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EVALUATION OF GROUNDWATER QUALITY IN SOME PARTS OF IMO STATE, NIGERIA.

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ABSTRACT

Evaluation of groundwater quality in some parts of Imo State was done, based on analyses of water samples from boreholes and springs. Analyses were based on American Public Health Association (APHA) guidelines. The overall average values of total heterotrophic bacteria, total coliform counts and *Escherichia coli* counts were 7.2622 x 10^4 CFU/ml, 12.5 CFU/100ml and 1.0 CFU/100ml respectively. The average value of pH was 6.7 while hardness ranged between 6.60mg/1 and 16.90mg/1; turbidity, 1.0mg/1-2.90mg/1; chloride, 8.96mg/1-21.00mg/1iron (II) ion, 2.6mg/l-3.71 mg/l, and nitrate, 4.88mg/l-6.4mg/1. Heavy metals were within the permissible limits except cadmium which recorded an overall average value of 0.1856ppm. The study reveals that groundwater in Imo State, if well handled, remains a safer source of drinking water supply to the populace.,

INTRODUCTION

Three main water sources have been established which include subsurface water (groundwater), surface water and atmospheric water (rainwater) (Obionu, 2001). These sources form major sources of water supply in Nigeria. Blum *et al* (1987) revealed that water sources in many rural and urban areas vary with seasons as many communities tend to have greater number of available water sources in form of rivers, ponds, and springs in the rainy season than in the dry season. Many people in rural areas in Imo State Nigeria depend mainly on available groundwater during dry season (Blum *et al*, 1987).

Underground water constitutes the largest and most valuable natural source of drinking water. The portability and availability of groundwater poses serious concern to nations, especially the industrialized ones. The composition of groundwater depends on soil types and geological materials rich in minerals. The amount of these substances makes it potable or otherwise (Patrick and Ford, 1990).

A number of human activities contribute to the adverse changes in the composition of groundwater sources. Some of these include increase in nitrate and phosphate concentrations, arising from extensive fertilization (Gazela *et al*, 1979); large number of coliforms, high concentration of chloride, nitrate and phosphate ions resulting from sewage infiltration (Sridhar and Pillai, 1993). Industrial effluents are also a major source of groundwater contamination.

Most groundwater is found in acquifer-underground layers of porous rock that are saturated from above or from structures sloping towards such rock. Normally aquifer depends on the grain sizes.

In Nigeria especially in the South Eastern States, hand-dug wells, boreholes and springs (groundwater), which provide major sources of water supply to the populace, have some levels of contamination. This is based on findings by some researchers. For instance, researches carried out on boreholes, wells and other groundwater in Port Harcourt, Enugu, and the Northern parts of Imo State, reveal some levels of contaminations (Ogan, 1989; Blum *et al*, 1987; Obiekezie *et al* 2006, Efe *et al*, 2005 and Ana *et al*, 2004). Health risks associated with contaminated water have been globally published.

MATERIALS AND METHODS

Water samples were collected from boreholes and springs in some parts of the State. Analyses were based on American Public Health Association (APHA, 1998) guidelines. The pH was determined *in situ* using pH-meter (Model 7413). Total hardness and chloride ions were determined titrimetrically while turbidity, nitrate and iron (II) ions were determined spectrophotometrically, using appropriate SERVA test kits: nitraver 5, ferrover 2, for nitrate and iron (II) respectively. Heavy metals concentrations were determined using UNICAM 919 Atomic Absorption Spectrophotometer (AAS).

In bacteriological analyses, total heterotrophic bacteria count was determined using pour plate technique which employed transferring 0.5ml of each water sample into petri dish and pouring about 25ml of molten nutrient agar, and incubating at 37^0C for 48 hours. Membrane filtration technique (MFT) was employed to determine total coliform count and *Escherichia coli* count.

RESULTS

Borehole water had an average total heterotrophic bacterial count of 2.234×10^4 CFU/ml while spring water was 1.22905×10^5 CFU/ml (Table 1). Average total coliform count, and *Eschrichia coli* count, were 18.0 CFU/100ml, and 7.0 CFU/100ml, and 1.0 CFU/100m, and 1.0 CFU/100ml, for borehole and spring water samples respectively.

The average pH values were the same (6.7) in both spring and borehole water samples. Average turbidity, hardness and nitrate records were higher (2.90 FTU, 16.90 mg/1 and 6.45mg/1 respectively) in spring water than in borehole water which recorded 1.00 FTU, 6.60mg/1 and 4.88mg/1 respectively. However, iron (II) ion and nitrate ions were higher in borehole water (3.71mg/1 and 21.00mg/1 respectively) compared to respective values of 2.61mg/1 and 8.96mg/1 in spring water samples. The values of heavy metals in borehole water were within the range of 0.0028pm – 0.3358ppm, but 0.0026ppm-0.0353ppm in spring water (Table 2).

Table 1:
Average values of bacteriological parameters of groundwater in some parts of Imo State

Ground water Source	Total Heterotrophic bacterial count (CFU/ml)	Total coliform count (CFU/100ml)	*E.coli* count (CFU/100ml)
Borehole	2.234×10^4	18.0	1.0
Spring	1.22905×10^5	7.0	1.0
Overall Average	7.2622×10^4	12.5	1.0

ABLE 2: Average value of Physico-chemical parameters of groundwater in some parts of Imo State.

Grondwater Source	pH	Hardness (mg/1)	Turbidity (FTU)	Fe^{2+} (mg/1)	Cl^- (mg/1)	NO_3 (mg/1)	Pb (ppm)	Hg (ppm)	Cd (ppm)	As (ppm)
Borehole	6.7	6.60	1.00	3.71	21.00	4.88	0.0538	0.0028	0.3358	0.0040
Spring	6.7	16.90	2.90	2.61	8.96	6.45	0.0026	0.0035	0.353	0.0072
Overall Average	6.7	11.75	1.95	3.16	14.98	5.17	0.0282	0.0032	0.1856	0.0056

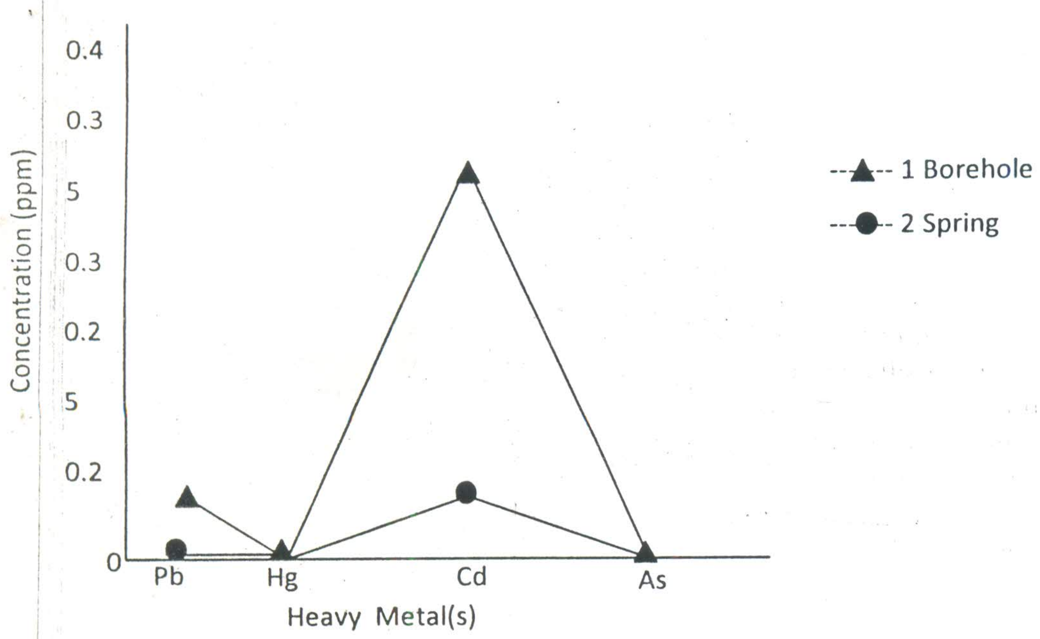

Figure 1: Graph showing Concentration of heavy metals in groundwater in parts of Imo State

DISCUSSION

The concept of water quality is a measure of its standards expressed in terms of physical, chemical and microbiological characteristics. The quality of water is determined by the concentration of biological, chemical and physical contaminants (Gienn *et al*, 1993). For instance, pH of natural water is determined by the dissolved substances, and can vary greatly. Acid springs generally have pH between 2 and 4. Nevertheless, such spring support the growth of micro-organisms adapted to such low pH (Morgan, 1990).

The pH values of groundwater in studied areas were within the acceptable limits of 6.5-8.5 (WHO, 2006).
Obikezie, *et. al.* 2006 and Nwaugo, *et al*, 2006 stated that water sources in South Eastern Nigeria tend to be soft which agrees with the values obtained in this study with an average hardness of 11.75mg/1. Turbidity, according to Tchobanoglous (1979), is the interference of light passage through water as a result of particles of dust, soil organics, micro-organism and other materials which

impede the passage of light through water by scattering and absorbing the rays. The low values of turbidity (1.00mg/1-2,90mg/1) recorded in groundwater samples is attributable to the natural filteration process (through gravitational movement of water across soil layers) which groundwater passes through.

The values of chloride in groundwater samples were within the range of 8.96mgII – 21.00mg/I which are within permissible limits. However the chloride in groundwater is as a result of leaching of chloride – containing rocks (Jackson, 1990). Ana *et al* (2004) recorded similar values on groundwater. High values of Iron (II) ion recorded agrees with the values recorded by Obiekezie (2006) in Awka and Obiekezie *et al* (2006) in Enugu. Report by Jackson (1990) showed that groundwater may contain up to 10mg/l or more of ferrous iron while acidic springs or mines may contain up to 6000mg/l of iron. Dissolved iron in water is not poisonous but can stain clothes and bathroom tiles. Nitrates in natural water originate from contamination of percolating water, carrying nitrate from sources such as decaying plant or animal materials, agricultural fertilizers, domestic sewage, etc. The results obtained in this study however, showed non-contamination of groundwater with nitrate pollutants.

The concentrations of heavy metals in the samples analyzed were below permissible limits except cadmium which recorded an average of 0/1856ppm: This differs from the findings of Obiekezie (2006) who obtained lower values. Groundwater is contaminated by the use of insecticides, pesticides, fungicides and fertilizers on agricultural lands, and consumption of such water endangers the liver, placenta, kidneys, lungs, brain and bones, as they are target organs (Fergusson, 1990).

Bird and animal droppings have been associated with contamination of spring water while borehole contamination have been linked to seepages from septic tanks, pit toilets and dump sites. This may be associated with the results obtained in this study.

REFERENCES

Ana, G.R.E, Sridhar M.K.C and Olawuyi, J. F (2004). Groundwater quality and Health risks in Onne Community near fertilizer complex in Southern Nigeria, 3rd *Earthwatch. Conference on Water, Earthwatch. pp* 79-84.

APHA (1998). *Standard Methods for the Examination of Water and Wastewater* (20th edition), American Public Health Association.

Blum, D., Feacham, R. G., Huttly S.R., Kirkwood, B. R and Emeh, R.N. (1987). The effects of distance and season on the use of boreholes in Northern Imo State, Nigeria, *Journal of Tropical Med. Hyg.* 90(1): 45-50.

Effe, S.I, Ogban, F.C., Horsfall, M, and Akporhonor, E.E (2005). Seasonal Variations of Physico-chemical characteristics in water resources quality in Western Niger Delta Region, Nigeria, *Journal of Appl. Sci. Environ. Mgt.* 9(1): 191-195.

Ejechi, B.O, Olabaniyi, S.B, Ogban F.E and Ugbe, F.C. (2007). Physical and Sanitary Quality of Hand-dug well water from oil producing area of Nigeria, *Environ Monit. Assess.*, 128 (1-3): 495-501.

Fergusson, J.E. (1990). *The heavy Elements: Chemistry, Environmental Impact and Health Effects,* Pergamon Press, Oxford, pp 24-57.

Gazela, S., Melloris L., and Probity, A. (1979). Hydrology and Environmental Protection, *Mineral Solvac, 6(3):* 239 – 248.

Glenn, T., Frangmeier, O, Elliot, G and Frevet, N (1993). *Soil and water conservation engineering,* John Willey and Sons, New York, pp 355-358.

Jackson, M.H. (1990). *Environmental Health Reference Books,* Butterworth – Heinemann, London, pp 9/8 – 9/22.

Morgan, P. (1990) *Rural Water Supplies and Sanitation.* Macmillan, London, pp.200-201.

Nwaugo, V. O; Obiekezie, S.O; Onyeagba, R. A; Okereke, J. N and Udebuani, A. C. (2006). The physico-chemical investigation of Amicol Lake in Ivo Area of Ebonyi State, *World Journal, of Biotechnology,* 7:1055 – 1061.

Obiekezie S.O (2006). Quality of groundwater utilized in Awka, Anambra State, Nigeria, *Inter. Journal of Biotechnology and Allied Sciences,* 1(1): 1-4.

Obiekezie, S. O, Abara, P.N., Okereke, J.N, and Ifeanyi, V.I (2006). Physico-chemical and bacteriological evaluation of underground water in Enugu Metropolis, Southeast Nigeria, *Int'l Journal. Of Natural and Appl. Sci:* 2(3): 240-245.

Obiekezie, S.O; Okereke, J.N; Anyalogbu, E.A; Okorondu, S. I. and Ezejiofor, T.I.N (2006). Underground water quality of rock mining in Ishiagu, Ebonyi State Nigeria, *Estud. Biologie 28(63): 63-71.*

Obionu, C.N (2001). *Primary Health Care for Developing Countries, Delta Publication Ltd, Enugu* 2nd Edition, pp 151.

Ogan, M.T. (1989). Magnitude of faecal contamination of rural community well water in Nigeria and its relationship to well and water properties, *Zentrabl. Hgi. Unwettned.,* 189(3): 279-283.

Patrick, R. E. and Ford, J. Q (1990); *Groundwater Contamination in the United States,* A publication of UNEP – industry and Environment, pp,. 29-30.

Sridhar, M.K.C and Pillai, S.C (1973). Pollution of Groundwater of Banglore: *Proceedings of the Seminar on Environmental Pollution, Central Public Health Engineering Research Institute, Nagpur, pp. 59-70.*

Tchobanoglous, G. (1979). *Wastewater Engineering: Treatment, disposal and reuse,* Tata McGraw-Hall Comp, New Delhi, pp 102-109.

WHO (2006). *Guidelines for drinking water quality,* World Health Organization, Geneva.