Asian Journal of Geological Research

3(4): 16-25, 2020; Article no.AJOGER.62872

Assessment of Ground Water Quality (A Case Study of Mando, Igabi Local Government Area, Kaduna State)

A. A. Ijah[1*], E. J. Zakka[1], O. N. Oladele[1] and O. E. Olagunju[1]

[1]Federal College of Forestry Mechanization, P. M. B. 2273, Afaka-Kaduna, Kaduna State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Author AAI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors EJZ and ONO managed the analyses of the study. Author OEO managed the literature searches. All authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Ahmed Abdelraheem Frghaly, Sohag University, Egypt.
Reviewers:
(1) Sandeep A. Meshram, College of Engineering Pune (COEP), India.
(2) Mohamed Ahmed El-Sadek, Nuclear Materials Authority, Egypt.
Complete Peer review History: http://www.sdiarticle4.com/review-history/62872

Original Research Article

Received 25 August 2020
Accepted 31 October 2020
Published 20 November 2020

ABSTRACT

This study shows the assessment of ground water quality in Mando Area of Igabi Local Government Area of Kaduna State. A total of twenty (20) samples of water (Ten (10) bore-hole water samples and Ten (10) hand dug well water samples) were collected randomly from different locations within the study area. The analysis of these samples was carried out in the Water Quality Laboratory of National Water Resources Institute Kaduna except for the the analysis of the heavy metals which was carried out at the Federal Ministry of Agriculture and Rural Development, Kaduna State. The result from the analysis shows differences in the average level of physiochemical and bacteria concentration for both categories of water samples. But this difference in concentration still falls within the permissible limit of both the World Health Organization (W.H.O) and (NSDWQ) standard for water quality, thus acceptable. The concentration of heavy metals like Lead and Chromium is same for both samples in the study area which is above the permissible level of WHO and NSDWQ standards. The average level of physiochemical and bacteria concentration of both categories of samples are thus; for bore-holes water sample: Electrical Conductivity is 109.56 $\mathcal{M}$s/cm, Turbidity is 0.07 NTU, Total Dissolved Solid is 54.5 ppm, Temperature is 25.2℃, Colour is 8.6 TCU, Ph is 6.4, Total alkalinity is 51.3,

**Corresponding author: Email: aadoga2@gmail.com;*

Nitrate is 25.72, Chloride is 22, Total Hardness is 39.52, Salinity is 35.8, Fluoride is 0.53, Iron is 0.012, Sulphate is 3.6, Lead is0.4, Chromium is -0.068, Total coliform is 13.8 and that of the hand dug well in same sequence is thus; 183.39, 1.76, 90.22, 25.15, 14, 6.6, 30.2, 42.56, 23.4, 56.8, 38.7, 0.24, 0.012, 2.3, 0.4, - 0.078 and TNTC.s

Keywords: Assessment; ground water quality; Mando; Igabi; Kaduna.

1. INTRODUCTION

Water is one of the most abundant and essential resources of man, and occupies about 70% of earth`s surface. About 97% of this volume of earth`s surface water is contained in the oceans, 21% in polar ice and glaciers, 0.3-0.8% underground. According to WHO [1] only about 1.1 million people have access to improve drinking water supply, in most cities, towns, and villages in Nigeria. Valuable mass-hours are spent on seeking and fetching water, often of doubt quality from distant sources [2]. According to Botkin and Keller [3], more than 97% of earth`s water is in the ocean and ice caps, and glaciers account for another 2%. Also, the ocean comprises of 97%, while 3% of the earth`s is fresh [4].Water in it`s pure state is acclaimed key to health and the general contention is the water is more basic than all other essential things to life [5]. Man requires a regular and accessible supply of water which forms a major component of the protoplasm and provides an essential requirement for vital physiological and biochemical processes. Two third of a person`s water consumption per day is through food while one third is obtained through drinking [6]. In addition to human consumption and health requirement purposes. Water is also considered a purifier in most religions [7]. Though all these needs are important since health of the population influence all other activities [8]. According to Odiette [9], environmental water usage includes artificial wet lands, artificial lake intended to create wildlife habitat, fish ladders around dams and water release from reservoirs to help fish spawn.

Groundwater is the water beneath the surface where all the voids in the rocks and the soil are filled. It`s a source of water for wells, boreholes, and springs. A borehole is a hydraulic structure which when properly designed and constructed, permits the economic withdrawal of water from an aquifer. It`s a narrow well drilled with a machine. Borehole water is the water obtained from borehole drilled into the aquifer or ground water zone, which is usually a fully saturated subterranean zone, some distance below the water table [10]. Groundwater is already used extensively in Nigeria through wells and boreholes. Ground water has been thought of as being a standard of water purity in itself, and to a certain extent, that is indeed true [11]. Apart from the essential role played by water in supporting human life, it also has, if polluted, a great potential for transmitting a wide variety of disease. According to Ademoroti, in most [12], countries like Nigeria were dangerous and highly toxic industrial and domestic waste of by dumping them on the earth into rivers and stream with total disregard for aquatic lives and rural dwellers.

Generally, borehole water is considered to have better microbial quality than that of hand dug well water because boreholes water is from deep aquifer while hand dug wells is from structure aquifer which makes it more acceptable to microbial pollutions [13] Consumption of some water can cause borne diseases such as typhoid and paratyphoid fevers (salmonellosis), as most of the enteric diseases are transmitted through water [14]. Contamination of ground water is a major problem plaguing the whole world, Africa and Nigeria is not an exception.This limits the quality of water available for domestic use globally. Groundwater pollution is as a result of anthropogenic factors including agriculture, industrialization and urbanization. Groundwater is known as the major source of water supply in Mando, and its contamination is a major environmental and health concern, and also a function of types of waste, season, topography, soil, underlying geology, surface water ingression and direction of groundwater flow.The aim of the study is to assess the quality of Groundwater supply sources (Boreholes and Hand dug wells) in Mando, Kaduna State.

2. MATERIALS AND METHODOLOGY

2.1 Sample Size and Sampling Technique

Razaq and Ajayi [15], define sampling as a systematic process used to select a required portion of a target population or area. In order to achieve a desired output and conduct a thorough

study. The sampling technique employed for this research is the purposive sampling technique, because sampling site for both Borehole and Hand dug well water sample collection was purposively chosen (grab samples). A total of twenty (20) samples {Ten Borehole and Ten Hand dug well water samples} were randomly collected from different locations within the study area for the purpose of this research work. Water samples were collected using clean and sterilized water sample bottles, properly labelled and transported immediately to the laboratory in a container of ice for physico-chemical and microbiological analysis. The water samples were analyzed within three hours of collection in order to avoid change in characteristics of the samples.

2.2 Laboratory Analysis of Samples

The conduct of analysis for this research work was carried out in the Water Quality Laboratory at National Water Resources Institute, Kaduna; where the physico-chemical and microbiological characteristics were measured. The parameters analyzed include, Total Dissolved SDS), Salinity, Nitrate, Total Coliform, Chloride, Total hardness, Temperature, Turbidity Electrical Conductivity, Total Alkalinity, pH, and Colour, Fluoride, Iron, Lead (Pb), and Chromium (Cr).

2.2.1 Analysis of turbidity using nephelometric method

Suspension of particles in water interfering with passage of light is called turbidity. Turbidity is caused by wide variety of suspended particles. Turbidity can be measured either by its effect on the transmission of light which is termed as turbidimetry or by its effect on the scattering of light which is termed as nephelometry. The acceptable and permissible limits are 1 and 5 NTU respectively. Turbidity can be measured using a turbidimeter in NTU.

2.2.1.1 Materials and reagents

Digital turbidity meter, sample cells, glass beakers, water sample, distilled water and soft tissue.

2.2.1.2 Procedure

The turbidity meter was placed on a flat surface and turned on. It was then calibrated using distilled water as blank. The sample cell was filled to mark, and then Inserted into the turbidity meter and covered with a light shield cap. the reading was displayed, then the first stable reading was taken and recorded.

2.2.2 Analysis of pH using potentiometric

pH stands for “Power of Hydrogen;” The measure of the concentration of hydrogen ions in a solution. pH relates directly to the amount of hydrogen ion (H^+) present in a water solution, the more the (H^+) the more acidic the water solution and the lower the pH.

2.2.2.1 Materials and Reagent

Digital pH meter, buffer solutions (pH 7), beakers, water sample, distilled water and soft tissue.

2.2.2.2 Procedure

The electrode was rinsed with distilled water and wiped with soft tissue. The meter was calibrated using the buffer solution. Rinse electrode with sample to be measured. Rinse beaker with sample to be analyzed and then pour the water sample into a beaker. Insert electrode without touching the bottom of the beaker, switch ‘’ON’’ the pH knob and take reading on the scale. Rinse the electrode with distilled water and store.

2.2.3Temperature measurement

Temperature is usually measured in degree centigrade (°C). Temperature affects the property of water such as solubility, viscosity, density and surface tension. also, the solubility of chemicals and bacteriological activities are influenced by temperature. Temperature also increases taste and odour but decreases the solubility of gasses.

2.2.3.1 Materials and reagents

Temperature compensated EC/TDS meter, Beaker (250ml), water sample, distilled water and soft tissue

2.2.3.2 Procedure

The water sample was transferred into a beaker and then the electrode of the conductivity meter was rinsed with distilled water. The electrode was then also rinsed with the sample to be analyzed and then inserted into the sample, the

meter was switched ''ON'' then the first stable reading was taken and recorded.

2.2.4 Analysis of colour using visual comparison method

Colour in drinking-water is usually due to the presence of coloured organic matter (primarily humic and fulvic acids) associated with the humus fraction of soil. Colour is also strongly influenced by the presence of iron and other metals, either as natural impurities or as corrosion products. It may also result from the contamination of the water source with industrial effluents and may be the first indication of a hazardous situation.

2.2.4.1 Materials and reagent

Lovibond comparator**,** cells, calibrated colour disc and water sample.

2.2.4.2 Procedure

A sample cell was filled to mark with distilled water and placed in the left sample position on the comparator, another cell was filled with the water sample to be analyzed, and placed in the right sample position of the comparator, the colour disc was then placed and rotated to match the color of both the sample and distilled water. The measurement on the disc was then taken and recorded.

2.2.5 Electrical conductivity analysis using cell potentiometric

Electrical conductivity refers to how much electricity can pass through a water sample. The measure of conductivity gives a fair approximation of the amount of ions present in a water sample. The higher the conductivity, the higher the percentage of dissolved ions in water. Conductivity is indicative for TDS. Conductivity is measured using a conductivity meter.

2.2.5.1 Materials and reagent

EC/TDS compensated meter, 12.88µS/cm EC standard solution, plastic beakers, water sample, distilled water and soft tissue.

2.2.5.2 Procedure

The electrode of the EC meter was first rinsed with distilled water and wiped with soft tissue. The meter was then calibrated using EC standard solution. The electrode was then removed and rinsed thoroughly with distilled water then wiped with soft tissue. The electrode was also rinsed with the sample to be measured. The probe was submerged into the beaker containing the water sample, the mode was changed to EC, then the reading was allowed to stabilize. The first stable reading was taking and recorded.

2.2.6 Gravimetric analysis of total dissolved solids (TDS)

TDS describes a number of inorganic and a small amount of organic matter that could be found dissolved in water, and it is usually expressed in milligrams per liter (mg/l). The concentration of dissolved solids may affect the taste of water (i.e. TDS of high concentration in portable water) and may also be unsuitable for industrial applications. The desirable limit for TDS is 500 mg/L in permissible limit. (NSDWQ).

2.2.6.1 Materials and Reagents

EC/TDS meter, beakers, water sample, distilled water and soft tissue.

2.2.6.2 Procedure

The electrode of the EC/TDS meter was first rinsed with distilled water and wiped with soft tissue. The electrode was also rinsed with the sample to be measured. The probe was submerged into the beaker containing the water sample, the mode was changed to TDS, then the reading was allowed to stabilize. The first stable reading was taking and nrecorded.

2.2.7 EDTA titrimetric methodof analysingtotal hardness

Hardness occurs in water due to the presence of alcium and magnesium ions. Calcium and magnesium come from geologic deposits. As water percolates through a rock containing calcium, magnesium or dolomite [$CaMg(CO_3)_2$], it comes out and makes the water hard. The degree of hardness of drinking water has been classified in terms of the equivalent $CaCO_3$ concentration as follows: soft -0-60mg/l, medium - 60-120 mg/l, hard - 120-180 mg/l, very hard - >180 mg/l.

2.2.7.1 Materials/reagent

Ammonia buffer, 0.01N EDTA solution, Eriochrome black T indicator, water sample, distilled water, burette, conical flask, beakers and measuring cylinder.

2.2.7.2 Procedure

100ml of the water sample was measured into a 250ml conical flask. 1ml of buffer solution was then added, it was then swirled gently, then two drops of Eriochrome black T indicator was added, and Titrated against 0.02N EDTA solution until change of colour occurred (the solution turned from wine red to blue with no hint of red).

2.2.7.3 Calculation

$$\text{mg/l Total Hardness} = \frac{\text{Titre} \times A \times 1000}{\text{Vol. of sample used}}$$

(Where: A = mg $CaCO_3$ equivalent to 1.00ml of EDTA Titrant =100)

2.2.8 Analysis of alkalinity using titrimetric (methyl orange) method

Alkalinity is a measurement of the concentration of all alkaline substances dissolved in the water. These substances are primarily carbonates, bicarbonates and hydroxides, etc. These alkaline substances buffer pH in the water by neutralizing acids. In other words, alkalinity is a measurement of the water's ability to resist change in pH.

2.2.8.1 Materials and reagent

0.02N sulphuric acid (H_2SO_4),phenolphthalein indicator, methyl orange, burette, measuring cylinder, beakers, water sample and distilled water.

2.2.8.2 Procedure

1N (0.5M) solution of sulfuric acid was prepared which was obtained by appropriately diluting 2.8ml of concentrated sulfuric acid in 100ml distilled water. Then 0.02N (0.01M) H_2SO_4 solution was prepared by diluting 20ml of the stock solution (1N H_2SO_4) with distilled water and made up to 1000ml in a volumetric flask. 100ml of the water sample was measured and transferred into a conical flask, two (2) drops of methyl orange indicator was then added and Titrated against 0.02N H_2SO_4 to the first colour change (faint pink) the titre value was recorded.

2.2.8.3 Calculation

$$\text{mg/l Total Alkalinity} = \times 1000$$

2.2.9 Chloride Analysis using argentometric titration

Chloride in drinking-water originates from natural sources, sewage and industrial effluents, urban runoff containing de-icing salt and saline intrusion. Excessive chloride concentrations increase rates of corrosion of metals in the distribution system, depending on the alkalinity of the water. This can lead to increased concentrations of metals in the supply. No health-based guideline value is proposed for chloride in drinking-water. However, chloride concentrations in excess of about 250 mg/l can give rise to detectable taste in water.

2.2.9.1 Materials and reagent

0.0141N $AgNO_3$ solution, Potassium chromate indicator, water sample, distilled water, measuring cylinder, beakers and burette.

2.2.9.2Procedure

100ml of the sample was measured into the conical flask, 2 drops of potassium chromate indicator was then added and swirled gently, then it was titrated with standard silver nitrate solution. The solution turned reddish-brown then the titre value was taken and recorded.

2.2.9.3 Calculation

$$\text{mg/L Chloride} = \frac{(A - B) \times N \times 35{,}450}{\text{vol. of sample used}}$$

Where

A = ml titrant
B = ml blank (0.25)
N = Normality (0.0141N)

2.2.10 Salinity analysis

Salinity can be calculated by multiplying the concentration of chloride by 1.65 this is an accepted constant

2.2.11 Nitrate analysis using nitrate kit test (colour chart) method

Nitrate (NO_3^-) is found naturally in the environment and is an important plant nutrient. It is present at varying concentrations in all plants and is a part of the nitrogen cycle. Nitrate can reach both surface water and groundwater as a consequence of agricultural activity (including excess application of inorganic nitrogenous fertilizers and manures), from wastewater disposal and from oxidation of nitrogenous waste products in human and animal excreta, including septic tanks.

2.2.11.1 Materials and reagent

Nitrate test kit, test tubes, nitrate reagent 1 and 2, distilled water, water sample and soft tissue

2.2.11.2 Procedure

10ml of water sample was transferred into a test tube, a pinch of nitrate reagent – 1 was added to it and then the solution was agitated for 5minutes. It was then Allowed to stand for few minutes and then the supernatant solution was decanted (about 5ml) to another test tube. Three drops of nitrate – 2 was then added to the supernatant solution and mixed well. It was allowed to wait for 5 minutes with occasional shaking. The final colour formed was then compared with nitrate colourchart, the nitrate concentration was then taken and recorded.

2.2.12 Microbiological parameters using membrane filtration method

The total group includes Faecal coliform bacteria such as *Escherichia coli* (*E. Coli*), as well as other types of coliform bacteria that are naturally found in the soil. Faecal coliform bacteria exist in the intestines of warm-blooded animals and humans, and are found in bodily waste, animal droppings, and naturally in soil. Most of the fecal coliform in fecal material (feces) is comprised of *E. Coli.*

2.2.12.1 Materials and reagent

Lauryl Sulphate Broth/ Eosin Methylene Blue (EMB), cotton wool, ethanol, aluminum foil, incubators, thermometer, water bath, analytical balance, oven, autoclave, hand gloves, forceps, measuring cylinder, membrane filter, membrane filtration unit, conical flasks, glass beakers, Petri dishes/plates, spatula, colony counter and distilled water.

2.2.12.2 Procedure

All the glassware to be used were cleaned using ethanol and flame and allowed to cool.

Preparation of culture media

a) 200ml of distilled water was boiled for at least 5 minutes, and then allowed to cool. Ten (10) level spoonsful of Lauryl Sulphate Broth were taken from the stock container and transferred into a clear plastic bottle using a spatula. 20ml of the boiled distilled water was poured into a plastic bottle and sealed tightly. the bottle was shake thoroughly so that the media is completely dissolved. The plastic bottle was then put in a water bath and heated so as to sterilize the prepared media

b) 3.6g of Methylene blue agar was weighed using a weighing balance and placed in a conical flask. 100ml of distilled water was measured using graduated cylinder. The conical flask was covered with wool and wrapping sheet. The media was cooked with electrothermal. When it starts bubbling, it was removed and kept on the ground and when it settles, it was returned to the machine. The process was repeated six times. After preparing the media, it was allowed to cool and put inside the Petri-dish (for culturing). Membrane filter method was used for the filtration process. The media was cultured for 24hours in an incubator. Fc = 44.5^0C and Tc = 37^0C

After 24hours, the colony was read. After incubation, the plates/Petri dishes were removed from the incubators. The characteristic pink colonies were counted in each case and record.

2.2.13 Sulphate analysis

Sulfates of calcium and magnesium form hard scale. Large concentrations of sulfate have a laxative effect on some people and, in combination with other ions, give water a bitter taste.

2.2.13.1 Materials

Sulphaver 4 sulphate reagent, 25ml cell, clock/timer, pipettes, measuring cylinder,

Table 1. Physicochemical and bacteriological analysis results of Boreholes in the study area

Measured Parameters	Neco-1	Neco-2	Eye Center-1	Eye Center-2	Eye Center-3	Faringida-1	Faringida-2	Lema-1	Lema-2	Lema-3	NSDWQ	WHO Limits
Electrical Conductivity (µs/cm)	132.4	88.9	145.0	149.3	120.0	85.2	48.7	143.9	90.0	92.2	1000	1000
Turbidity (NTU)	0.4	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1	5	5
Total Dissolved Solids (ppm)	66.3	43.9	71.2	74.4	59.2	41.9	24.5	71.8	45.7	45.8	500	500
Temperature (^{o}C)	25.0	25.6	25.3	24.7	25.4	25.5	24.7	25.1	25.1	25.8	-	-
Colour (TCU)	5	5	5	3	5	15	15	15	15	3	-	15
pH	7.3	6.4	6.6	6.3	6.0	6.1	5.8	5.8	7.1	6.3	6.5-8.5	6.5-8.5
Total Alkalinity (mg/l)	45.00	45.00	63.00	61.00	46.00	43.00	60.00	60.00	41.00	49.00	-	500
Nitrate (mg/l)	20.20	14.40	36.00	32.10	34.50	13.50	36.00	27.60	21.60	21.30	50	50
Chloride (mg/l)	14.75	26.74	29.24	21.24	21.74	19.24	24.24	18.74	22.74	21.24	200	200
Total Hardness (mg/l)	29.00	18.00	44.00	49.00	41.00	25.00	48.00	53.00	45.00	43.00	150	500
Salinity (mg/l)	24.34	44.12	48.25	35.05	35.87	31.75	35.00	30.92	37.52	35.05	200	200
Fluoride (mg/l)	0.40	0.62	0.02	0.76	1.39	0.76	0.54	0.72	0.05	0.53	1.5	1.5
Iron (mg/l)	0.02	0.03	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.02	0.3	0.3
Sulphate (mg/l)	2.00	6.00	0.00	4.00	3.00	5.00	8.00	8.00	0.00	0.00	100	250
Lead (mg/l)	0.651	0.216	0.568	0.471	0.149	0.225	0.314	0.788	0.351	0.393	0.01	0.01
Chromium (mg/l)	-0.120	-0.002	-0.057	0.019	-0.175	0.084	-0.346	-0.200	0.006	0.111	0.05	0.07
Total Coliform (cfu/100ml)	14	8	TNTC	21	4	8	46	16	8	13	10	10

Table 2. Physicochemical and bacteriological analysis results of Hand dug wells in the study area

Measured Parameters	Neco-1	Neco-2	Eye Center-1	Eye Center-2	Eye Center-3	Faringida-1	Faringida-2	Lema-1	Lema-2	Lema-3	NSDWQ limits	WHO Limits
Electrical Conductivity (µs/cm)	223	223	141.1	143.8	175.8	180.6	217	177.6	183.6	173.5	1000	1000
Turbidity (NTU)	1.0	3.2	4.1	4.2	0	0	3.4	0	0	1.7	5	5
Total Dissolved Solids (ppm)	111	110	70.0	71.5	88.2	91.1	111	88.7	91.9	68.8	500	500
Temperature (^{o}C)	25.0	25.1	25.4	25.2	24.6	25.1	25.4	25.1	25.1	25.5	-	-
Colour (TCU)	10	15	15	15	5	20	15	15	15	15	-	15
pH	7.3	7.0	6.8	6.7	6.5	6.6	6.6	6.5	6.1	6.3	6.5-8.5	6.5-8.5
Total Alkalinity (mg/l)	31.00	30.00	37.00	38.00	28.00	25.00	27.00	26.00	26.00	34.00	-	500
Nitrate (mg/l)	34.86	34.56	45.00	48.00	36.36	61.50	34.56	58.5	63.00	9.30	50	50
Chloride (mg/l)	28.74	29.24	17.74	19.74	24.74	24.74	28.74	20.24	21.74	18.24	200	200
Total Hardness (mg/l)	68.00	64.00	42.00	48.00	45.00	49.00	77.00	48.00	58.00	69.00	150	500
Salinity (mg/l)	47.74	48.25	29.27	32,57	40.82	40.82	47.72	33.40	35.87	30.10	200	200
Fluoride (mg/l)	0.26	0.34	0.38	0.36	0.13	0.09	0.13	0.10	0.27	0.29	1.5	1.5
Iron (mg/l)	0.01	0.00	0.01	0.02	0.07	0.00	0.00	0.00	0.00	0.01	0.3	0.3
Sulphate (mg/l)	1.00	0.00	6.00	0.00	5.00	0.00	0.00	5.00	6.00	0.00	100	250
Lead (mg/l)	0.683	0.430	0.715	0.518	0.148	0.152	0.336	0.353	0.208	0.582	0.01	0.01
Chromium (mg/l)	-0.120	-0.093	-0.106	-0.344	-0.088	0.004	-0.100	-0.054	0.134	0.200	0.05	0.07
Total Coliform (cfu/100ml)	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	10	10

beakers, DR/2010 Hach spectrophotometer and water sample.

2.2.13.2 Procedure

A clean sample cell was filled to mark with the water sample. One (1) Sulphaver 4 sulphate reagent was added and then mixed thoroughly and allowed to stand for 5 minutes. The colour development was observed. The blank cell was inserted into the sample well, and covered with a light shield cap and switched ''ON'' at 450nmwavelength to calibrate the Hach spectrophotometer. After 5 minutes contact time for colour development, the sample cell was inserted in the sample well and covering the vial with light shield cap. It was then Switched ''ON'' at 450nm wavelength and the displayed reading was recorded as the sample sulphate concentration.

2.2.14 Flouride Analysis

Reduces incidence of tooth decay when optimum fluoride concentrations present in water consumed by children during the period of tooth calcification. Potential health effects of long-term exposure to elevated fluoride concentrations include dental and skeletal fluorosis. Fluoride can easily be determined in a water sample using the WAGTECH test kit.

2.2.14.1 Materials

7100 Wagtech Photometer**,** water sample, zirconyl chloride tablet (flouride 1), eriochrome cyanine tablet (flouride) and sample vial

2.2.14.2 Procedure

The photometer was first calibrated with the water sample to be analyzed. Zirconyl chloride and Eriochrome cyanine tablets were then added and crushed thoroughly in a 10ml sample of water. The content was then allowed to stand for 5 minutes to allow full colour development. The colour produced is directly proportional to the fluoride concentration and is measured using the 7100 Wagtech photometer.

2.2.15 Iron analysis

Forms rust-colored sediment; stains laundry, utensils, and fixtures reddish brown. Objectionable for food and beverage processing.Can promote growth of certain kinds of bacteria that clog pipes and well openings. It can be determined using the spectrophotometric meter or by using the wagtech test kit.

2.2.15.1 Materials

7100 Wagtech Photometer, Water sample, Zirconyl chloride tablet (flouride 1), Eriochrome cyanine tablet (flouride) and Sample vial.

2.2.15.2 Procedure (WAGTECH)

The photometer was calibrated with the water sample to be analyzed. iron tablet (alkaline thioglycolate) was added to 10ml of the water sample. The content is allowed to stand for 1minute to allow full colour development. The colour produced is proportional to the iron concentration and is measured using the 7100 WAGTECH photometer.

3. RESULTS AND DISCUSSION

People are increasingly concerned about the safety of their water, as of now the main source of drinking water in urban and rural areas is mainly boreholes and hand dug wells. Current improvements of analytical methods which allow for the detection of impurities even at lower concentrations make it easier to ascertain the quality of the water we drink.The results of some physicochemical, biological parametersand heavy metalsanalyzed in borehole and hand dug well water samples from some randomly selected sampling sites in the study area (Mando, Igabi Local Government Area) are presented in Tables 1 and 2 respectively:

4. CONCLUSION

The results of this study have shown that the quality of the majority of the shallow wells and Borehole water in Mando are generally good for domestic uses. Borehole water had values for most parameters within the stipulated standard for drinking water quality. However, Ph values of borehole samples were lower than that of the hand dug well samples thus indicating that both borehole and hand dug well require treatment before drinking.The total coliform count in borehole samples from Neco-1, Eye Center-1, Faringida-2, Lema-1, and Lema-3 are of concern and are recommended for disinfection, while the total coliform count of the HDW water samples are of a greater concern as they all show a higher level of contamination. Most of the physicochemical parameters of the samples were within acceptable limits for drinking purposes. Nonetheless, Lead concentration in both water samples are higher than the allowable

and calls for urgent concern. Thus, these parameters should be continuously monitored because of their possible threats to health at higher concentrations. Nevertheless, the presence of coliforms in all the samples generally called to question their suitability for domestic uses. Although the presence of coliform in a water sample may not necessarily pose any danger of diseases infestation when consumed, it is definitely a sign of poor sanitary system in the environment where the wells and boreholes are constructed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ademoroti CM. Environmental Issues and Management in Nigerian Development. Ibadan. Evans Publisher. 1996;67-75.
2. Botkin DB, Keller EA. Environmental Science: Earth as a Living Planet. New York. (2nd edition) John Wiley & Sons Inc. 1998;472-476
3. Chilton J. Groundwater, Water Quality Assessments – A Guide to Use of' Biota, Sediments and Water in Environmental Monitoring – 2nd Edition; 1996.
4. Eja ME. Water Pollution and Sanitation for Developing Countries. Calabar, Seaprint (Nig) Co. 2002;9-10.
5. Edungbola LD, Asaolu SO. A Parasitological Survey: Onchocerciasis in Babana District of Kwara State, Nigeria. American Journal of Tropical Medicine & Hygiene. 1984;33(999):1147-1154
6. Foel EW, Nenneman RA. How Peace came to the World. Cambridge. MIT Press. 1986;112-121
7. Kulshreshtha, SN. A Global Outlook for Water Resources to the Year 2005. Water Resources Management. 1998;12(3):167-184.
8. Linsley RK, Frazini JB. Water Resources Engineering, 3rd Edition. McGraw-I 1111 International Book Company; 1979.
9. Miller GJ. Environmental Science Sustaining the Earth. California (3rd Edition) Wadsworth Publishing Company. 1992;232-265.
10. Muyi TD. Water and the Body. Daily Sun. Tuesday, August 7, 2007 edition.2007;3.
11. NWRI. Training Guide for Basic Water Treatment Operations. Kaduna. National Water Resources Institute. 1997;1.
12. Odiette, WO. Environmental Physiology of Animals and Pollution Diversified Resources. Lagos.1999;187-218.
13. Ogan MT. Examination of Surface Water Sources of Domestic Water Supply in Port Harcourt Area. Chemical Hydrology Supply. 1988;79:3.
14. WHO. Guidelines for Drinking Water Quality Vol. 1 Geneva Addendum to the 3rd Vol. 1 Recommendations World Health Organization.2006;23-48.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/62872