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QUALITY ASSESSMENT OF HAND DUG WELLS IN ADO-EKITI TOWNSHIP OF EKITI-STATE, NIGERIA

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ABSTRACT

Safe and potable water is of utmost necessity. Though the earth contains about 70% of water but not all are accessible and potable. Physiochemical and Bacteriological analysis of water sample from hand dug wells located in different parts of Ado- Ekiti township of Ekiti – State, Nigeria, were Carried out to ascertain the quality of the ground water. Water samples were collected from fifteen (15) hand dug wells in Ado local government area and investigated to determine the suitability of the water .The parameters determined included Temperature, odour, taste, turbidity, colours, Ph, total dissolved solid (TDS), total hardness, chloride calcium, nitrite, nitrate, magnesium, aluminium using conventional equipment and standard laboratory procedure. The results indicates that some of the physical and chemical parameter are within the acceptable limits of World health Organisation (WHO) and Nigeria limit standards for drinking water quality standard for consumption(NSDWQ). The pH ranged between 5.8 - 6.8, indicating toxic pollution, conductivity between 38-534us/cm, turbidity and temperature was between 4-6 NTU and 21.1- 28.7 ℃. Concentration of nitrite, nitrates and calcium ranged between 0.01-0.20mg/l, 1032mg/l and 60.5-88.4mg/l. Fluoride between 10 - 30mg/l which does not comply with the recommended standards. Alkalinity and Hardness ranged between 115.9-830mg/l and 113.7-158mg/l. Well water in some areas where moderately hard to very hard. Bacteriological examination revealed pollution in all the water samples. Total coliform ranged between 15-30Cfu/100ml with a mean value of 21.6Cfu/100ml which is an indication of faecal contamination. Thermo tolerant coliform ranged between 0 – 1Cfu/100ml with a

mean value of 0.1Cfu/100ml.This microbial contamination posed a threat to well water quality and could lead to an increase of water borne disease such as urinary tract infections, meningitis, diarrhea e.t.c. However complementary treatments are recommended to enhance the quality of the hand dug well water as desirable in Ado.

KEYWORD: Hand dug wells, Quality, Total coliform, Escherichia Coliform hazard, Ado-Ekiti.

INTRODUCTION

Water is one of the prime necessities of life. It is the most reliable natural resource vital to the existence of any form of life. The availability of good quality water is an indispensable feature for preventing disease and improving quality of life (Oluduro and Adeoye, 2007). The determination of ground water quality for human consumption is important for wellbeing of over increasing population (Ishaku, 2011). The scarcity of potable water is not peculiar to Nigeria alone but also for some other developing country as reported by Wikipedia (2010). It is reported that more than one billion people worldwide about 16% of world population did not have access to improved water source. Distribution of fresh water resource is uneven throughout the world and the fresh water availability is becoming scarce day by day owning to population growth and diverse human activities. (Freeze and cherry, 1979). In the absence of fresh water and surface water resources, ground water is exploited to meet the demand exerted by various sectors. Partial variation in the quality of groundwater in response to local geological set-up and anthropogenic factors warrants the evaluation of the quality of groundwater for any purpose including that of human consumption (Chessbrough, 2000). Assessment of the water quality for drinking purpose involve the determination of the chemical composition of groundwater and the remedial measure for the restoration of the quality of water in case its deterioration demand and identification of possible source of the contamination of ground water. Groundwater pollution is mainly due to the processes of industrialization and urbanisation that has progressively developed over time without any regard for environmental consequences (Longe and Balogun, 2010).

In Ado metropolis, government council within the metropolis provide mechanized bore-hole and hand dug wells for the people as an alternative source of drinking water in this area where treated water from the state water corporation does not reach Ado-Ekiti has a population of 308,621 as projected from 2006 census at a growth rate of 3.5% and a daily water demand of 120million litres per day (NPC, 2006). To access the water resource and

ensure sustainability, national and international criteria and guidelines established for water quality standard were used (WHO, 2005, 2011, 2014 and NSDWQ, 2007).The past related work of Adetoro & Popoola, 2014 looked into how wastes dumping site affect the ground and surface water quality especially in developing countries where problem related to wastes disposal and management are very common and serious. The increase in population had Lead to increase in hand dug wells annually to the extent that well water is becoming the principal source of domestic water within Ado-Ekiti township. (Ikem etal,2000) reported that leaching of hydrophobic organics and long term bioavailability and metal fixed by soil organic matters need to be studied to have a better approach in handling ground water pollution.

The hydrology of an area is controlled by factor such as geology, climate and structure of the area. This is as a result of the geological formation underlying the area, the structure determine the type of aquifer to be encountered and the means of recharging them (Tay, 2007). The physical and chemical parameter useful for water quality assessment are determined by the pressure of both organic and inorganic compounds that are either suspended or dissolved in it, while some of the compound are toxic to ecosystem, some constitute nutrients to aquatic organisms and others are responsible for aesthetics of the water body (Abubakar and Adekola, 2012). The objective of this study is, therefore to access the quality of groundwater and the result generated will aid in the understanding of the physical, chemical and biological parameters of hand dug wells in Ado–Ekiti township.

MATERIALS AND METHOD

1. Study Area

Ado-Ekiti is the capital of Ekiti-state with one local government council area named Ado-Ekiti local Government. Ado - Ekiti is located in Southwestern part of Nigeria with a population of 308,621 people (NPC 2006). Ado-Ekiti has a tropic humid climate with two major seasons of relatively raining season from April to October and dry season from November to March. Ado –Ekiti has an average annual rainfall Within the range of 1405mm and 2400mm of which raining season takes about 90%. .Ado Ekiti is Situated between latitude 7.62° North and longitude 5.22° East and 456m elevation about the Sea level. Ado – Ekiti has witnessed rapid population growth and urbanization since it became capital city of Ekiti-State in October 1, 1996 from the then Ondo state. Ado –Ekiti is about 48square kilometre from Akure, Ondo state capital and 344kilometer in 1956 and by 1996 it has grown to about 19.6 square kilometers with a total land area of about 700kilometer square.

Ado-Ekiti has an average density of about 441 person/kilometres square (Adebayo etal, 2015). Presently the town has a projected Population of 1,111,953 since 2010 (Orioye, 2015). The rapid increase in ground water usage, therefore call for the need to evaluate the sustainability of water used for domestic purposes and the potential sources of pathogenic bacteria. The result obtained will contribute to the understanding of the physiochemical and bacteriological characteristic of the hand dug wells in Ado-Ekiti local government area. The study area was divided into five (5) zones and each zone comprises of three (3) locations. Water samples were Collected from the areas highlighted in Table 1.

Table 1: Zones and Locations of selected hand dug wells in Ado local government area, Ekiti-state.

Zone A: Polytechnic Road	Zone B: Ikere Road	Zone C: Falegan Road	Zone D: Iyin Road	Zone E:Adebayo Road
W1:- Aba Erinfun	W4- Ajilosun	W7:-Fabian	W10:Trade fair	W13:Iworoko
W2:-Olokemeji	W5:-Moferere	W8:-Olaoluwa	W11: Basiri	W14:Pathfinder
W3:-Odo-Ado	W6:Ajebandele	W9:-Atikankan	W12: Fajuyi	W15:Nova

Note: W1 - W15: Wells

2. Water Sampling

The study area was divided into five (5) Zones and three (3) water samples were collected from each hand dug well. Five (5) litres of the groundwater sample were collected in 500ml sterilised Polyethylene bottles, stored in a germ-free atmosphere at 4^0c and placed in a cold bag for onward transfer to the laboratory for qualitative analysis. Grab simplify method was adopted for collection of water within samples, Analysis were carried out immediately at the water laboratory of federal polytechnic Ado- Ekiti and Afe-Babalola University both in Ado, Ekiti- state. Physiochemical analysis of water sample were analysed by appropriate and acceptable international standard method (APAH 2005, WHO, 2011, 2014) and the Nigeria standard for drinking water quality standard (NSDWQ, 2007).

3. Water Analysis

The physical parameters tested for include, odour, taste, colour, turbidity and temperature. Turbidity was determined by Shaking the sample vigorously and then transfer into a sample cell to at least two-thirds full using mephelometric method (APAH 1998). Appropriate range on the turbid meter was selected when the reading is stable and recorded on site. The temperature and the pH were recorded on site while the temperature was determined by a

digital hach thermometer. The sample were analysed for total dissolve solids (TDS), total hardness, nitrate, nitrite, calcium, chloride magnesium, fluoride were carried out using titration method in the water laboratory of the Federal Polytechnic, Ado-Ekiti using standard method of examination, (APHA, 2005,NSDWQ, 2007).The bacteriological test were carried out to determine the presence of thermo tolerant coliform bacteria and Escherichia coli. These were obtained using the Pour Plate method. The sample were prepared in 0.1% buffered peptone water and duplicate 1ml aliquots dilution were poured in to 10ml each of molten plate agar in universal bottles. The samples were thoroughly mixed and in abated for 24 hours at 37° (Anon, 2009).

RESULT AND DISCUSSIONS

The result and comparison of the hard dug well water sample parameters with the world Health Organisation Standard (WHO) and the Nigeria standard for drinking water quality (NSDWQ) were presented in the tables 2, 3, 4 and 5 respectively. Table 2 shows the physiochemical qualities while Table 5 shows the physiochemical and bacteriological values. Table 3, shows the bacteriological qualities and Table 4 shows the mean value of hand dug wells quality based on the zoning arrangement of Ado – Ekiti township.

Table 2: Physiochemical quality of hand dug well water in Ado local government area of Ekiti –State.

Location	Depth (m)	Temp °C	Colour HU	Conductivity Us/cm	Turbidity (NTU)	TH (mg/l)	PH	Fluoride (mg/l)	TS (mg/l)	Chloride (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	TDS (mg/l)	Alkalinity (mg/)	Nitrite (mg/l)	Nitrate (mg/l)
W1	6.3	26.6	5	50	6	141.9	6.7	0.05	2.2	24.2	88.4	53.5	0.6	115.9	0.06	10
W2	7.2	27.6	5	50	5	149.1	6.0	0.10	2.6	132.5	84.5	56.6	0.8	183	0.02	28
W3	6.3	27.1	5	57	5	138.5	6.0	0.35	1.8	143.2	80.3	58.2	0.4	152.5	0.02	30
W4	4.5	26.3	5	40	6	138.6	6.2	0.03	1.3	647.7	78.3	60.3	0.2	549	0.02	30
W5	5.4	27.3	5	38	6	158.5	5.8	0.75	1.7	675.2	88.3	70.2	0.2	866	0.15	22
W6	7.2	26.8	5	50	6	144.9	6.3	0.50	1.3	234.5	84.5	60.4	0.2	561.2	0.08	11
W7	6.3	26.8	5	50	4	113.7	6.4	0.75	2.9	454.7	60.3	53.2	1.5	572.3	0.02	25
W8	7.2	26.1	5	75	5	122.6	6.4	0.67	10.6	551.2	68.8	53.8	9.8	378.2	0.01	10
W9	5.4	27.7	5	163	4	138.0	6.3	0.75	12.6	206.7	78.0	60.0	1.6	224.6	0.01	10
W10	4.5	26.8	5	534	5	151.1	6.7	0.03	10.2	482.3	80.5	70.6	0.2	439.2	0.01	15
W11`	3.6	27.9	5	174	5	149.0	6.5	ND	0.7	585.7	79.2	69.8	0.6	573.4	0.02	30
W12	4.5	26.4	5	175	5	155.5	6.4	ND	0.9	365.2	86.4	69.1	0.8	830	0.01	12
W13	5.4	27.5	5	175	5	128.7	6.2	1.10	13.6	205.4	70.4	58.3	12.3	645	0.12	17
W14	9.9	28.7	5	152	5	124.6	6.5	0.65	13.6	323.4	68.3	56.3	12.8	646	0.20	32
W15	8.1	26.9	5	174	5	126.1	6.8	ND	13.5	346.3	69.3	56.8	12.2	656	0.17	25

Note ND: Not detected

Table 3: Bacteriological Constituents in Hand Dug wells in Ado- Ekiti Township.

Samples	Depth (m)	T. Coliform (Cfu/ml)	E. Coliform (Cfu/ml)
W1	6.3	22	0
W2	7.2	29	0
W3	6.3	19	0
W4	4.5	15	1
W5	5.4	23	0
W6	7.2	25	0
W7	6.3	18	0
W8	7.2	27	0
W9	5.4	30	0
W10	4.5	21	0
W11	3.6	15	1

W12	4.5	18	0
W13	5.4	22	0
W14	9.9	23	0
W15	8.1	17	1

Table 4: Mean values of Hand Dug Well Water Quality in Each Zone Compared with WHO and NSDWQ values.

Sample Unit	Temp °C	Turbidity (NTU)	PH	Conductivity (Us/cm)	TDS (mg/l)	Chloride (mg/l)	Calcium (mg/l)	Magnessium (mg/l)	Alkalinity (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	TS (mg/l)	TH (mg/l)	Fluoride (mg/l)	T. coli (Cfu/ml)	E.coli (Cfu/ml
WHO	Cool	0.5	6.5-8.5	400	500	200	75-200	50-80	600	0.2	50	500	100-500	1.5	0	0
NSDWQ	Cool	0.5	6.5-8.5	1000	500	250	0-65	0-20	600	0.2	50	500	50-150	1.5	0	0
ZONE A																
W1	26.6	6	6.7	50	0.6	124.2	88.4	53.5	115.9	0.06	10	2.2	141.9	0.05	22	0
W2	27.6	5	6.0	50	0.8	132.5	84.5	56.6	183	0.02	28	2.6	149.1	0.10	29	0
W3	27.1	5	6.0	57	0.4	143.2	80.3	58.2	152.5	0.02	30	1.8	138.5	0.35	19	0
Mean	27.1	5.3	6.2	52.3	0.6	133.2	84.4	56.1	150.5	0.03	26.7	2.2	143.2	0.17	23.3	0
ZONE B																
W4	26.3	6	6.2	40	0.2	647.7	78.3	60.3	549	0.02	30	1.3	138.6	0.03	15	1
W5	27.3	6	5.8	38	0.2	675.2	78.3	60.3	549	0.02	30	1.7	158.5	0.75	23	0
W6	26.8	6	6.3	50	0.2	234.5	84.5	60.4	561.2	0.08	11	1.3	144.9	0.50	25	0
Mean	26.8	6	6.1	42.7	0.2	519.2	83.7	63.7	658.7	0.08	21	1.4	147.3	0.43	21	0.33
ZONE C																
W7	26.5	4	6.4	50	1.5	454.7	60.3	53.2	572.3	0.02	25	2.9	113.7	0.75	18	0
W8	26.1	5	6.4	75	9.8	551.2	68.8	53.8	378.2	0.01	10	10.6	122.6	0.67	27	0
W9	27.1	4	6. 3	163	1.6	206.7	78.0	60.0	524.2	0.01	10	12.6	138	0.75	30	0
Mean	26.8	4.3	6.4	96	4.3	404.2	69.1	55.7	491.7	0.02	15	8.7	124.8	0.73	25	0
ZONE D																
W10	26.8	5	6.7	534	0.2	482.3	80.5	70.6	524.6	0.01	15	10.2	151.1	0.03	21	0
W11	27.9	5	6.5	174	0.6	585.7	79.2	69.8	459.2	0.02	30	0.7	149.0	0.65	15	1
W12	26.4	5	6.5	294.3	0.53	477.7	82.1	69.8	519.1	0.02	20	3.93	151.9	0.41	18	0.33
Mean	27.0	5	6.5	294.3	0.53	477.7	82.1	69.8	519.1	0.02	20	3.93	151.9	0.41	18	0.33
ZONE E																
W13	27.5	5	6.2	175	12.3	205.4	70.4	58.3	830	0.12	17	13.6	128.7	1.10	22	0
W14	28.7	5	6.5	152	12.8	323.4	68.3	56.3	645	0.20	32	13.6	124.6	0.65	23	0
W15	26.9	5	6.8	174	12.2	346.3	69.3	56.8	646	0.17	25	13.5	126.1	0.35	17	1
Mean	27.7	5	6.5	166	12.5	291.7	69.4	57.2	707	0.17	24.7	13.3	126.5	0.7	20.66	0.33

Table 5: Mean values of Hand dug well water quality of Ado-Ekiti local government council compared with the WHO and NSDWQ values.

Parameter	Ado-local Gov. area		WHO	NSDWQ
	Mean values	Ranges		
Temperature ℃	27.08	21.1-28.7	Cool temp	Cool temp
Colour (HU)	5	0-5	0-15	0-15
Conductivity (Us/cm)	130.47	38-534	400	1000
Turbidity (NTU)	5.7	4-6	0-5	0-5
Total Hardness (mg/l)	138.7	113.7-158.5	100-500	50-150
PH	6.4	5.8-6.8	6.5-8.5	6.5-8.5
Fluoride (mg/l)	0.34	0.05-0.75	0-1.5	0-15
Chloride (mg/l)	356.21	132.5-575.2	0-200	0-250
Calcium (mg/l)	77.57	60.5-88.4	75-200	0-65
TDS (mg/l)	4.95	0.2-12.8	500	500
Alkalinity (mg/l)	779.49	115.9-830	600	500
Nitrite (mg/l)	0.073	0.01-0.20	0.2	0.2
Nitrate (mg/l)	22.6	10-32	50	50
Magnesium (mg/l)	60.47	53.2-70.6	50-80	0-20
Total coliform (Cfu/ml)	21.6	15-30	0-10	0-10
E.coliform (Cfu/ml)	0.2	0-1	0	0

A. Physiochemical Characteristics

PH: The PH of water sample varied from 5.8 to 6.8 with a mean value of 6.4. Zone B has the least mean value of 6.1 while Zone D and E have the highest mean value of 6.5 each. The value fell within the recommended value of WHO and NSDWQ of 6.5-8.5 value.

Colour: The colour of the water samples in all the area fall within the WHO and NSDWQ set limits of acceptable standard for drinking and domestic water of 5HU.

Conductivity: The result shown in Table 5 shows that conductivity values of water samples in all the areas fell within the limits of acceptable standard of WHO and NSDWQ. The values ranged between 38 and 534 us/cm and a mean value of 130.47us/cm. Zone B has the least mean value of 42.7us/cm and Zone D with highest mean value of 294.3us/cm.

Turbidity: The turbidity varies from 4 -6 NTU and a mean value of 5.7NTU for all the areas. Well1 in Zone A and all the wells in Zone B does not fall within the recommended values. It has values of 6NTU against 5NTU.

TDS: Total dissolve solid varies from 0.2 -12.8mg/l with a mean value of 4.95mg/l. The TDS concentration of water samples from all the area fell within the set limit of WHO and NSDWQ.

Alkalinity: The alkalinity varied from 115.9-830mg/l with a mean value of 779.49mg/l .Zone A has the least mean value of 150.5mg/l while Zone E has a mean value of 707mg/l. All the Zones except Zone E fell within the set limits of WHO and NSDWQ of 600mg/l.

Total Hardness: the hardness varies from 113.7-158.5mg/l with average mean value of 138.7mg/l. zone C has least mean value of 124.8mg/l and zone D with highest mean value of 151.9mg/l which is a little higher than recommended standard of 100-500mg/l of WHO. Hardness reacts to the reactions that occur between soap and scale formation which increases the boiling point of water. The hardness could be as a result of leaching of Ca and Mg ions into the groundwater.

Chloride ions concentration: The chloride ions ranged from 132.5-575.2mg/l with a mean value of 365.21mg/l. Zone A has the least ion of 133.2mg/l and Zone B has the highest mean value of 519.2mg/l. All the Zones except Zone A does not fall within the recommended standard of WHO and NSDWQ of 200mg/l and 250mg/l. Excess chloride in water impact bad taste and this may indicate contamination from urine and sewage.

Nitrate and Nitrite: The water samples from all the wells fell within the recommended limit. The nitrate value varies from 10-32mg/l with average mean value of 22.6mg/l. Nitrite value varies from 0.01-0.20mg/l with average value of 0.073mg/l. An excessive amount of which, if taken over a period of time can constitute health hazard such as Cyanosis and Asphyxia called blue-baby syndrome in infants under 3months. Nitrites are quickly converted into nitrate by bacteria which exist in the air. Nitrate reach directly with haemoglobin in the human blood and produces methemoglobin which destroys the ability of blood to transport oxygen in the blood.

Calcium and Magnesium Ions: There is no adverse health impact specifically attributable to these ions in drinking water. But the presence of Ca^{2+} Mg^{2+} ion in drinking water may cause hardness of water. The calcium ions varies from 60.5-88.4mg/l with a mean value of 77.57mg/l. Zone C has the least mean value of 69.1mg/l and Zone A has the highest mean value of 84.4mg/l. Most of the wells in these areas did not fall within the acceptable recommended value of WHO and NSDWQ. Magnesium varies from 53.3-70.6mg/l with average mean value of 60.47mg/l. Zone c has the mean value of 55.7mg/l while Zone D has the highest mean value of 69.8mg/l. Their presence in water will disallow water forming lathe

with soap thereby preventing economic management of water resources. The accumulation of the ions will also affect plumbing materials in the house.

B. Bacteriological characteristics

Table 3 showed that all the well water samples in all the areas were contaminated with Total coliform and E. coliform bacteria in some areas. Presence of these in water samples causes urinary tract infections, meningitis, diarrhea, morbidity and mortality. The values varies from 15 – 30 Cfu/ml for total coliform with average mean of 21.6Cfu/ml. Zone D has the least value of 18Cfu/ml while Zone C has the highest mean of 25Cfu/ml. E-coli value varies from 0 – 1Cfu/ml with average mean value of 0.2Cfu/ml. The presence of total coliform and E-coli bacteria contamination of some of the water samples may be as a result of the location of the hang dug wells closeness to septic tank/soak away, contaminated drawers/containers to draw water from some of the wells could pollute the water. The recommended value of WHO and NSDWQ stipulated standard were 0 in 10ml. Major treatment of these well water would be required before it could be used for domestic purposes. Disinfections of wells and some other forms of treatment such as chlorination, filtration sedimentation would be require in other to make the water desirable for consumption.

CONCLUSIONS AND RECOMMENDATION

The study reveals that most of the physiochemical parameters of the hand dug well water samples in Ado-Ekiti metropolis fell within the recommended standard for drinking purposes. It was observed that the water sample were generally soft. The calcium concentration in some hand dug well water were higher compared with the acceptable limits however the presence of calcium and magnesium in the water does not pose any adverse health problems but may cause hardness of water. The consequence is that it dis- allow water from foaming lathe with soap thereby prevent economic management of water resources and also cause damage of plumbing materials. Presence of Nitrite and Nitrate in detectable quantities was an indication of poorly managed waste resulting from inappropriate disposal method in some areas. These constituent should be monitored for some period of time because of the serious environmental risk it may pose on human health such as cyanosis and asphyxia in infants under 3 months of age. Moreover, the bacteriological analysis conducted revealed the presence of Total coliform bacteria in the water samples and Escherichia coli in some wells. The indication is that people drinking the water are subject to acute renal failure and haemolytic aneaemia. Well water in all these areas were poor and not suitable for human

consumption and therefore be subjected to proper water treatment. The water samples in all the areas should be monitored sometimes and regular routine test conducted to ascertain vulnerability of the source of water to nearby source of thermo tolerant and Escherichia coliform bacteria. People should be enlightened on the best way and method of disposing wastes materials to prevent well water from contamination.

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