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Assessment of Heavy Metals and Some Physicochemical Parametersof Borehole Water in Selected Communities in Uromi, Edo State

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Abstract:- The research work was to determine the standard of heavy metals and some physicochemical parameters of borehole water in Uromi community, Edo state Nigeria.Six sample of borehole water were collected from six different communities. Threephysical and eight chemical parameters such as TDS, EC, P^H , HCO_3, Cl, SO_4, Mg, Ca, Hardness, Na and K were analyzed respectively. Seven heavy metals viz., Zn, Pb, Cd, As, Fe, Co and Cr were analyzed using standard procedures of Atomic Absorption Spectroscopy (AAs). The analyzed sampleresults were compared with the World Health Organization (WHO) permissible limit. Among the analyzed samples, regarding to physicochemical parameters result falls within the WHO permissible limit. For the heavy metals, Fe (2.18mg/l), Co (0.03 – 0.04mg/l), Cd (0.03 – 0.04mg/l) and Cr (0.09mg/l) were above WHO limit for drinking water while Zn (0.05 – 0.30mg/l) were below the limit. However, Co (0.01mg/l) in Onewa and Cr (0.05mg/l) in Egbele match with WHO permissible limit. The result showed that only Efandion and Egbele borehole water in the study area are safe for drinking while others are not safe because of high concentration of metal present such as Fe, Cd, Co and Cr in the study area, which are capable of causing health hazard to the host communities. From the findings, the result suggested that the affected borehole water in the study area required further treatment beforeconsumption.

Keywords:- *Borehole water, polyethylene bottles, HNO_3 and Bulk scientific 210 VGP model (AAS).*

I. INTRODUCTION

Contamination of water bodies such as lakes, river, ground water, aquifer and oceans without adequate treatment and properly channel of it will always result to water pollution. These water pollution occur when pollutant such as (fertilizer, industrial waste and agricultural waste etc) when discriminately discharge into the water bodies without proper treatment to get rid of the harmful substances which can pose health risk to the human body. Anadu and Harding (2000) point out that in the past few decades, public concern over the quality of drinking water have grown considerably. The concerns have arisen as a result of increase awareness about environmental pollution and episodes of water borne disease outbreak. According to Oyegun (1983), a large number of miseries, sickness and deaths occur due to infectious diseases which are related to open water supplies in the most tropical developing countries. Water borne disease will always occur in the world because; many developing countries lack quality drinking water. WMO (2002), predicted that by the year 2025 many African countries will experience water scarcity. The availability of good quality water will be indispensable feature for preventing disease and improving quality life (Dinrifo et. al.,2010). Water quality deals with the physical, chemical and biological characteristics in relation to all other hydrological properties. Water pollution is a major global problems which needs proper evaluation and revision of water resources policy at all levels, (international down to individual aquifers as well). Daniel et.al (2006), point out that water pollution is a leading worldwide cause of death and disease. Ngila (2013), revealed that water pollution of ground water forms pollutants when released to the ground that can be leached into ground water, hence constituting contaminants within aquifers. Movement of water deposition within the aquifer spreads the pollution plume over the wide area, it advancing boundary often called a plume edge which can then interest with ground water. It has observed that ground water is more convenient and less vulnerable for pollution than surface water. Municipal water supplies are derived solely from ground water Abolanle S, A. et.al (2017). Mercury, Cadmium, lead and other persistent organic pollutant such as dichlorodiphenyltrichloroethane (DDT) has successively build up food chain, which causes a stepwise effect on human health through genotoxicity or endocrine disruption. It is gradually destroying the parasite of man and his dwelling. Water is an important resources for living system, industrial processes, agricultural production and domestic use (Itodo and Itodo 2010).

Sufficientsupply of non contaminated water is one the major perquisites for a healthy life. Much effort has been put

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in place to make many water resources good for consumption. The important of clean and link between contaminated water and illness was not clearly understood until later half of the 19th century (Elinge; et. al 2011). Water is in three state; liquid, solid and gas (invisible water vapour in air). It is liquid at standard ambient temperature and pressure but often coexist with its solid and gaseous state. A global concern has being raised about water pollution and it effects on human health. The main issue of ground water pollution is the indiscriminate disposal of waste materials directly or indirectly to the land surface. Any waste containing soluble materials, can infiltrate into the water bodies and possible lead to ground water pollution. Kolo and Waziri.,(2012), reported that toxic metals are mostly carcinogenic in nature when it is accumulated in visual and sensory organs of human beings and this can lead to cancer. Thus, water is said to be safe for drinking, if it's free from chemicals and microbial contaminants.

Boreholes water which serves as drinking water for most people in Nigeria could be contaminated by toxic metals by naturals or anthropogenic sources. The intake of these metals could be dangerous to human health especially when they occur in very concentrations as observed in this study. Drinking water should be portable for human consumption and for all usual domestic and industrial purposes (WHO, 1999). The important of water in our daily activities makes it compulsory that thorough examination and treatment be carries out on it before consumption. Human activities within the busy environment could affect the quality borehole water used as the source of drinking water by inhabitants. In most of the drinking water, the heavy metal present should be in a trace amount for the proper functioning of the body. Ground waters concentrations of metal elements and their suitability for human consumption are of great concern. Theseelements are actually necessary for good health, but high concentration of it may trigger to acute or chronic toxicity in human body.

Monday morning fever, zinc shake, neuropathies, characterized, headache and fatigue cough has been characterized by this high level of heavy metal in the body.

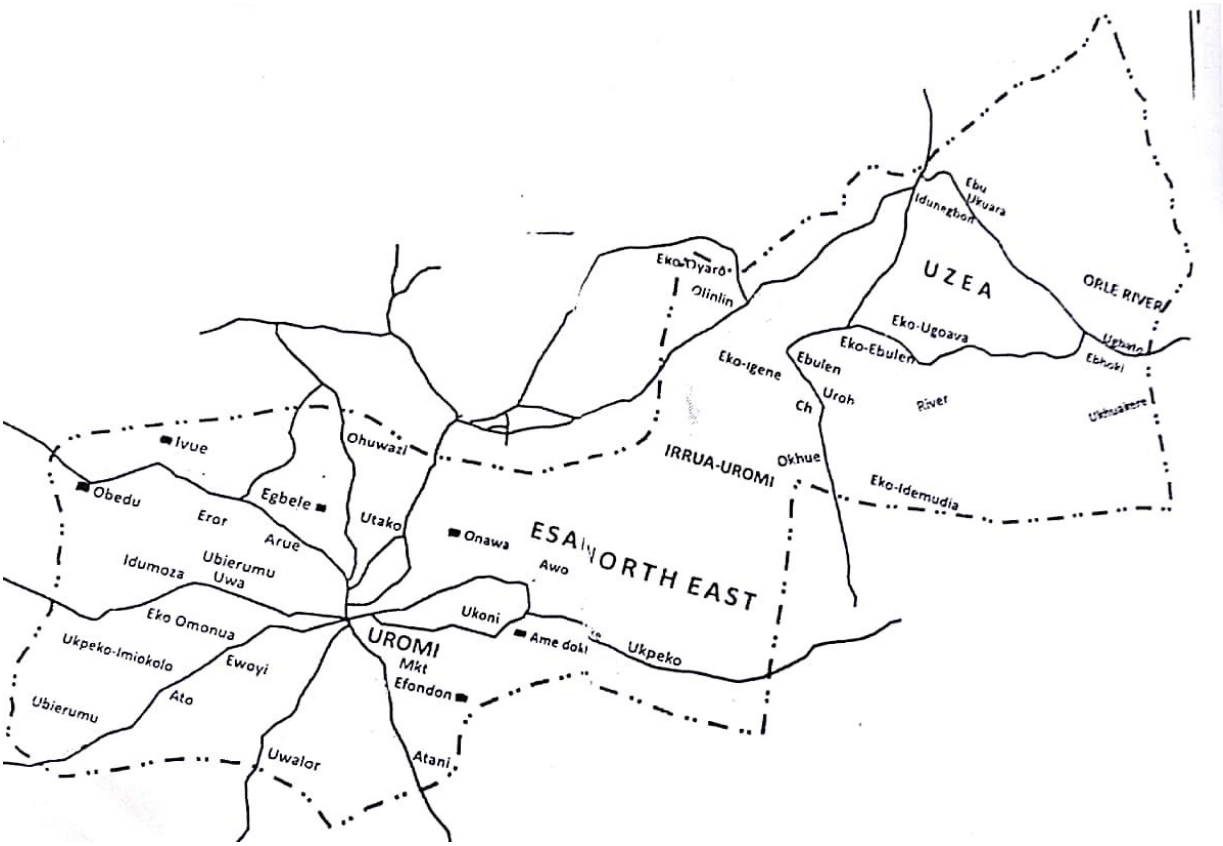

Fig 1:- Map of Esan North East, showing the study

Indicate the study areas on the map

II. OBJECTIVE OF THE STUDY

The research work was to determine the standard of heavy metals and some physicochemical parameters of borehole water in Uromi community of Esan North East L.G.Aof Edo state, Nigeria. And compare the result with WHO standard for the purpose of suitability of water in the study area.

III. MATERIALS AND METHODS

Borehole water sample used in the research work were carefully and randomly collected from six different areas within Uromi in Esan North East local government area of Edo state. The sample locations are Amedokhian, Efandion, Egbele, Obedu, Onewa and Ivue. The samples were collected in polyethylene bottles which has been thoroughly washed and rinsed with distilled water and were then taken

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to the sampling site. These bottles were then washed and rinsed again with the water sample. The water sample were collected from borehole by placing the empty cleaned polyethylene bottle directly to the rushing water from the borehole nuzzle after it has been allowed to rush for about five minutes in order to avoid rust from the pipe wall. The bottle was raised above the ground to avoid splashes from the ground and the water samples were tightly covered after collection. 5ml of prepared 0.01m of HNO_3 acid was added to each of the water sample to prevent the sample from bacterial activities. The value of each heavy metals present in the six water sample was determined using Bulk scientific 201 VGP model Atomic Absorption Spectroscopy machine (AAS). The atomizer was partly depends in the sample which causes the sample to get to the excited state by the process called atomization. The cathode lamp that has the same wavelength characteristic with the element of interest was fixed on the atomic absorption spectroscopic machine. PH, electric conductivity and turbidity was analyzed using PH meter, electric conductivity meter and turbidity meter respectively to achieve their required values from the water sample.

IV. RESULT AND DISCUSIONS

Heavy metals and permissible limit set by WHO in part per meter (mg/L) Sample location Zn Pd Cd As Fe Co Cr							
WHO standard (ppm (mg/L)	3.00	0.01	0.003	0.01	0.30	0.01	0.05
Amedokhian	0.06	BDL	BDL	BDL	BDL	0.04	0.09
Efandion	0.05	BDL	BDL	BDL	0.14	0.01	BDL
Egbele	0.35	BDL	BDL	BDL	0.28	BDL	0.05
Obedu	0.30	BDL	BDL	BDL	2.18	0.03	BDL
Onewa	0.29	BDL	0.04	BDL	BDL	0.01	BDL
Ivue	0.27	BDL	0.03	BDL	0.17	BDL	BDL

Table 1. Result of laboratory analysis of the heavy metals

BDL = Below Detection Limit.

V. DISCUSSION

Table 1. 0.Shows the heavy metals result in borehole water from Uromi community in Esan north central L.G.A of Edo state.

In Amedokhian, the values of 0.0mg/l Zn,0.04mg/l Co and 0.09mg/l Cr were detected while Pd, Cd, As and Fe were below detection limit. Among all the detected metals, only Zn fell below, Co and Cr fell above world health organization (WHO). 0.05mg/l Zn, 0.14mg/l Fe and 0.01mg/l Co were detected in Efandion while Pd, Cd, As and Cr were below detection limit. The values of all the detected metals are below WHO permissible limit, these permissible limits shows that borehole water from Efandion are safe for drinking.

In Egbele, the result shows that the values of 0.35mg/l Zn, 0.28mg/l Fe and 0.56mg/l Cr were detected while Pd, Cd, As and Co were below detection limit. Of all the detected metals, only Zn is below WHO permissible limit while Cr corresponds to WHO limit. So therefore, Egbele borehole water is safe for drinking as regard to WHO permissible.

In Obedu water sample, 0.30mg/l Zn, 2.18mg/l Fe and 0.03 Co were detected while Pd,Cd, As and Cr were below detection limit. Among all the detected metals, Fe has the value above WHO permissible limits while Zn is below. Therefore, in comparing the values with WHO permissible limits drinking water, Obedu borehole water is not safe and should be treated before consumption. The result in Onewa water sample shows that the values of 0.29mg/l Zn, 0.04mg/l Cd and 0.01mg/l Co were detected while Pd, As, Fe and Cr were below detection limit. Among all the detected metals, only Co has the permissible limit of WHO. Cd has the value above WHO permissible, while Zn are below the limit. From the result shown in Onewa water sample, it indicates that Onewa borehole water is not safe for drinking.

In Ivue, it shows that the values of 0.27mg/l Zn, 0.03mg/l Cd, 0.17mg/l Fe, were detected while Pd, Co, As and Cr were below detection limit. Among all the detected metals, Zn and Fe are below while Cd are above WHO permissible limit. Therefore, comparing the values with WHO permissible limit for drinking water, Ivue borehole water is not safe for consumption and should be treated.

Sample location	(1000 ppm) TDS	(400 $\mu.s/cm$) EC	(6.5 8.5) P^H	(500 mg/L) HCO_3	(250 mg/L) Cl	(250 mg/L) SO_4	(150 mg/L) Mg	(75 mg/L) Ca	(500 mg/L) hardness	(200 mg/L) Na	(12 mg/) K
Amedokhian	635	510	7.1	180	70	109	40	35	212	66	6.8
Efandion	429	573	7.3	146	63	96	36	51	237	92	4.3
Egbele	368	642	7.5	160	52	204	57	70	318	58	5.7
Obedu	491	1023	7.4	213	78	300	56	61	190	130	7.5
Onewa	533	815	7.3	198	67	79	60	30	282	125	7.3
Ivue	290	930	7.2	202	81	48	100	40	265	76	5.2

Table 2. shows the result of the physical and chemical parameter of the study area and the standard

Parameters set by WHO

The physical and chemical parameter of water samples was analyzed. The physicall parameters include Total dissolved solids (TDS), Electrical conductivity (EC) and pH, while the chemical parameter includes Bicarbonates, chloride, sulfate, magnesium, calcium, hardness, sodium, potassium. The result was discussed according to Muhammad,M; et.al (2013).

Total Dissolved Solids (TDS): According to Who (2008), there is no health based limit for TDS in drinking water. Drinking water becomes more significantly and increasingly unpalatable at TDS level greater than 1000ppm. The TDS in the study area ranged from 290 to 635ppm. Hence, therange was acceptable within the world health organization limit and the concentration of TDS is not harmful.

Electrical Conductivity (EC): According to WHO standards EC value should not exceeded 400µS/cm. In study areas, EC value was 510-1023 µS/cm. These results clearly indicate that water in study areas was considerably ionized and has higher level of ionic concentration activity due to excessive dissolve solids. Thus, it is a fine conductor of electric current.

pH : P^h of water, is refer to the hydrogen ion concentration present in water. It ranges from 0 to 14. Water with a ph of 7 is considered a neutral while a lower of it is referred to acid. The ph of the study area were ranged from 7.1 to 7.5. These ranges indicate the permissible limit of world health organization, since the ph of the study area falls within the standard of 6.5 to 8.5.

Bicarbonates (HCO_3): It is observed that bicarbonate value is not recommended by world health organization but however, it is considered not to be more than 500mg/l. Although current study revealed the concentration of bicarbonate to be 225 to 320 mg/l as cited by Muhammad M; et. al (2013). This bicarbonate is the standard alkaline constituent found in all surface and ground water bodies. The values of bicarbonate in the study area were ranged from 146 to 213mg/l. These imply that, the value of bicarbonate in the study area did not exceed WHO limit.

Chloride (Cl): Chloride in water may be considerably increased by treatment processes in which chlorine or chloride is used. From the study area, the chloride value ranges from 52 to 81mg/l. The highest chloride value was found in Ivue water sample, although the value does not exceed the world health organization standard. The low value still need more treatment enhancement since it is the main activity for metabolism in human body and other main physiological processes.

Sulfate (SO_4): The main function of sulphate in water is to stabilize protein structures in the body. The maximum limit of sulfate according toWHO is 250mg/l. And from the analysis, the value ranges from 48 to 300mg/l. the highest value of sulphate was found in Obedu water sample which is above WHO standard. This high value of sulphate in Obedu may be due to oxidation of pyrite and mine drainage. Although no negative impact of sulfate on human health has been reported.

Magnesium (Mg): Magnesium in water is very highly essential, since it is needed in biochemicalreaction in the body build up. Magnesium maintain nerves and muscle function, it support a health immune system, keeps the heart beat steady and also helps bones to remain strong. The quality of magnesium in the study area was significantly low compare to the WHO limit of 150mg/l. the values ranges from 36 to 100mg/l. this low values of magnesium can actually caused health issues if not well treated.

Calcium (Ca): Calcium is 5th most abundant element on the earth crust and is very important for human cell physiology and bones. About 95% calcium in human body stored in bones and teeth. The high deficiency of calcium in humans may caused rickets, poor blood clotting, bones fracture etc. and the exceeding limit of calcium produced cardiovascular diseases(Saji Kumar et. at 2013). According to WHO (1996) standards its permissible range of calcium in drinking water is 75 mg/l. but in the study areas, results show that the values of calcium ranges from 30-70 mg/l.the values does not exceed WHO standard apart from Amedokhia, Onewa and Ivue that has low values of 35,30 and 40 respectively.

Hardness: According to World Health Organization (WHO) hardness of water should not be above 500 mg/l. because it mainly consists of calcium and carbonate which are the most dissolved ions in water. A range of 109 to 308 was observed in the study area which is not above WHO

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standard. These imply that the hardness of water from the study area is not harmful to the host communities.

Sodium (Na): Sodium plays an important role in the body system. A good quality of sodium in human body prevents so many diseases such as hypertension, headache and kidney damage etc. In most countries, majority of water supply is less than 20mg/l while some exceed the WHO standard of 250mg/l of sodium (WHO, 1984). According to WHO standards, the value of sodium in drinking water is 200mg/l. In the study area, the sodium ranges from 58 to 130mg/l. only Obedu and Onewa shows 30 to 40% of WHO standard of sodium in the sample analysis.\

Potassium: potassium in the human body lies between 110 to 140g. Potassium is very vital for human body function like, heart protection, regulation of blood pressure, protein dissolution and muscle construction nerve stimulus etc. Potassium deficient is very rare but may lead to depression, muscle weakness, heart rhythm disorder if it occurs. Potassium permissible limit by WHO is 12mg/l. Fromtable 2 above, the result shows the values of potassium to be 4.3 to 7.5mg/l.

VI. CONCLUSION

From table 1.0 above, it shows that only Efandion and Egbele borehole water is safe for drinking in the study area, according to WHO permissible limits. Other borehole water sample which could not meet the WHO permissible limit was limited either by high and low values of heavy metals present in the study area. Some were below detection limit, making the water unsafe for consumption. The level of Zn metals that fell below the WHO standard in all the borehole water could be as a result of minimal activity in the sampled area. The high content of Pd, Co, As and Cr as obtained might be due to mobility of the retention ability of the matrix composition of the terrain. The (heavy metals and physicochemical parameters) below detection limits, above or low within WHO permissible limit should be more of interest in order to control health hazard and therefore, all the affected borehole water should be treated to match WHO permissible limit to avoid problem to human health as a result of unsafe water consumption.

REFERENCE

[1]. Anadu, E.C. and Harding A.K. (2000): Risk perception and bottled water use. Journal of America Water Works Assoc. November, page 82–92.

[2]. Oyegun, R.O. (1983): 'Water Resources in Kwara State,' M & S Publishing Coy Ltd., Ilorin, Nigeria, 113 pp.

[3]. WMO (2002): Water Resources issues in Africa a Ministerial Conference on Water 29-30 April. Abuja Nigeria, P. 1-4.

[4]. Dinrifo, R.R., Babatunde, S.O.E., Bankole, R.O. andDemu, Q.A. (2010): "Physicochemical properties of rain water collected from some Industries Areas of Lagos State. Nigeria". European Journal of Scientific Research: 41(3), 383-390 .

[5]. Pink, A., Daniel, H. and Larry, H. (2006): A Billion People Worldwide Lack Safe Drinking Water And Investing In Tomorrow's Liquid Gold, Pp 1-7.

[6]. Ngila, Bhekie B. Mamba. " Remediation studies of trace metal in natural and treated water using surface modified biopolymer nanofbers", Physics and Chemistry of the Earth, Parts A/B/C, 2013.

[7]. Ablanle Saheed Adekunle, John Adekunle Oyedele Oyekunle, Oluwaseyi Ojo, Nobanathi W. Maxakato. "Determination of polycyclic aromatic hydrocarbon levels of groundwater in Ife north local government area of Osun state, Nigeria", Toxicology Report 2017.

[8]. Itodo, A.U and Itodo H.U. (2010): Nature and Science Vol.8, Pp 54 – 59.

[9]. Elinge, C.M; Itodo, A.U; Peni, I.J; Birniu-yauri; U.A and Mboug, A.N. (2011): Assessment of Heavy Metals Concentrations in Borehole Wtaers in Aliero Community of Kebbi State. Journal of Advances in Applied science research, Vol.2 (4), Pp 279 – 286.

[10]. Kolo, B.G and Waziri, M. (2012): Determination Of Some Heavy Metals In Borehole Water Sample of Selected Motor Parks In Maiduguri, Nigeria. International Journal of Basic and Applied Chemical Sciences, Vol.(2), Pp 19 – 20.

[11]. WHO (1999): Bulletin of WHO, Pp 86 – 88.

[12]. Muhammad, M; Samira, S; Faryal A. and Farrukh J. (2013). Assessment of Drinking Water Quality and its Impact on Residents Health inBahawalpur City.International Journal of Humanities and Social.

[13]. Sajil Kumar, P.J., and E.J. James. "Physicochemical parameters and their sources in groundwater in the Thirupathur region, Tamil Nadu, South India", Applied Water Science, 2013.

[14]. WHO. (1996). Guidelines for Drinking Water Quality. Recommendation, Vol. 1, Geneva: World Health Organization (WHO).

[15]. WHO. (1984). Guidelines for Drinking Water Quality. Health Criteria and Other Supporting Information, Vol. 2, Geneva: World Health Organization (WHO).