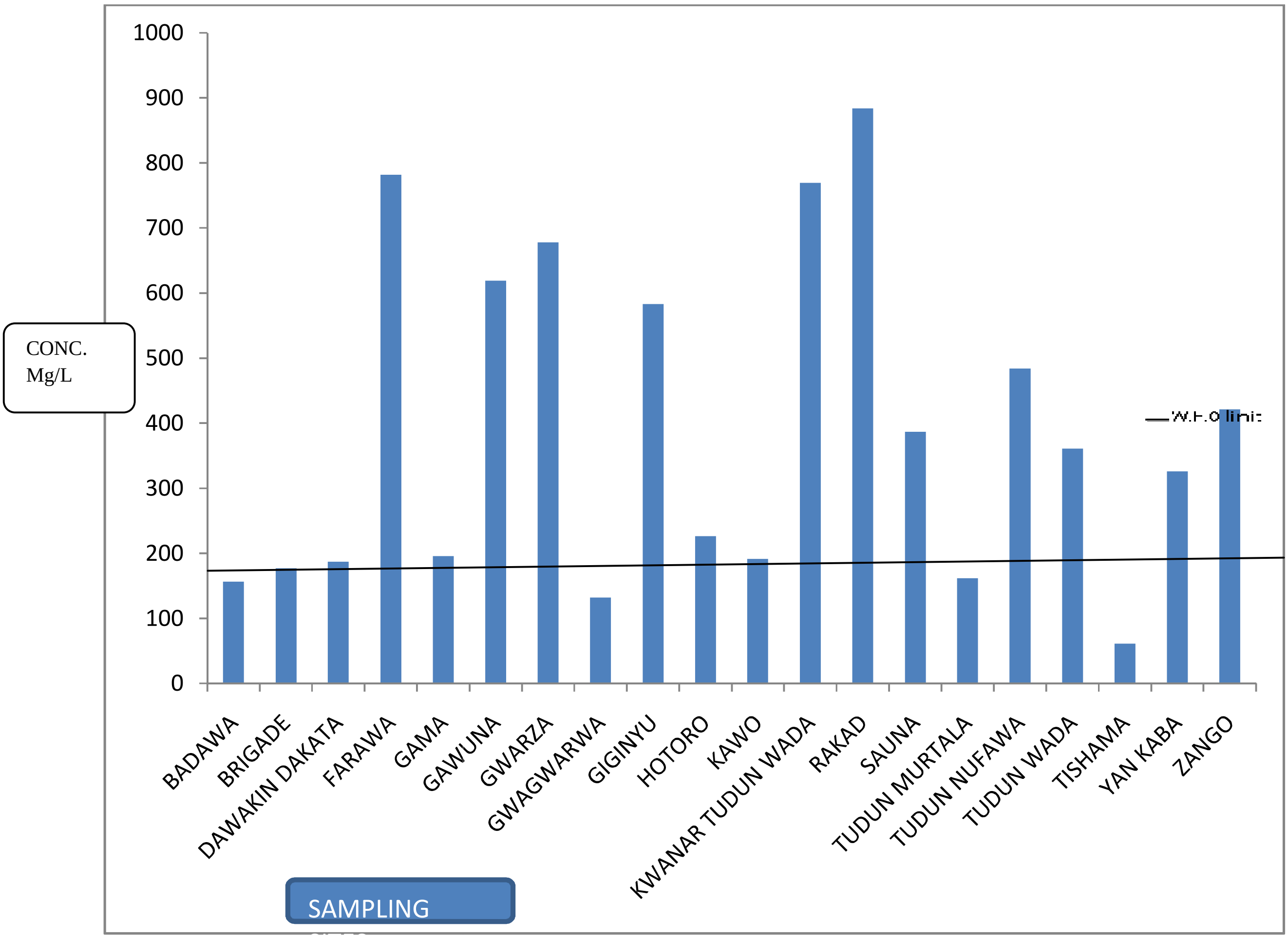

Fig 7: Magnesium hardness level in drinking water samples from the boreholes

Alkalinity levels were assessed in the water samples, and is presented in fig 8, the results indicated that majority of the sampling sites have alkalinity levels above the W.H.O. maximum contaminant level of 500 mg dm^{-3} (W.H.O, 2005). Alkalinity value in water provides an idea of natural salts presents in water. The cause of alkalinity is linked to the minerals that dissolve in the water.The various ionic species that contribute to alkalinity include bicarbonate, hydroxide, phosphate, borate etc. (Wetzel, 2001).

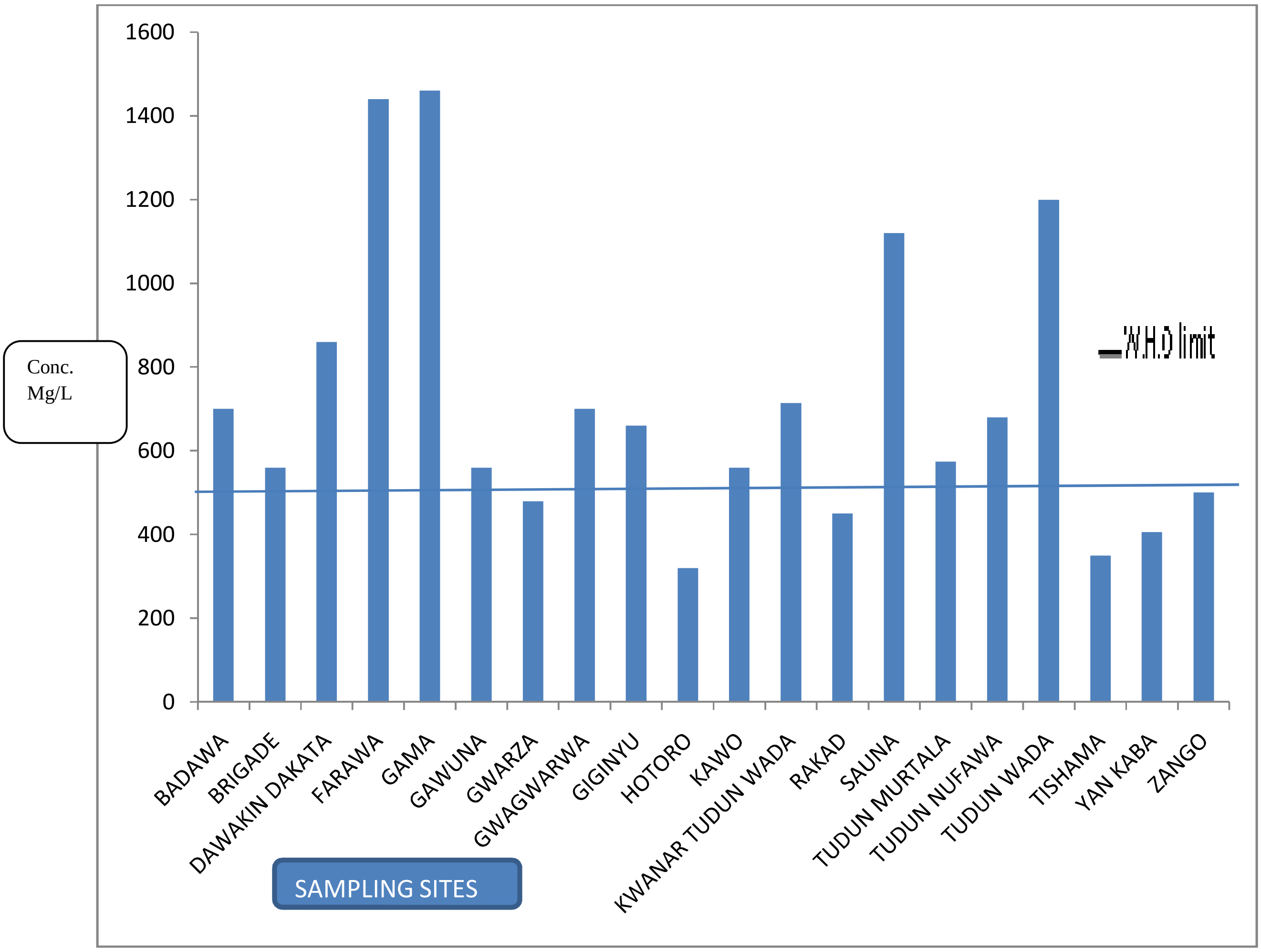

Fig 8: Alkalinity level in drinking water samples from the boreholes

CONCLUSION

Physico-chemical assessment of borehole water samples from Nasarawa LGA of Kano metropolis were carried out. There had been deleterious levels in almost all the chemical parameters while the physical parameters are within the W.H.O safe limit.However, since the chemical parameters had indicated high levels that stand above W.H.O safe limits, there is the tendency of high potential health hazards to the inhabitants of the areas that uses these water resources for drinking and other domestic purposes without treatment.

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