Ground Water Development for Portable Water Supply in Offa, Kwara State, Nigeria

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ABSTRACT

Water is an essential food and basic component for life, the need of water is strongly ascending and has a diversified function, which is not only important for drinking purpose, but is also vital for any developmental activities. This study determined the quality of ground water in both borehole and hand dug wells within Offa Metropolis (from the four region of Offa i.e. North, South, East and West) in order to know their level of portability for human consumption, also comparing their chemical, physical and biological content to the Nigerian Standard for Drinking Water Quality and World Health Organization (WHO). The parameters for quality checks were grouped into three which are chemical, physical and biological parameters. The physical parameters are; colour, odour, taste and turbidity. The chemical parameters are; pH, Aluminum, phosphorus, chlorine, iron and manganese and total solid. While the biological parameter is bacteria count using total coliform count method. From laboratory analysis, the result obtained revealed that some parameters are high in terms of concentration, some are within the range required while some parameters are below the required range. The high concentration of manganese value are; 0.4, 0.3, 0.5, 0.7 all in mg/L greater than 0.2mg/L of Nigerian Standard for Drinking Water Quality standard for manganese and for phosphorus value; 0.70, 0.45, 0.58, 0.65, 0.58 all in mg/L which are greater than maximum permit (i.e. 0.3mg/L). In accordance to the result obtained, some of the borehole water from the four regions were found to be safe for consumption and some are found to be treated before use due to their chemical compositions while the well water from Secretariat area, Olorunkuse Area, Aleri Sawmill Area, Omoowo Area and Total Area of Offa are not safe for consumption without treatment due to presence of chemical composition. It is therefore recommended that detailed analysis should be carryout on the surrounding of point where boreholes or wells are to be sited, to be able to determine the toxic nature of the soil and its chemical compositions.

KEYWORDS: Ground Water, Portability, Concentration, Consumption, Offa Metropolis.
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1. LITERATURE REVIEW

Haliru, Aliyu and Hong (2013), Adamawa State used DR 2000 Spectrophotometer, flame photometer and titrimetric method in assessment or the physical and chemical properties of ground water. Fifteen water samples were collect from boreholes in the Study area. The samples were collected from existing borehole for water supply according to chiton method. The field parameter such as pH, Electric Conductivity (EC) and Total Dissolved Solid (TDS) were

measured in the field using pH meter, and conductivity/TDS meter respectively, the chemical parameters were analysed using spectrophotometer, flame photometer and of chromium hexavalent exceeded world health organization standard which was a attribute to ground water coming into contact with sewage and waste source from human activities. The study was concluded that the water is not suitable for human consumption without treatment.

Bu, Xiang, Sijue and Quanfa (2010) used multivariate statistical techniques and guiding method for the temporal and spatial variation of water quality in the Jinshui River in China. The study sampled water quality at twelve sampling site from October 2006-August 2008.

The following twenty five representative variable were tested for: Temperature, pH, Electrical Conductivity (EC), Total Dissolved Solid (TDS), Dissolved Oxygen (DO), 5- day Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Bicarbonate (HCO_3) Sulfate, Ammonia Nitrogen (NH_4N), Nitrate Nitrogen (NO_4N), Total Nitrogen (TN), or Thophosphate (PO_4P), Dissolved Phosphorus element (DP), Total Dissolved Phosphorus (TDP), Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na), Iron (Fe), Silicon (Si) and Polythylene plastic bottles rinsed three times with distilled water for laboratory analysis. All samples were refrigerated at 4^oC prior to analysis. For COD, T-Hands, DS, PO_4P, DP, TDP and dissolved trace elements. The samples were acidified to pH<2 using high-purity nitric acid, while samples from TN analysis were acidified by strong sulfuric acid.

Temperature, PH, EC, TDS, DO, NH_4N and NO_3N were detected in situation using multi parameter water quality monitoring instrument. Bicarbonate, SO_4Cl, the T-hand were determined by titration. BOD was calculated through quantifying the dissolved Oxygen of the samples before and after 5days incubation at 20^oC and COD was measured by the Potassium permanganate method. The TPD was analysed by digestion and acalorimetric method.The results were expressed in terms of factors of loadings of the twenty-five variables on VARIMAX rotation in the river, in which all of them showed significant classification in the Cluster Analysis (CA) represent as no pollution, moderate pollution and high pollution levels.

Five factors were also determined in the area, denoted as salinity, turbidity, organic pollution, oxide-related process and erosion. It was concluded that water qualities in November 2007, March 2008, and August 2008 were highly influenced by trophicity factor. Akoro and Adiyan (2007) used plain test photometer method for the determination of trace metals such as Fe, Cu, Mn, Zn and some physiochemical properties in drinking water samples from the Brong Aofa region, Ghana. The drinking water samples were collected in prewashed polythene bottles. pH and conductivity of the samples were measured while collecting the samples. Each water samples was taken four times at four different sampling periods with an interval of three months.

The samples were analyzed using procedure outline in the plain test photometer method. The results obtained from the study revealed that the concentration of the investigated major ions and trace metal was in the drinking water samples from these communities were found to below the guides for drinking water given by the W.H.O. It was concluded that the water in these communities is safe for domestic consumption as the levels of these ions pose no health hazard. Haliru, Aliyu and Hong (2013) concluded in a journal titled “ground water quality assessment for domestic and irrigation purposes in Yola Adamawa State” that the implication of the elevated level of heavy metal in some sample of ground water is a serious cause for concern to public health. Most of the groundwater sample are good and can be used for irrigation with adequate soil management. The samples were collected from 15 boreholes and hand dug wells that represented groundwater. An in-situ measurement was made for conductivity, pH, total dissolved solid (TDS) and temperature using a Standard turbidity meter, bicarbonate (HCO_3) measurement was carried out using titration method. The result was compare with the WHO and NSDWQ guidelines for portable water.

Fakayode (2013), come into conclusion that the concentration level or contaminants examine in ground water sample in the well investigated fall within the maximum acceptable concentration stipulated by World Health Organization (WHO) and National Agency for Food and Drugs Administration and Control (NAFDAC) except GW2 for set season. It was concluded that the concentration level will be higher than level stipulated by the regulatory bodies in future base on the predicted value, hence there is a need to upgrade the dumping site to prevent future base contamination of ground water.

Adegbola (2002) used atomic absorption spectrometer method in determine impact assessment of selected pollution source on ground water quality. A reconnaissance survey was carried out at the study area in order to locate the major sources of pollution. Twenty hand dug well were randomly selected base on their proximity or closeness to pollution. The result was compared with the standard guide line value by World Health Organization (WHO), most of the parameters were not found averagely to deviate from the standard or found to be present in high concentration except for conductivity, pH and CU. It was concluded that a sample that had 95% of the parameter tested to be at unsatisfactory level was located within cassava processing and milling industries.

According to Longman dictionary, water is a clear colourless liquid falls as rain, fills lake, river and necessary for life to exist. Rain water is a form of precipitation in which liquid water falls to the earth's surface. It form a major part of the hydrologic cycle in which water from the oceans evaporates, condenses into clouds and precipitates back to the earth rind eventually and eventually return to the ocean through stream and rivers, to repeat the circle again as stated by Dara (2006) in their own contribution in the journal titled "Assessment of quality of drinking water source in the Federal University Owerri P. 1964".

According to Ayoade (1988) in the book, “tropical hydrology and water resources" importance of water cannot emphasize, water make life possible as without it life and civilization cannot be or survive. It is therefore not surprising that early civilizations flourish ground water valleys, such as those the Nile in Egypt, Indus in India, Hungbo in Chin, and Euphrates and Tigris in ancient Mesopotamia. Modern civilizations are as well dependent on water for survival as the early ones. In fact, the entire history of man on earth can be written in terms of his need for water. Plants on which man depend for his food cannot grow without water they need it for photosynthesis and take their nutrients from the soil in solution. Also Oparaocha and Obi (2010) stated that water is an essential element in the maintenance of all forms of life and most living organisms can survive only short period without it in their journal titled "Assessment of quality of drinking water sources in the Federal University of Owerri".

2. MATERIALS AND METHODS

Sampling

The samples are gotten from different designated Area in Offa Kwara State. The Offa town were divided into four cardinal points which are Offa South, Offa East, Offa North and Offa West the area cover by Offa South are total area, Eid prayer ground area and for Offa North the areas are Atari Area, Poly Area, Abuja Area, and Olalomi Carpet building area for Offa west the samples were collected from Itafa area, Aleri-sawmill area, Omo-owo area, and Olounkuse area. The water sample is taken from well and borehole. The test carried out include chemical content which are Chlorine, Iron, Aluminium, Phosphorus, pH, Manganese, also physical content which are turbidity, colour, odour and taste and biological content, the test carried out is bacteria count.

Test for pH, Turbidity, Total Dissolved Solid (TDS), odours, total coliform can be performed with minimal equipment and cost and provide accurate information on the state of the well and borehole water. Ideally these tests should be done every 6-12 months to ensure that the water is still safe to drink. The tests will indicate if the well and borehole water quality is staying the same or will give an early indication that some activity is impacting it. Any indication of quality detervation can then be corrected at an early stage. The water samples are taken in the following steps; these samples are pumped from well for about three minutes while the boreholes are collected within the minute. Also the samples are collected within one minute also the samples are collected into a clean clear bottle the test for odour, colour and taste are done with the aid of distilled water and the sample are observed using the sense organ which are tongue, nostril and visual observation for colour.

The test for turbidity, Aluminium, Phosphorus, Manganese, Chlorine, Iron and carried out with an instrument called colorimeter, which has a scheduled program for each test also these test procedures are achieved with some reagent for each chemical contents. The colourmeter is a digital and modern instrument with accessories and it can be used to perform many test on water for each test there are set program which make it easy test expensive and save time in perform the test and the result are display. Bacteria tests are carefully performed in order to obtain meaningful result. The pipes from the pump are briefly obtain meaningful results. The pipes from the pumps are briefly scorched with a match to insure that any detected bacteria are from the water itself and not from the pump surface. Then the water is allowed to flow for 2-3 minute before the Sample is obtained. The sterile plastic sample bags were filled, and the inner surface of the bag is taken care on not allowing hand to touched.

Total confirm, the water sample is carefully pour into the sample vials until the liquid level reaches the fill line (The Lamonte test require 5 vials; the COLIMOR test uses 1 jar with a red liquid media). Ensuring that the lip of the vial and the inner surface of the cap do not touch anything. The cap were place back and the vials is upright in the provided box and set aside for 24-36 hours. The changes in colour, gas formation are observed and the positions of the thimble in the vials are recorded. pH of water are determined by use of pH meter (Digital) which gave the clear value of the pH of each sample. The result were observed and recorded.

3. RESULTS & DISCUSSION

Results

The result obtained from the physical, chemical and biological analysis of water samples from the study areas are shown in tabular form below, also the tables consist of the maximum permit for each parameter set by World Health Organization (W.H.O) and Nigerian Standard for drinking water Quality (NSDWQ).

Table 1: The Result of Colour for four Area

Location	Offa North	Offa South	Offa East	Offa West	Unit	WHO	NSDWQ
B1	Colourless	Colourless	Colourless	Colourless	TCU	15	15
B2	Colourless	Colourless	Colourless	Colourless	TCU	15	15
B3	Colourless	Colourless	Colourless	Colourless	TCU	15	15
W1	Colourless	Colourless	Colourless	Colourless	TCU	15	15
W2	Colourless	Colourless	Colourless	Colourless	TCU	15	15

Table 2: The Result of Odour

Location	Offa North	Offa South	Offa East	Offa West	Unit	WHO	NSDWQ
B1	Colourless	Colourless	Colourless	Colourless	-	-	-
B2	Colourless	Colourless	Colourless	Colourless	-	-	-
B3	Colourless	Colourless	Colourless	Colourless	-	-	-
W1	Colourless	Colourless	Colourless	Colourless	-	-	-
W2	Colourless	Colourless	Colourless	Colourless	-	-	-

Table 3: The Result of Water Taste

Location	Offa North	Offa South	Offa East	Offa West	Unit	WHO	NSDWQ
B1	Tasteless	Tasteless	Tasteless	Tasteless	-	-	-
B2	Tasteless	Tasteless	Tasteless	Tasteless	-	-	-
B3	Tasteless	Tasteless	Tasteless	Tasteless	-	-	-
W1	Tasteless	Tasteless	Tasteless	Tasteless	-	-	-
W2	Tasteless	Tasteless	Tasteless	Tasteless	-	-	-

Table 4: Result of Turbidity

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	0	6	5	0	NTU	5-15	5
B2	2	15	13	0	NTU	5-15	5
B3	9	19	6	5	NTU	5-15	5
W1	0	12	16	0	NTU	5-15	5
W2	3	27	5	6	NTU	5-15	5

Table 5: Result of Manganese

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	0.3	0.2	0.4	0.2	Mg/L	0.4	0.2
B2	0.4	0.3	0.4	0.3	Mg/L	0.4	0.2
B3	0.5	0.7	0.3	0.4	Mg/L	0.4	0.2
W1	0.4	0.3	0.2	0.3	Mg/L	0.4	0.2
W2	0.4	0.4	0.3	0.4	Mg/L	0.4	0.2

Table 6: Result of Aluminum

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	0.011	0.016	0.016	0.010	Mg/L	0.3	0.2
B2	0.000	0.025	0.000	0.020	Mg/L	0.3	0.2
B3	0.020	0.020	0.020	0.000	Mg/L	0.3	0.2
W1	0.012	0.012	0.012	0.012	Mg/L	0.3	0.2
W2	0.000	0.025	0.000	0.022	Mg/L	0.3	0.2

Table 7: Result of Phosphorus

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	0.10	0.17	0.70	0.17	Mg/L	0.3	0.3
B2	0.23	0.23	0.11	0.00	Mg/L	0.3	0.3
B3	0.00	0.65	0.65	0.58	Mg/L	0.3	0.3
W1	0.22	0.58	0.45	0.25	Mg/L	0.3	0.3
W2	0.19	0.24	0.36	0.45	Mg/L	0.3	0.3

Table 8: Result of Chlorine

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	0.00	0.09	0.07	0.06	Mg/L	1.0	1.0
B2	0.15	0.05	0.03	0.08	Mg/L	1.0	1.0
B3	0.19	0.06	0.05	0.09	Mg/L	1.0	1.0
W1	0.05	0.07	0.01	0.07	Mg/L	1.0	1.0
W2	0.10	0.06	0.06	0.06	Mg/L	1.0	1.0

Table 9: Result of Iron

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	0.00	0.02	6	6.1	Mg/L	0.3	0.3
B2	0.05	0.05	3.91	6.49	Mg/L	0.3	0.3
B3	0.16	0.04	2.15	6.30	Mg/L	0.3	0.3
W1	0.12	0.02	4.32	6.30	Mg/L	0.3	0.3
W2	0.02	0.02	1.92	5.17	Mg/L	0.3	0.3

Table 10: Result of pH

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	3.70	1.52	6	6.1	Mg/L	6.5-9.5	6.5-8.5
B2	2.80	2.30	3.91	6.49	Mg/L	6.5-9.5	6.5-8.5
B3	4.80	5.90	2.15	6.30	Mg/L	6.5-9.5	6.5-8.5
W1	1.10	6.85	4.32	6.30	Mg/L	6.5-9.5	6.5-8.5
W2	5.01	6.60	1.92	5.17	Mg/L	6.5-9.5	6.5-8.5

Table 11: Result of pH

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	FREE	FREE	FREE	FREE	CFU	-	10
B2	FREE	FREE	FREE	FREE	CFU	-	10
B3	FREE	FREE	FREE	FREE	CFU	-	10
W1	1.17	2.08	FREE	4.5	CFU	-	10
W2	FREE	3.15	0.57	9.0	CFU	-	10

Table 12: Result of Total Solid

Location	North	South	West	East	Unit	WHO	NSDWQ
B1	0	0	0	0	Mg/L	500	500
B2	0	0	0	0	Mg/L	500	500
B3	0	0	0	0	Mg/L	500	500
W1	0	0	0	0	Mg/L	500	500
W2	0	0	0	0	Mg/L	500	500

KEY:
B: Borehole
W: Well

4. DISCUSSION

Taste and odour
Taste and odour in water are caused by the presence of decomposed organic material and volatile chemicals. From the result obtained in table 2 & 3 it shows that the samples are tasteless and odourless

Colour
Water are coloured due to dissolved impurities, waste from industrial activities. From the result in the table 1 above, sample carried out it was concluded that the water samples are colourless

Turbidity in water is because of suspended solid and coloidial matter. It may be due to eroded soil caused by dredging or due to the growing of microorganisms. High turbidity makes filtration expensive from the result in the table 4 if was observed that the sample from the following area are beyond the standard of W.H.O which is 5-15.00 FAU, the areas are Itafa Area, Eid Praying Ground Area and Total Area

Aluminium is used in water treatment to remove diseases caused microorganisms, it occurs naturally in many food in low pharmaceutical and drinking water refer to aluminium reactions for its react to water, oxygen and acid. WHO standard for the aluminium in water ranges from 0.05- 0.3mg/l
From the result, table 6 shows that the ranges of aluminum which fall between 0.000-0.022, which means a sample from Olorunkuse was from east, Total Area from north exceed the maximum permit.

Chlorine
It has been the most widely used disinfectant for water treatment in the world. There is concern in scientific and regulatory community over the use of chlorine compound to disinfect drinking water. The range of chlorine set by WHO is 0-1.0. From the result in table 8, the range of chlorine obtained is between 0.01-0.19 which means chlorine in the water samples are minimal.

Manganese
It occurs naturally in water, soil that may erode into these waters. However human activities are also responsible for much of the manganese contamination in water, the standard set by WHO for manganese is 0.4 for maximum permit and table 5 shows that some sample from Offa North like total area, Eid Praying Ground Area and some sample from south contain much manganese.

Phosphorus is a chemical compound containing phosphate, phosphorus is non-metallic elements which are necessary for life and it is found in rock as in organic phosphate. Phosphate level greater than 1.0 may interfere with coagulation in water treatment plant. From the result in table 7 it shows that some sample from total area, Aleri sawmill area, omoowo area are above the standard range of 0-0.3 by WHO.

Iron
Iron can be troublesome chemical in water supply. Making up at least 5% of the earth crust. Iron is one of the most earth plentiful resources. The maximum permit for iron is 0.3 mg/L by NSDWQ. From the result in table 9 of the test if shows that some of the sample fall below the range while some are found above the standard.

pH
The pH of water is important in determination of water quality since it affect other chemical reaction such as solubility and metal toxicity. WHO and NSDWQ standard for PH range from 6.5 -8.5 and the result in table 10 shows that the samples fall below the range except two well sample from south that fall above the range.

Total Solid

The total solid value range was 500mg/L by WHO and NSDWQ as a maximum permit. And the total solid could be due to the present of organic and inorganic matters and is one of the characteristics of water and waste water. It determination reveal the pollution level of such water and waste water. The analysis of the result shows in table 12 that the range of total solid of the sample fall below the maximum permit even there is no dissolved solid.

Bacteria Count

Coliform bacteria may not cause disease but can be indicators of pathogenic organisms that cause diseases. They latter could cause intestinal infection, dysentery, hepatitis etc. The range of bacteria in water is 1-10
From the result in table 11 it was observed that some well water samples contain coliform such as well from Atari area, Eid praying ground area and Olorunkuse area but it is not up to maximum permit.

5. CONCLUSION

From the results of analyses carried out on various water sample from wells and borehole in Offa Local Government of Kwara State, which are shown in the tables, it can be deduced that 96% of samples collected from borehole from the four regions satisfy the Nigeria Standard for Drinking Water Quality and other standard of quality of water mean while the remaining 4% of the sample contain some amount of chemicals in excess above the set standard.
From the result and other investigation carried out, it can then be confirmed that wells with little distance from dumping site, cassava processing site, septic tank and other human activities are contaminated by Organic and inorganic matters present in the soil.

6. RECOMMENDATION

State. The following recommendations are given for the development of groundwater for Portable water supply;

1. Detailed analysis should be carry out on the surrounding grounding of point where borehole or wells are to be sited, to be able to determine toxic nature of the soil and its PH level.
2. Scientific techniques should be adopted for the environmental control for the catchment areas, river or stream.
3. Monitoring of recharge water should be undertaken as it moves toward point of recovery. This is critical to help ensure that water quality is maintained, to provide early wanting or unexpected problems, and to help maintain the long-term supply of portable water.
4. Government should empower groundwater monitoring agencies in order to work effectively in tracking changes in groundwater level, assess the effect of climate on groundwater level and providing groundwater contamination information.
5. Sustainability water management should be encouraged in order to preserve groundwater and maximize the groundwater resources.
6. Geographical Information System (GIS) should be used in carried out data analysis of the water, as this will minimize errors and save time.
7. For safety purpose, all well water in Offa local Government should be treated before been use for domestic purposes.
8. A certain distance should be set between septic tank, dumping site and wells even boreholes also should be distanced from dumping sites.
9. Government and stakeholders in the affected area should work together to stop people from consuming the affected water by providing another means of portable water also people activities that pollute the groundwater should be relocated.
10. More micro-biological characteristic of water should also be included in subsequence research because of its health implications Health.

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