ISSN 2229-5518

EVALUATION OF GROUNDWATER IN UROMI, EDO STATE, NIGERIA.

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ABSTRACT - This study is aimed at evaluating the quality of groundwater from Hand Dug Well (HDW) in Uromi, Esan North East local Government Area, Edo State, Nigeria. Uromi lies north-east of Esan, located on longitude 3° 24' E and latitude 6° 27' N. It is covered with land area of about 2987.52 square kilometres. Groundwater samples were collected from HDWs and subjected to physical and chemical analysis. The results were compared with WHO standards. Analysis of results showed evidences of pollution from both physical and chemical sources. These manifested in the low levels of pH (5.25) and high levels of nitrite (4.44mg/L). It was established that the wells nearer to agricultural farms were more polluted due to incessant use of inorganic fertilizer for crop cultivation than those farther away.

Keywords - Groundwater, aquifer, pollution, properties, quality, sea level, surface

1 INTRODUCTION

Water is a natural essential commodity that has no substitute and where there is scarcity of it, there is bound to be crisis of water borne diseases, as every source of water could serve as possible repository of such diseases [1]. Groundwater is used for irrigation, domestic and industrial water supply and irrigation all over the world. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions [6].

Groundwater includes all water found beneath the earth's surface in a saturated zone of the aquifer [5]. They are formations that contain sufficient saturated permeable materials to yield sufficient quantities of water to wells and springs [2]. Groundwater can be extracted by means of HDWs and boreholes at various depths. A large percentage of the world population depends on groundwater as their main source of drinking water [7], [8], [9]. This is because it is accessible anywhere; it is less capital intensive to develop and maintain; it is less susceptible to pollution and seasonal fluctuations and of natural good quality [10], [11]. However, the quality is under intense stress from increasing demand and

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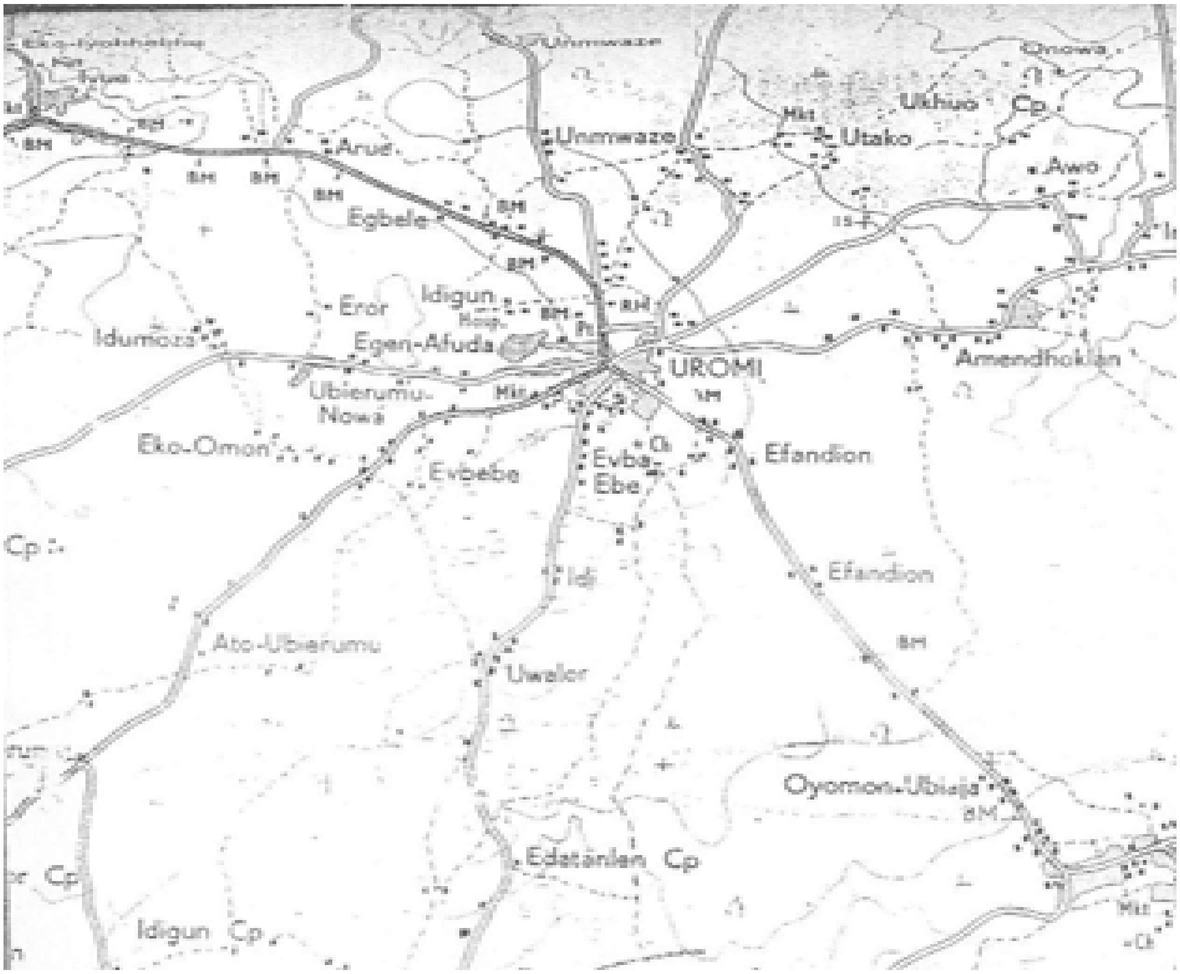
withdrawal, significant changes in land use pattern, climate change and pollution arising from geology and geochemistry of the environment [12], [13].

In this study, attempt is made to evaluate the quality of groundwater from hand dug well in Uromi for human consumption.

2 STUDY AREA

Uromi is one of the earliest settlements among the present thirty–one kingdoms in Ishan [14] and its neighbours are the Kukuruku (Owan/Etsako) in the north, Irrua in the north-west, Ugboha and Ubiaja in the south, Ugbegun and Igueben on the south-east [15]. Uromi is made up of twenty villages and they are located approximately on a landmass of not more than 60 square miles. Among the Esan plateau dwellers, Uromi stands topmost on the plateau sitting at about 1000 feet above sea level, with the village of Ivue occupying the highest point on the Ishan plateau with about 1,490 feet above sea level [16]. Underlying the plateau are lignite group of rocks consisting of clay, fine grained sands, lignite and carbonaceous clay. Being a plateau region, the people of Uromi had great difficulty in accessing drinkable water, as the people had to develop a system of digging pits to trap and preserve running rain water for use especially in the dry season. This was not quite effective, especially as the water was to a large extent considered unhygienic. Women and children who are the major drawers of water suffer untold hardships in the cause of searching for water for household use. In recent time, considerable numbers of rural communities now have HDWs however, the quality of water being exploited requires examination [3].



Source: *Ministry of Lands & Survey, Abuja. 2012*

3 METHODOLOGY

Data for the study were generated from primary source. Data from the primary source include the result of laboratory analysis and the instrumentation that was carried out on collected samples to determine quality parameters. Groundwater samples were obtained from 10 locations. The physical properties examined include pH, electric conductivity, total dissolved solid while the chemical properties includes; nitrogen oxide (NO_2), manganese (Mn), hardness, total suspended solid, zinc (Zn), iron (Fe), copper (Cu), alkalinity, turbidity and colour [17]. The chemical analysis was carried out in Edo Environmental Laboratory and Consult, Palm house, Sapele road, Benin City, Edo State, Nigeria.

The properties and methods of analysis are presented in Table 1. The description of water samples collected from HDWs in 10 communities are presented in Table 2 and the values of physical and chemical

ISSN 2229-5518

properties of water sample in Uromi are presented in Table 3.

Table 1: Water quality properties, methods of determination and equipment.

Properties	**Equipment/method**
pH	pH meter
EC	EC meter
Total Dissolved Salt (TDS)	TDS meter
Turbidity	Turbidity meter
Total Dissolved Solids (TSS)	Quantitative analysis
Alkalinity	Titration
Hardness	Titration
Colour	Colorimeter
Copper (Cu)	Spectrophotometer
Nitrogen oxide (NO_2)	Spectrophotometer
Manganese (Mn)	Spectrophotometer
Zinc (Zn)	Spectrophotometer
Iron (Fe)	Spectrophotometer

Table 2: Description of Water samples collected from HDWs in 10 communities of Uromi

Hand Dug Wells	**Location**
HDW 1	Obeidu
HDW 2	Eror
HDW 3	Arue
HDW 4	Eguare
HDW 5	Oyomon
HDW 6	Onewa
HDW 7	Amedeokhain
HDW 8	Efandion
HDW 9	Unuwazi
HDW 10	Ubierumum_oke

4 RESULTS

Table 3 shows the values obtained in 10 communities of Uromi in comparison with WHO standards

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Table 3: Physical and Chemical Properties of Water Samples in Uromi.

Hand dug well No.	**pH**	**(EC)** (µs/cm)	**TDS (Mg/l)**	**TSS (Mg/l)**	**Hardness (Mg/l $CaCO_3$)**	**Turbidity (FAU)**	**Colour (ptCo)**	**Alkalinity (Mg/l $CaCO_3$)**	**(Fe) (Mg/l)**	**Zn (Mg/l)**	**Mn (Mg/l)**	**Cu (Mg/l)**	**NO_2 (Mg/l)**
HDW 1	6.95	76.5	40.6	Nil	1.42	1	1	43	ND	0.13	ND	ND	Nil
HDW 2	6.50	104.6	71.6	Nil	2.76	3	1	66	ND	0.18	ND	ND	Nil
HDW 3	5.59	18.4	14.7	Nil	2.70	2	1	86	ND	0.07	0.04	ND	3.22
HDW 4	6.80	80.5	57.1	Nil	2.69	2	2	73	ND	0.21	0.02	ND	4.44
HDW 5	5.86	36.7	18.2	Nil	3.55	1	1	90	ND	0.33	ND	ND	Nil
HDW 6	5.25	47.2	32.7	Nil	2.22	4	2	56	ND	0.07	ND	ND	Nil
HDW 7	6.72	42.6	27.5	Nil	1.46	4	2	62	ND	0.51	ND	ND	Nil
HDW 8	5.95	54.4	39.2	Nil	3.36	3	2	77	ND	0.06	ND	ND	3.30
HDW 9	5.71	34.2	25.5	Nil	1.80	2	1	81	ND	0.15	ND	ND	3.12
HDW 10	6.57	18.8	14.4	Nil	2.53	3	1	120	ND	0.21	ND	ND	3.86
WHO Standards	**6.5-8.5**	**1000**	**1000**	**N/A**	**100-500**	**5**	**15**	**500**	**3**	**5**	**0.5**	**1.00**	**3.00**

FAU = Formazin Attenuation Units, **µs/cm** = Micro second per centimetre, **Mg/l** = Milligram per litre, **ptCO** = Platinum-Cobalt Scale

The result of the analysis indicates that the pH values ranges between 5.25 and 6.95 with five of the boreholes observed to be below the WHO standards. Oyomon and Onewa shows pH value of 5.86 and 5.25 which were below the WHO standards for drinking water (6.85-8.5), thereby making the well water acidic. In Arue, Efandion and Uniuwazi, sample results shows pH of 5.59, 5.95 and 5.71 respectively were below the WHO standards of (6.5-8.5). Electrical conductivity values obtained ranged between 18.4 $\mu s/cm$ and 104.$6\mu s/cm$ which again, show conformity with WHO standards. Total Dissolved Solids (TDS) of water sample ranges between 14.4mg/L and 171.6mg/L while the Total Suspended Solids (TSS) analysis shows no trace of total suspended solids. The values for water hardness ranges is between 1.42 mg/L and 3.55mg/L, turbidity; 1FAU and 4FAU, colour; 1 and 2ptCO, alkalinity; 43mg/L and 120mg/L, Total Iron (Fe); nil, Zinc (Zn); 0.07mg/L and 0.51mg/L, Manganese (Mn); was not detected in 8 water samples, while HDW 3 and HDW 4 were in the range of 0.02mg/L and 0.04mg/L, Copper (Cu); nil, Nitrite (NO_2); high values above WHO standards in 5 of the groundwater samples with range of 3.12mg/L and 4.44mg/L. This observation may have been influenced by pit latrines and farm lands where fertilizer containing inorganic Nitrogen, Phosphorous and Potassium (NPK) were used and sited close to the boreholes. Eguare and Ubierumun-Oke shows NO_2; 4.44mg/L and 3.86mg/L respectively to be above WHO standards of 3.0mg/L. The high concentration of NO_2 as observed in the result may be connected to inorganic fertilizers used during intense farming. When there is excessive rainfall, NO_2 is leached below the plants roots and pollute groundwater. NO_2 is highly leachable and readily moves with water through the soil profile. Obiedu, Error and Amedeokhain values for NO_2 were within the desirable limits of WHO standards for drinking water. High NO_2 of 3.22mg/L in Arue, 3.30mg/L in Efandion and 3.86mg/L in Uniuwazi were again above the WHO drinking water standards of 3.0mg/L.

5 DISCUSSION

In this study two properties pH and nitrite as shown in Tables 3 were observed to be in excess according to WHO standards. This may have health effects on short or prolonged consumption of water from these sources. Low pH in groundwater can allow toxic chemicals to become mobile and available for uptake by aquatic plants and animals. Heavy metals and base cations are mobilised by increasing acidity in soil and groundwater [13]. Potential soil metals of concern in connection with human health are cadmium and aluminium. However, when acidic groundwater is fed into pipe systems other metals such as lead and copper can be elevated to a toxic level. This is capable of producing conditions that are toxic to aquatic life and more, water with high pH can corrode household plumbing and their associated systems. Many investigations show that a sharp increase in the concentration of most metals occurs when the pH drops by 4.5 [13].

The major biological effect of nitrite in humans is its involvement in the oxidation of normal haemoglobin to methaemoglobin, which is unable to transport oxygen to the tissues [17]. The reduced oxygen transport becomes clinically manifest when methaemoglobin concentrations reach 10% of that of haemoglobin and above. This condition is called rnethaemoglobinanemia, cyanosis and at higher concentrations asphyseia. Infants under 3 months of age and pregnant women are more susceptible to methaemoglobin formation.

6 CONCLUSION

In this study, high level of nitrite and pH were observed as clear evidence of physical and chemical pollution. Low pH values of 5.25-6.95 were obtained from water samples which were below 6.5-8.5 as recommended by WHO. Similarly, high nitrite concentrations of 3.12mg/L-4.44mg/L were observed which were again higher than WHO acceptable limits of 3.0mg/L. It is expected that increased and/or continued combined environmental interventions, through public health education by community based health workers, awareness and sensitization campaigns on the sustainable use of inorganic fertilizer may improve groundwater integrity. However, sodium carbonate should be used as a purifier for acidic groundwater and again, wells located within 50 meters from pollution source should be abandoned and future wells should be constructed beyond 250 meters from pollution source.

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