QUALITY ASSESSMENT OF SURFACE AND GROUND WATER OF HONG LOCAL GOVERNMENT AREA OF ADAMAWA STATE, NIGERIA

ABSRACT

The surface and ground water quality of Hong Local Government Area of Adamawa State was studied to examine their suitability or otherwise the use of surface and ground water for drinking and domestic purposes. Nine water samples, three from streams, three from dug wells and three from boreholes were randomly collected, each during dry season in the months of October and November, 2016. The samples were analysed with reference to World Health Organisation (WHO) standards and National Agency for Food and Drug Administration and Control (NAFDAC). The results of the analysis revealed that the physico-chemical parameters studied and concentrations of heavy metals determined, falls within the maximum permissible limits of WHO and NAFDAC standards for drinking water. However, the water samples were predominantly alkaline (pH 6.30 ± 0.10 to 7.00 ± 0.10), (6.70 ± 0.20 to 7.30 ± 0.20), and (7.60 ±0.20 to 8.20 ± 0.10), in boreholes, dug wells and streams water respectively. The heavy metals concentrations were determined using Atomic Absorption Spectrophotometric method. The suitability of water for domestic and drinking purposes indicates that water samples were within the standards prescribed for potable waters.

Key words: Quality Assessment, Streams, Dug wells, Boreholes, Hong, Adamawa State

INTRODUCTION

In reality, the water required for domestics consumption should possess a high degree of purity and should be free from suspended and dissolved impurities, like bacteria. Both dug wells and boreholes water are expected to be less contaminated. However, there are possibilities of introduction of contaminants, depending on management and the temperature gradient of the water environment (Alexander, 2008a).

Reports according to Alexander, 2008a; 2008b; Musa *et al.*, 2004 observed that ground water is one of the important sources of drinking water for large population throughout the world. Ground water is presumed to be naturally protective and free of impurities as compared to surface water. Man through a variety of activities and modern technologies is dramatically changing the characteristics of ground water systems. Various activities like agriculture, power generation, chemical and other industries are potential sources of ground water contamination such as fertilizer, pesticides, herbicides etc. Other important source of water contamination is urban pollution due to sewage, septic tank effluent and drainage waters and also biological contaminations such as biodegradable organic and inorganic matters (Ishaku *et al.*, 2011). Ground water account for nearly 90% of drinking water supply while the surface water account for 10%-20% supply of drinking water especially in rural areas (Ogabatele *et al.*, 2007).

According to several reports from Olatunji *et al*., 2015; Adeyemi *et al*., 2003, groundwater plays a vital role as an important source of potable water in both rural and urban areas of Nigeria. It remains the largest available source of fresh water, thus it forms a very important part of the water supply chain. There is a growing demand for groundwater in virtually all parts of Nigeria. This is due to rapid growth in population and increasing industrial activities. However, surface water is naturally highly susceptible to contamination, but groundwater is less susceptible. Nevertheless, once groundwater is polluted, remediation is usually very difficult and expensive to undertake. Also, its quality cannot be restored by stopping the pollutants from the source (Purandara and Varadajan, 2003).

The problem of water contamination both underground and surface water has become more acute especially in the area of denser population (Abdullahi *et al*., 2010). Though studies have been conducted by some people on water and has been reported that there is a need for monitoring and examining various chemical and biological parameters so as to create awareness and corrective measures (Adefemi, 2007).

However, the parameters mentioned above are of great importance since water is essential nutrient for survival of all humanity that involve in bodily function and makes up about 75% of total body weight (Offei Ansah, 2012). It has been analysed that lack of good quality water for drinking causes headaches, anthrities, heart burn etc

Providing safe drinking water is one of the most complex challenges facing African rural communities. The continent has the highest number of people lacking access to safe, drinkable water, more than 3.4 million of people die each year from water sanitation and hygiene-related causes and majority of these are in Africa (Olalekan *et al*., 2015).

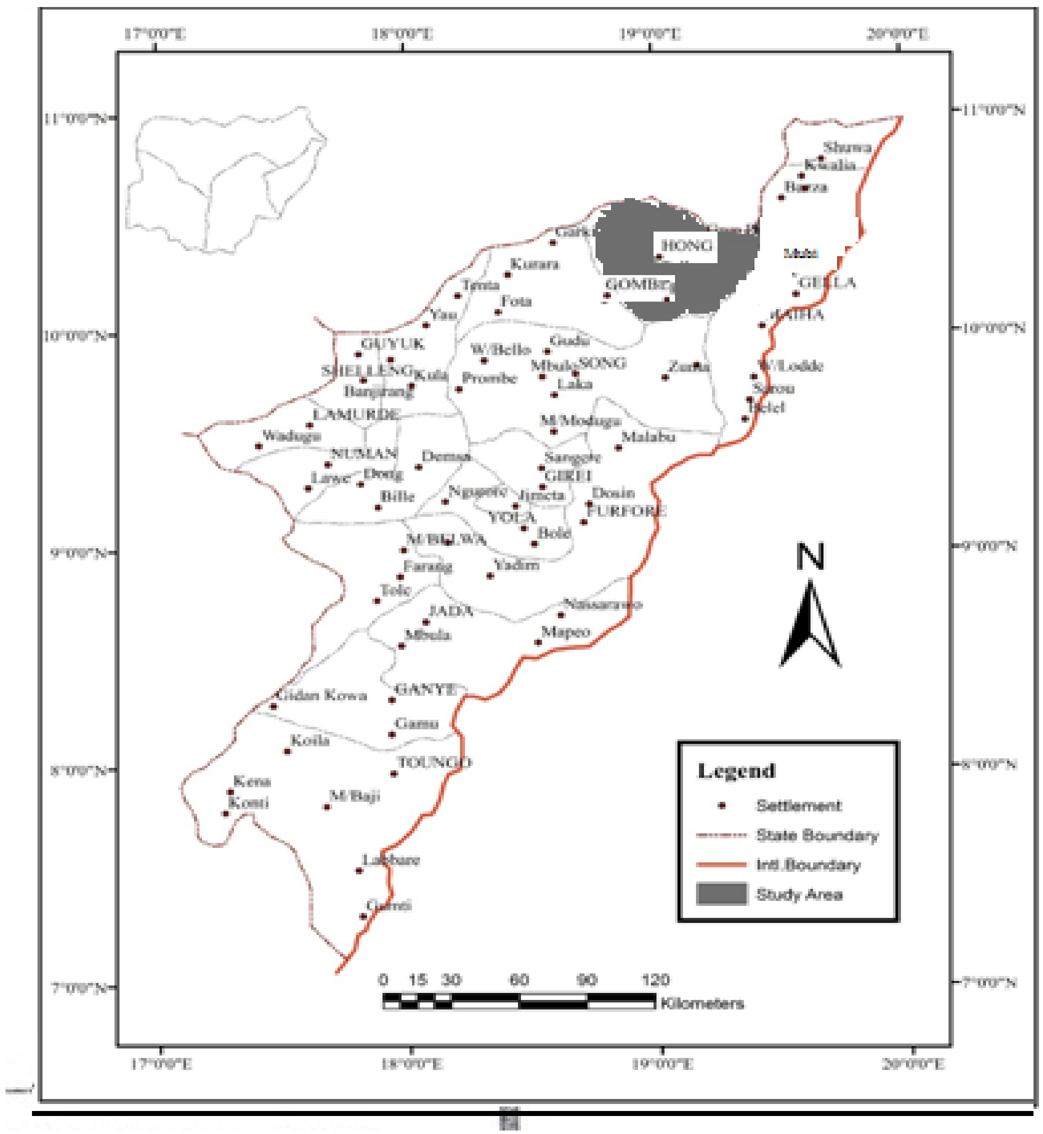
Traditionally many societies have depended on surface water resulting in diseases such as, bilharzia, sleeping sickness, river blindness, guinea worm, diarrhoea etc (Carpenter *et al.*, 1998). Apart from these factors the activities of micro-organisms, temperature and pressure are responsible and hatch chemical characteristics mentioned earlier.

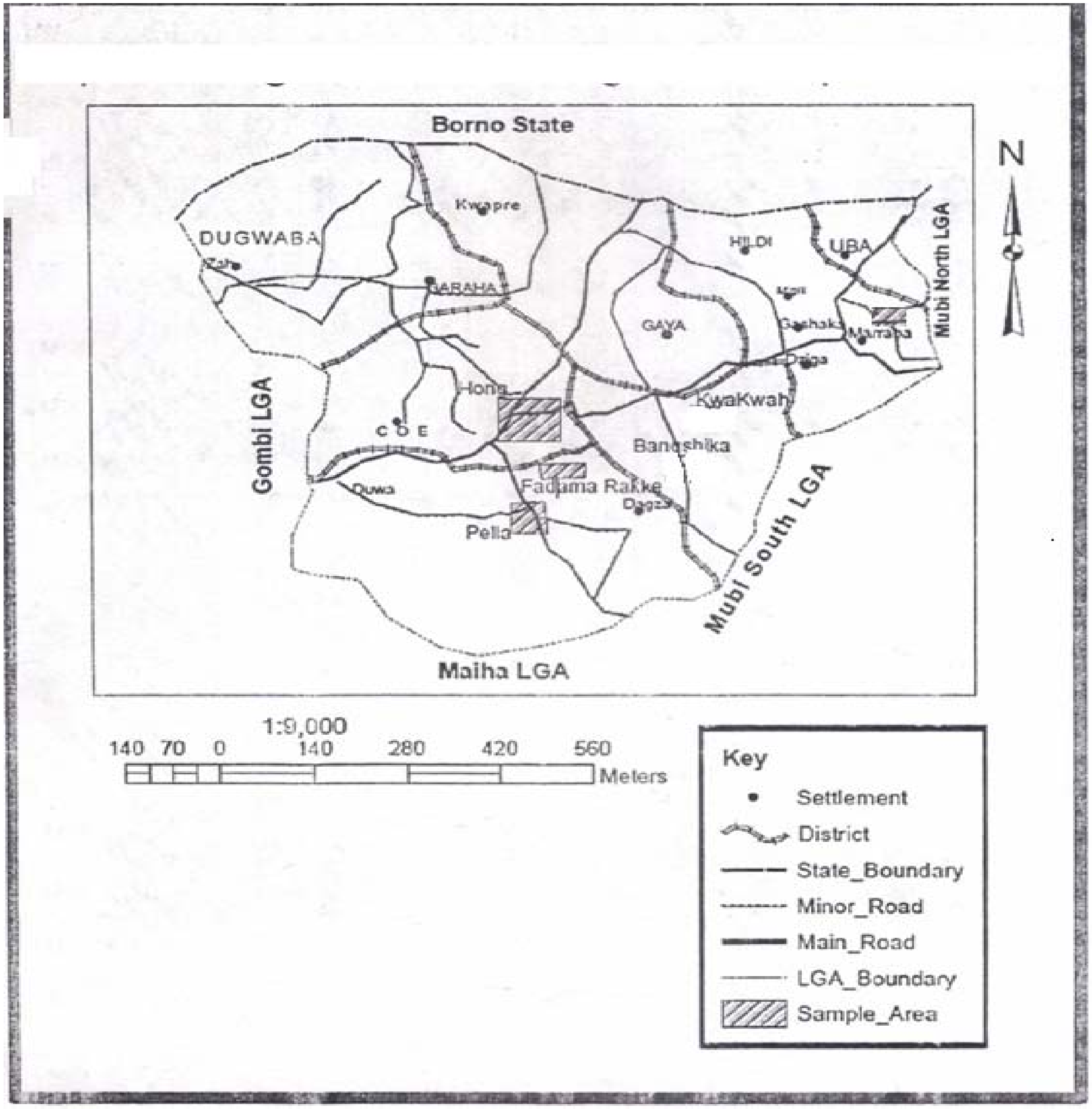
The aim of this study is to assess the quality of streams, boreholes and dug wells waters, which are the chief sources of water supply in Hong Local Government Area of Adamawa State, Nigeria, by determining the physico-chemical parameters and heavy metals levels in order to ascertain their suitability for drinking and domestic purposes. However, there is also the need for routine studies of the water quality which will serve as a check to forestall the prevalence of epidemics of water borne diseases in the area under study.

MATERIALS AND METHODS

Study Area

Hong Local Government Area is situated in the North-Eastern part of Adamawa State Nigeria. It lies between latitude 10.38^{0}N and longitude 12.35^{0}E. It shares boundary with Gombi in the south, Mubi North and Mubi South in the west and Michika to the North. Hong Local Government area has land mass of about 2419 square kilometer and a total population of 195580 people (National population census 2011). The topography of Hong local government is a picture of mountain land transverse by river, valley of Hawul and Kuliyi.





Borno State
N
DUGWABA
Kwapre
GARAHA
HILDI
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GAYA
Marraba
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Banashika
Duwa
Fadama Rakke
Dagza
Pella
Mubi South LGA
Maiha LGA
1:9,000
140 70 0 140 280 420 560
Meters
Key
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Sample_Area

Figure 1: Map of Adamawa State showing Hong Local Government Area

Figure 2: Map of Hong Local Government Area showing the sample locations.

Sample Collection

Three samples each of dug wells, streams and boreholes water were randomly collected from the study area during the months of October and November, 2016. The samples were collected from Mararaba, Fadama rake, Hong, Kala'a, Makera and Pella. The water samples were collected using previously cleaned 1000 cm^3 polyethene bottles. The bottles were first washed with detergent and rinsed with distilled water and then rinsed with the water to be sampled and filled to the brim with it. The water samples were preserved with trioxonitrate (v) acid (Alexander, 2008a).

Sample Preparation

pH and temperature were measured immediately at the point of collection of sample. The pH was measured using Jenway 3505 pH meter. The water temperature was measured with the help of mercury thermometer graduated up 110 ^0C. Turbidity was measured by Nephelo-turbidity meter (systronic type No 131). Total Dissolved Solid (TDS) and Electrical Conductivity were determined using multipurpose JENWAY portable combined TDS/Conductivity meter (4510 model) the probe portion of the equipment was inserted into the water sample about 1cm depth and the reading was display and recorded.

Determination of Fluoride

Fluoride was determined according to the method described by Hong *et al.*, 2013. 50ml of the water sample was pour into a Nessler tube and one 'Excess-AL' tablet was added, mixed thoroughly. 50ml of the sample was pour into a second Nessler tube and one 'A-Z' tablet was added to both the first and second Nessler tube. In the left-hand compartment of the Nessler 50, a third Nessler tube containing 50ml of sample only was placed. One of the tube containing the sample and reagent (A-Z tablet and AL tablet) was placed in the right hand of the compartment. The comparator bearing the NOM Disc was fitted onto the Nessler 50 and allowed to stand for 15minutes for colour to develop in the right hand tube which was within the range of standards on the disc. The tube was placed in turn in the Nessler 50 and the colour was matched in both tubes against the disc using the North daylight. The reading was noted and the differences in the readings give fluoride content of the sample which was recorded in mg/L.

Determination of Heavy metals

The method described by Tsafe *et al.*, 2012 was adopted. Magnesium, calcium and heavy metals concentrations were determined using Atomic Absorption Spectrophotometer (Buck scientific 210). The water sample was aspirated into the instrument after all the necessary set up and standardization procedures. Atomic vapour was produced as the sample drop on the acetylene flame, a beam of monochromatic light with a wavelength at which only the element of interest was absorbed, pass through the flame. The atom of the element in flame absorbed some amount of light which was corresponding to it concentration. This was detected on the display unit read as the absorbance. A calibration curve of each element was plotted using the absorbance of the standard against their corresponding concentration and it was used to determine the concentration of the elements in the samples.

Results and Discussion

Results

Table 1: Physico-chemical Parameters of Stream water

Sample Locations	pH	Temp (^{o}C)	E.C (µS/cm)	TDS (mg/L)	Turbidity (NTU)	Ca (mg/L)	Mg (mg/L)	F (mg/L)
Pella	7.60±0.28	25.00±1.40	3.75±2.53	4.23±1.06	4.45±2.42	0.65±0.01	0.53±0.16	0.93±0.06
Hong	7.10±0.21	28.50±2.12	4.28±0.38	4.81±0.43	6.73±0.60	2.54±0.64	0.74±0.42	1.05±0.11
Fadama Rake	8.10±0.92	33.00±1.40	3.41±0.70	3.92±0.29	5.48±0.41	5.80±4.17	1.78±0.01	1.28±0.04
Kaala	8.10±0.57	30.00±1.40	2.84±1.03	3.28±1.49	4.59±2.09	2.27±0.19	1.11±0.30	1.11±0.13
Makera	-	-	-	-	-	-	-	-
Mararaba	8.20±0.03	29.00±0.03	3.21±0.02	3.88±0.02	6.40±0.01	14.97±0.01	1.82±0.02	0.84±0.03
Range	7.10±0.21-8.20±0.03	25.00±1.40-33.00±1.40	2.84±1.03-4.28±0.38	3.92±0.29-3.28±1.49	4.45±2.42-6.73±0.60	0.65±0.01-5.80±4.17	0.53±0.16-1.78±0.01	1.28±0.04-0.93±0.06
NAFDAC	6.5-8.5		1000	500	5.0	75	30	1.0
WHO	6.5-8.5		1000	500	5.0	75	50	1.5

Results were presented as mean and standard deviation of five replicate determinations
NAFDAC= National Agency for Food and Drug Administration and Control.
WHO= World Health Organization.

Table.2: Heavy Metal Concentrations of Stream water (mg/L)

Sample Locations	Cd	Pb	Fe	Cu	Zn
Pella	ND	ND	0.04±0.04	0.06±0.01	ND
Hong	ND	ND	0.04±0.01	0.09±0.01	ND
Fadama Rake	ND	ND	0.20±0.15	0.02±0.00	ND
Kaala	ND	ND	0.09±0.01	0.06±0.04	ND
Makera	-	-	-	-	-
Mararaba	ND	ND	0.19±0.01	ND	ND
Range			0.02±0.15- 0.19±0.00	ND-0.09±0.01	
NAFDAC	0.003	0.01	0.3	1.0	5.0
WHO	0.003	0.01	0.3	1.0	5.0

Results were presented as mean and standard deviation of five replicate determinations

ND= Not Detected

Table.3: Physico-chemical Parameters of Dug wells water

Sample Locations	pH	Temp (^{0}C)	E.C (µS/cm)	TDS (mg/L)	Turbidity (mg/L)	Ca (mg/L)	Mg (mg/L)	F^- (mg/L)
Pella	6.70±0.20	29.00±1.00	2.42±1.56	2.62±1.68	3.67±2.35	4.71±1.80	1.78±0.07	0.85±0.10
Hong	7.00±0.50	28.00±0.50	3.36±1.95	4.07±1.55	5.70±2.17	22.96±6.41	1.80±0.07	0.90±0.20
Fadama Rake	7.30±0.15	28.67±0.50	2.77±0.99	3.22±1.16	4.51±1.62	17.12±3.23	1.80±0.12	1.11±0.19
Kaala	6.70±0.32	28.93±0.90	1.91±0.39	2.37±0.36	3.32±0.51	5.00±2.52	1.91±0.08	0.27±0.12
Makera	7.10±0.50	28.00±0.50	2.87±0.25	3.28±0.52	4.59±0.73	18.85±9.52	1.53±0.57	0.91±0.14
Mararaba	6.90±0.15	27.67±0.57	2.36±1.41	3.06±1.61	4.28±2.26	22.84±4.60	1.91±0.16	0.75±0.10
Range	6.70±0.20-7.30±0.15	27.67±0.57-29.00±1.00	1.91±0.39-3.36±1.95	2.37±1.16-4.07±1.55	3.32±0.51-5.70±2.17	4.71±1.80-22.84±4.60	1.53±0.5-1.91±0.16	0.27±0.12-1.11±0.19
NAFDAC	6.5-8.5		1000	500	5.0	75	30	1.0
WHO	6.5-8.5		1000	500	5.0	75	50	1.5

Results were presented as mean and standard deviation of five replicate determinations

Table 4: Heavy Metal Concentration in Dug wells (mg/L)

Sample Locations	Cd	Pb	Fe	Cu	Zn
Pella	ND	ND	0.08±0.01	0.03±0.02	ND
Hong	ND	ND	0.02±0.01	0.06±0.02	ND
Fadama Rake	ND	ND	0.07±0.01	0.07±0.02	ND
Kaala	ND	ND	0.09±0.01	0.02±0.02	ND
Makera	ND	ND	0.06±0.04	0.07±0.01	ND
Mararaba	ND	ND	0.02±0.01	0.02±0.02	ND
Range			0.02±0.01-0.08±0.01	0.02±0.02-0.07±0.01	
NAFDAC	0.003	0.01	0.3	1.0	5.0
WHO	0.003	0.01	0.3	1.0	5.0

Results were presented as mean and standard deviation of five replicate determinations

ND= Not Detected

Table 5: Physico-chemical Parameters of Borehole water

Sample Locations	pH	Temp (^0C)	E.C (µS/m)-	TDS (mg/L)	Turbidity (NTU)	Ca (mg/L)	Mg (mg/L)	F^- (mg/L)
Pella	6.33±0.12	30.33±0.60	2.70±0.20	3.26±0.61	4.57±0.86	3.70±1.36	1.04±0.08	0.81±0.04
Hong	6.80±0.28	30.00±0.87	2.42±0.65	3.33±0.75	4.66±1.04	16.66±11.74	1.83±0.06	0.95±0.68
Fadama Rake	7.03±0.12	30.23±0.68	2.77±0.99	3.22±1.16	4.51±1.62	5.00±2.52	1.91±0.08	1.11±0.19
Kaala	6.70±0.10	29.50±0.87	1.91±0.39	2.37±0.36	3.32±0.51	4.66±3.18	1.61±0.49	0.93±0.58
Makera	6.80±0.06	29.00±0.50	1.87±0.94	2.96±0.91	4.15±1.28	13.02±8.59	1.65±0.51	0.74±0.16
Mararaba	6.80±0.17	29.17±0.76	2.36±1.40	3.06±1.61	4.28±2.26	8.28±9.09	1.71±0.08	0.68±0.11
Range	6.33±0.12-7.03±0.12	30.33±0.60-29.00±0.50	1.87±0.94-2.42±0.65	3.33±0.75-2.37±0.36	3.32±0.51-4.66±1.04	4.66±3.18-16.66±11.74	1.61±0.49-1.91±0.08	0.68±0.11-1.11±0.19
NAFDAC	6.5-8.5		1000	500	5.0	75	30	1.0
WHO	6.5-8.5		1000	500	5.0	75	50	1.5

Results were presented as mean and standard deviation of five replicate determinations.

NAFDAC= National Agency for Food and Drug Administration and Control.

WHO= World Health Organization.

Table 6: Heavy Metal Concentrations of Boreholes water (mg/L)

Sample Locations	Cd	Fe	Pb	Cu	Zn
Pella	ND	0.05±0.04	ND	0.02±0.02	ND
Hong	ND	0.03±0.02	ND	0.02±0.02	ND
Fadama Rake	ND	0.02±0.01	ND	0.02±0.03	ND
Kaala	ND	0.04±0.03	ND	0.02±0.01	ND
Makera	ND	0.05±0.04	ND	ND	ND
Mararaba	ND	0.04±0.03	ND	0.02±0.01	ND
Range		0.02±0.01-0.05±0.04		ND-0.02±0.01	
NAFDAC	0.003	0.3	0.01	1.0	5.0
WHO	0.003	0.3	0.01	1.0	5.0

Results were presented as mean and standard deviation of five replicate determinations.
ND=Not Detected
NAFDAC=National Agency for Food and Drug Administration and Control.
WHO=World Health Organization.

Discussion

The results of various physico-chemical parameters in streams, dug wells and boreholes water were presented in tables 1, 3 and 5 respectively, while the results of the heavy metals concentrations were tabulated in tables 2, 4 and 6 for streams, dug wells and boreholes water respectively. The pH value of stream in Table 1 ranges between 7.60±0.28 to 8.20±0.03. The lowest value was recorded at Pella while the highest value was recorded at Mararaba. The results of dug wells water varies from 6.70±0.20 to 7.30±0.15, while the pH values of boreholes were between 6.33±0.12 to 7.03±0.12. The results which indicated slightly acidic (6.30) to slightly alkaline (8.20) (near neutral). The nature of both the groundwater and surface water are well within the standard limits prescribed for various uses of water including drinking water supplies. Except for Pella borehole (6.30) which is slightly below the standard limits (6.5-8.5) (WHO, 2008; NAFDAC, 2012). pH is the most important parameter that served as an index for pollution and also measured the hydrogen ion concentration (H^+) and negative hydroxide ion (OH^-) in water.

Temperature varied from sample to sample. The temperature of stream water in the study area ranged from 25.00±1.40 ^oC to 33.00±1.40 ^oC with the lowest temperature recorded in Pella and the highest temperature recorded at Fadama rake. The results for dug wells water ranged from 27.67±0.57^oC to 29.00±1.00^oC. The temperature of borehole water ranges from 29.00±0.50 ^oC to 30.33±0.60 ^oC. It has been suggested that solar radiation, clear atmosphere and low water level increases the temperature of water body (Alexander, 2008b). The lowest temperature was recorded in a stream covered with tree which could have reduced the effect of solar radiation on the stream water.

The results of the electrical conductivity were between 2.84±1.03 to 4.28±0.38 uS/cm, 1.91±0.39 µS/cm to 3.36±1.95 µS/cm, and 1.87±0.94 to 2.77±0.99 µS/cm, for streams, dug wells and boreholes water respectively. All the samples analysed have their electrical conductivity values very low but were within the WHO and NAFDAC standard limits (1000µS/cm). The result of the study area was in accordance to work carried out in boreholes and dug wells by Odiba *et al* (2014). The electrical conductivity is a useful parameter of water quality for indicating salinity hazard (Alexander *et al*., 2011) which greatly affects the taste and thus has a significant impact on the users' acceptance of the water as potable (WHO, 2008). The electrical conductivity is the numerical expression of the water`s ability to conduct an electric current, it depends on the total concentration, mobility, valence and temperature of the solution of ions. Electrolytes in solution dissociate into positive (cations) and negative (anions) ions and impart conductivity. Most dissolved inorganic substances are in the ionized form in water and contribute to the conductance (Hong *et al*., 2013)

In natural water Total dissolved solid (TDS) consists mainly of inorganic salts such as carbonates, chloride, sulphate, phosphate, nitrate, magnesium, calcium, sodium, iron etc and small amount of organic matter and dissolved gases (Alexander *et al*., 2011). In the present study the

TDS values varies from 3.28±1.49 to 4.81±0.43mg/L for stream water, 2.62±1.68 to 4.07±1.55mg/L for dug wells water and 2.77±0.36 to 3.33±0.75mg/L for boreholes water. These values were relatively very small compared to the maximum value given by WHO (2008) which is 500mg/L. This shows that the amount of dissolved suspended solid particles is very low

Turbidity is the physical parameter, which is a measure of the cloudiness of water. It is caused by particles suspended or dissolved in water that scatter light making the water appeared cloudy or murky. Generally, turbidity has no direct health effects; however, it can interfere with disinfection and provides a medium for microbial growth (Olalekan *et al*., 2015). The results of turbidity for stream water in table 1 ranges from 4.45±2.42 NTU recorded in Pella and 6.73±0.06 NTU recorded in Hong. Most of the values were slightly above WHO and NAFDAC standard limit of 5NTU, except for Pella and Kaala which are within the WHO standard limit. The turbidity values of dug wells and boreholes water ranges from 3.32 ± 0.51 to 5.70±2.17 NTU and 3.32±0.51 to 4.66±1.04 NTU respectively. The samples of both the boreholes and dug wells were all within the WHO standard limits of 5NTU. The results of all the samples studied were lower compared to the results, reported in a similar study carried out on dug wells and boreholes by Alexander (2008a) (7.10 to 8.50 NTU).

In the water samples investigated of the study area calcium concentrations varies from 0.65±0.01to 14.97±0.01mg/L, 4.71±1.80 to 22.96±6.40mg/L, and 3.70±1.36 to16.66±11.74mg/L for streams, dug wells and boreholes respectively. Calcium is an essential constituent for various functioning of the human body. Its low concentration in drinking water may cause defective teeth and rickets (Alexander, 2008b). It is essential for nervous system, cardiac function and coagulation of blood. The standard desirable limit for calcium in drinking water is 75mg/L (WHO, 2008). Calcium hardness has been classified as 0-20mg/L (Soft); 20-40 mg/L (moderately soft); 40-80 mg/L (moderately hard); 80-120 mg/L (hard), >120 mg/L (very hard) (Odiba *et al*., 2014). Calcium distribution in the water samples showed that all the samples lie within the standard permissible limit of drinking water. The results of samples of groundwater were low as compared to similar study in dug wells and boreholes reported by Ishaku *et al* (2011).

The concentration of magnesium in water is comparatively less than calcium possibly due to lesser occurrence of a laxative effect result, and relative abundance in rocks (Alexander, 2008b). The WHO standard maximum permissible concentration of magnesium in drinking water is 50mg/L. The concentration of magnesium in the study area ranged from 0.53±0.16 to 1.82±0.01mg/L for streams, 1.53±0.57 to 1.91±0.08mg/L for dug wells and 1.04±0.08 to 1.91±0.08mg/L for boreholes. All values of the analysed samples were very low.

The fluoride concentration in Fadama rake for both streams, dug wells and boreholes water were slightly above NAFDAC standard limit of 1mg/L but were still within WHO standard limit. The fluoride concentration in the study area, were between 0.84±0.00 to 1.28±0.04 mg/L, 0.75±0.10 to 1.11±0.19mg/L, and 0.68±0.11 to 1.11±0.19mg/L for streams, dug wells and boreholes water respectively. The values of the samples in the study area were within the WHO standard limit of 1.5mg/L. High concentration of fluoride contaminant in the water samples of the study area tends to be in association with crystalline rocks containing fluorine-rich minerals, especially granites and volcanic rocks, shallow aquifers in arid areas experiencing strong evaporation, sedimentary aquifer undergoing ion exchange and inputs of geothermal water.. However, when present in drinking water at concentrations much above the guideline value of 1.5mg/L, long term use can result in the development of dental fluorosis or at its worst bone fluorosis (Olalekan *et al*., 2015; Kateria *et al*., 2014).

Iron in drinking water may be present as geological sources, industrial waste and domestic discharges and also from mining products. Excess amount of Iron (more than 10mg/kg) causes rapid increase in respiration, pulse rate, coagulation of blood vessels and hypertension (Alexander, 2008b). Iron is one of the heavy metal which is necessary for health, it plays a role in human nutrition; it help in the formation of protein hemoglobin, which transport to all cells of the body (Babagana *et al*.,2014). The standard desirable and the maximum permissible limits of iron in drinking water is 0.3mg/L and 1.0mg/L respectively according to WHO, 2008. The concentration of the iron in the water samples investigated ranged between 0.04±0.01 mg/L to 0.20±0.15mg/L in streams, 0.02±0.01mg/L to 0.09±0.01mg/L in dug wells and 0.02±0.01 to 0.05±0.03mg/L in borehole. All the water samples had their iron concentration within this desirable limit for drinking water. Although, the results of all the water samples analysed in this study were in agreement with results reported by Babagana *et al.*, (2014).

The concentration of copper varies from ND to 0.09±0.01mg/L, 0.02±0.01 to 0.07±0.01mg/L, and ND to 0.02±0.01mg/L, for streams, dug wells and boreholes water respectively. All the samples in this study were within the WHO and NAFDAC maximum limit of 1.0mg/L. Copper is essential to humans, the daily adult requirement has been estimated at 2.0mg. copper salts are used in water system to control biological growths in reservoir and distribution pipes and to catalyze the oxidation of manganese (Alexander, 2008b). Individual with copper toxicity show an abnormally high level of copper in the liver, kidney, brain, eye and bones. Acute toxicity of ingested copper is characterized by abdominal pain, diarrhea, vomiting and metallic taste in mouth (Babagana *et al*., 2014).

Lead, cadmium and zinc were not detected in all the water samples analysed.

Conclusion

The physicochemical parameters studied were all within the standard desirable limit for drinking water quality recommended by WHO (2008) and NAFDAC (2012) except, that the turbidity values of most streams were slightly above WHO standard limits (5NTU). From this study it is concluded that both the surface and ground waters of Hong Local Government Area of Adamawa State, Nigeria are generally suitable for drinking and domestic purposes. However, there is need for regular monitoring of the water quality of the study area, so as to ascertain their suitability, as human activity are regularly changing the concentration of these water quality parameters so as to forestall the outbreak of water born diseases.

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