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Physico-chemical Assessment of Groundwater in Enen-Ito Community, Odukpani L.G.A., Cross River State, Nigeria

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Abstract— *Physico-chemical assessment of ground water in Enen-Ito community of Odukpani L.G.A., Cross River State, Nigeria was carried out to ascertain the pollution level of the ground water which serves as major supply of water to people living in this community. Water samples were collected from three boleholes used frequently by the people for analysis using various standard methods. The parameters determined include pH, Temperature, Conductivity, Turbidity, Total Dissolved Solids (TDS), Hardness, sodium, Lead, Manganese. Microbial loads were also determined. The results obtained infer that all the parameters analyzed fell within NIS 554: 2007 reference standard permissible limit for potable water in all of the samples. Although result of this study compares favourably well with the acceptable limit, there is therefore, need to establish sewage treatment plants in areas so that untreated sewage as well as agricultural activities common to these areas does not contaminate the water bodies. Hence, regular and quantified monitoring of geochemical characteristics of the surface water will be useful for sustainable water management.*

Keywords—*Assessment, characteristics, geochemical, monitoring, parameters, Physicochemical, pollution, reference, standard.*

I. INTRODUCTION

Water is one of the most important natural resources and a pre-requisite for sustenance of life. It is a key element for the socio-economic development of any nation. The usage however, depends on the quality and volume of water available. It is used for agricultural, domestic, industrial, recreational and environmental activities.

Exploitation of water resources to meet the demand of the rising human population, supported by industrialization and urbanization has place ground water resources under great threat both in terms of quality and quantity. The groundwater quality in any area is a function of its physical and chemical parameters which in turn are highly influenced by geological formations, climatic conditions and anthropogenic activities (WHO, 2006; Itah and Akpan, 2003).

Water pollution has become a global threat which varies in magnitude and type from one location to another depending on the local condition of such area (Itah and Akpan, 2003). Water according to Kofoworola, 2007 is considered polluted when there is change in its composition and condition making it less suitable for any or all of the functions and purposes in its natural state. In the report of Sujjatha and Reddy, 2003 pollution of ground water could come from the following; sewage, disease causing agents, sediment pollution, inorganic plant and algal nutrients, organic compounds, inorganic chemicals, radioactive substances and thermal pollution into the aquifer. Recently, rapid industrialization has played a major role in polluting the environment and causes severe degradation in the pedosphere, hydrosphere and atmosphere. Water used in industries as stated by Itah and Akpan, 2005 creates a waste that has potential hazard for our environment because of the introduction of various contaminants such as heavy metals into soil and ground water aquifer.

Groundwater contamination according to Harter, 2003 is an undesirable change in groundwater quality resulting from human activities. Urban growth, increased industrial activities, intensive farming, and overuse of fertilizers in agricultural production have been identified as drivers responsible for these changes (Patwardhan, 2003). Unsatisfactory water supplies and unwholesome sanitary conditions can result in poor human health (Chukwu, 2008). Therefore, the maintenance of water quality at acceptable levels is an essential requirement for successful use of water resources. In order to safeguard the long-term sustainability of the groundwater resources, the quality of the water needs to be continuously monitored. The overall goal of such assessment is to obtain a comprehensive picture of the spatial distribution of groundwater quality and the changes that occur, either naturally or under the influence of man (Soladoye and Ajibade, 2014). This paper therefore examined the suitability of groundwater in Enen-Ito community, Odukpani L.G.A., Cross River State as source of drinking water.

II. STUDY AREA

The study was carried out in Enen-Ito, Odukpani Local Government Area (LGA), Cross River State (Table 1).

TABLE 1: Study Site/Location with Latitude and Longitude of Ground Water Sampled

S/N	Sample I.D.	Coordinates		Elevation (m)
		Latitude	Longitude	
1	GW1	5.059653	8.147049	28
2	GW2	5.070597	8.147736	57
3	GW3	5.068288	8.136492	10

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III. Materials and Method

a. Collection of Water Samples

Ground water samples were obtained were carried out with bailers that were properly decontaminated between samples to avoid cross contamination. Water samples were then transferred into one liter plastic containers which were washed thoroughly, rinsed with de-ionized water, and labelled appropriately for easy identification. The collected and labelled sampled were fixed and preserved in Ice chest cooler for onward transmission to Mifor Consult Nigeria Limited Laboratory for analysis.

b. Determination of Physico-chemical Parameters

Calibrated Hanna digital meter (HI 2215-02 & HI 9813-6) were used to analyzed for Parameters such as pH, conductivity, DO, temperature, turbidity, TSS and TDS were done *in-situ*, while Sodium, Lead and Manganese concentrations were obtained using Atomic Absorption Spectrophotometer (AAS 300) and Gas Chromatography Mass Spectrophotometer (GCMS 5890 Series II) all in Mifor Consult Nigeria Laboratory, 55 Marian Road-Calabar, Cross River State.

IV. Result And Discussion

Result of the laboratory analysis carried on ground water samples in this study as presented in Table 2 revealed concentration within recommended standard by Nigerian Industrial Standard (NIS 554: 2007 Reference Standard) for drinking water. However, according to the report of WHO, 2006 water is considered safe if the concentrations of undesired substances do not exceed the recommended safe limit.

pH

In the report of Chukwu, 2008 pH of water generally is influence by geology of catchments area and buffering capacity of water controls the chemical state of many nutrients including dissolved oxygen, phosphate, nitrate etc. due to this effect, aquatic organisms are affected by pH changes as their metabolic activities are pH dependent.

The low pH in rivers according to Patwardhan, 2003 could be attributed to dilution effect of rain water during rainy season. pH Nonetheless, has no direct adverse effects on health; however, Raihan, and Alam, 2008 report that higher values of pH hasten the scale formation in water heating apparatus and also reduce germicidal potential of chloride results in the formation of trihalomethanes, which are toxic in nature and cannot support aquatic life.

pH level for the study was within the permissible limit prescribed by NIS 554: 2007 Reference Standard.

Temperature

One important aspect of water temperature is its effect on the solubility of gases, such as oxygen (Itah and Akpan, 2005). More gas can be dissolved in cold water than in warm water. Animals, such as salmon, that require a high level of dissolved oxygen will only thrive in cold water. Increased water temperature according to Kofoworola, 2007, also leads to increase photosynthetic rate of aquatic plants and algae, which in turn lead to increased plant growth and algal blooms and can be harmful to the local ecosystem. A change in ground water temperature however, can affect the general health of the aquatic organisms, thus changing the quality of the river/stream.

Temperature level for the obtained water samples across the various stations were within permissible limit of NIS 554: 2007 Reference Standard.

Total Hardness

Hardness in water as documented in WHO, 2006 is caused by the presence of calcium and magnesium. Its presence is indicated by soap scum. The degree of hardness of water varies considerably from one community to another depending on local conditions. According to WHO, 2004, water with hardness above 200 mg/l depending on the interaction of some factors such as pH and alkalinity, may lead to scale deposition in treatment works, distribution systems, pipe work and tanks within buildings. Although, no health implication has been recorded so far for hardness in water, water with hardness below 100 mg/l tend to have a low buffering capacity and hence, become more corrosive to water pipes (Adekunle *et al.*, 2007). Result of the study revealed concentrations within NIS 554:2007 permissible limit of 150 mg/l.

TABLE 2: Result of Ground Water Physicochemical Characteristics

Parameter/Sample Station	GW1	GW2	GW3	NIS 554: 2007 Reference Standard
pH	6.22	6.36	7.14	6.5-8.5
Temperature (^oC)	29.6	28.8	29.5	Ambient
Hardness	35.2	38.5	33.1	150
Conductivity (µS/cm)	99.67	70.43	65.69	1000
Turbidity (NTU)	4.3	3.7	4.1	5
Total Dissolved Solids (mg/l)	77	53	65	500
Manganese (mg/l)	ND	ND	ND	0.2
Sodium (mg/l)	ND	ND	ND	200
Lead (mg/l)	ND	ND	ND	0.01

***NIS**=Nigeria Standard for Drinking Water, **ND**=Not Detected; **GW**=Ground water

Conductivity

Conductivity indicates the presence of dissolved solids and contaminants especially electrolytes (Kofoworola, 2007). The more ions in the solution, the higher the conductivity. In the report of Adekunle *et al.*, 2007 conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate and phosphate anions or sodium,

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magnesium, calcium, iron and aluminum cations. Other possible sources of increase conductivity could be natural enrichment in electrolytes, phenomena of mineralization or weathering of sediments (Sujatha and Reddy, 2003). However, conductivity level for the study was observed to fall within the regulatory limit prescribed by NIS 554: 2007 Reference Standard.

Turbidity

Patwardhan, 2003 defines turbidity as a measure of water clarity which determines how far light can travel in water. Light is necessary for the growth of aquatic plants, which serve as food for fishes and other aquatic animals. Water with high turbidity, reduces oxygen level which eventually leads to death of aquatic organisms.

As reported by Patwardhan, 2003 the greater the amount of total suspended solids in water, the murkier it appears and the higher the measured turbidity.

Turbidity level for the study falls within permissible limit of 5NTU prescribed by NIS 554: 2007 Reference Standard.

Total Dissolved Solids (TDS)

In the works of Kumar *et al.*, 2017 excess dissolved solids in any water body create an imbalance due to increased turbidity, and thus cause suffocation to aquatic life even in the presence of high dissolved Oxygen. Similarly, Harter, 2003 reported ground water with high residue to be less palatable and may induce an unfavourable physiological reaction and may even result to gastrointestinal irritation, as well as constipation to humans. Outside the health implication, high TDS concentration may also be aesthetically unsatisfactory for bathing and washing (Soladoye and Ajibade, 2014). The concentration of TDS for the study was within the allowable limit of 500 mg/l.

Heavy Metal

Concentration of sodium, lead and manganese in the study were below equipment detection limit.

V. Conclusion

Rapid industrialization and urban development results in deterioration of water quality. The values of all physiochemical were found within the permissible limits of NIS 554 Reference Standard guideline for drinking water. However, regardless of the result which compares favourably with the acceptable limit, there is need to establish sewage treatment plants in areas so that untreated sewage as well as agricultural activities common to these areas does not contaminate the water bodies. Hence, regular and quantified monitoring of geochemical characteristics of ground water in this area will be useful for sustainable water management.

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