Exploratory Survey of Geochemical Aspects of Underground Water in Ehime Mbano Area Se Nigeria

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Abstract

The exploratory survey of geochemical aspects of underground water resource in Ehime Mbano area of Imo State South-eastern Nigeria has been carried out. Since the creation of Ehime Mbano Local government area in 2001, there is the need for sub surface water quality assessment since the surface water has been polluted due to population explosion. The study was carried out by acquiring geologic and topographic maps of the area for easy identification of sample population areas, and to identify geological boundaries. Spring outcrops, landuse elements, especially waste dump sites and agricultural projects were visited and examined. A total of 6 water samples, 2 from springs and 4 from boreholes were collected randomly and analysed. Analysis was carried out using atomic absorption spectroscopy for major cations. Heavy metal analysis was undertaken using spectrophotometer, potassium was determined using flame photometer method, concentration of total iron (Fe2+) was determined calorimetrically using spekker absorption meter, while total dissolved solids (TDS) was determined using glass fiber filter. Turbimetric method was used to assess turbidity. Physical parameters like ph and dissolved oxygen were measured insitu in the field with appropriate standard meters. The result of geochemical survey shows that the water has high turbidity, high iron, slightly acidic, soft , portable and suitable for domestic, industrial and irrigation purposes. Above all the water has no bacteria presence, no heavy metals also no laxative effect. The average pollutional index of 2.50 indicates a slight pollution though Ezeoke Nsu area (NE) is highly polluted. Remediation to the problems of slight water pollution is proposed.

Index terms—

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Onunkwo -A, Uzoije A.P Abstract-The exploratory survey of geochemical aspects of underground water resource in Ehime Mbano area of Imo State South-eastern Nigeria has been carried out. Since the creation of Ehime Mbano Local government area in 2001, there is the need for sub surface water quality assessment since the surface water has been polluted due to population explosion. The study was carried out by acquiring geologic and topographic maps of the area for easy identification of sample population areas, and to identify geological boundaries. Spring outcrops, landuse elements, especially waste dump sites and agricultural projects were visited and examined.

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2 I. Introduction

Rock types, their weathered products and precipitation from rainfall contribute greatly to the chemistry and pollutional trend of surface and ground water **??**Wilson, 1981). Man's activities such as dumping of refuse, agricultural practices and animal dung also determine the pollution of surface and ground water (Horton, 1995). Groundwater pollution may also be caused by the disposal of solid or liquid wastes in pits, abandoned boreholes or even stream channels and landfills. Others are poorly constructed or designed septic tanks, sewage disposal systems (Ellis, 1988). Chemicals such as lead, arsenic and radioactive minerals derived from chemical waste disposal sites of factories and mining industries also contribute possible pollutants. The introduction of contaminant or pollutant into an aquifer system starts with the infiltration of the pollutant through a water medium induced by precipitation. Ground water pollution may be a point or diffuse source (Todd, 1959). Point source of groundwater pollution may result from the location of a disposal pits, ponds or lagoons, mines or industrial wastes, disposal points, direct into an unconfined aquifer system. Diffused groundwater pollution source are more complicated and hence difficult to identify and remediate since it is difficult to locate the origin and areas of impact of the contamination (Raymond , 1979). The aim of the study is to examine the ground water contamination level in Ehime Mbano area of Imo state, south-eastern Nigeria. Water related diseases from subsurface has been reported in the past. Feachem et al. 1998 reported high incidence of waterrelated diseases in thickly populated settlements with their sources traced to wells. Also Palmer and Holman (1997), observed that chemical pollutants such as heavy metals which constituted cancer and other related illnesses was traced to the underlying ground water from poorly managed waste source in a Delhi city of India. In the strength of these, the assessment of the ground water quality of the study are becomes imperative following the unprecedented population explosion occasioned by the movement of the people to the suburbs due to government policy. The physiography is dominated by a segment of Northern , South eastern trending Okigwe regional escarpment which stands at elevation of between 61m and 122m above sea level (Alfred 1992). Vegetation in the area is tropical rain forest which is prevalent in the Southern states of Nigeria **??** Oguntoyimbo, 1987). Due to great demand of land in the area coupled with other human activities especially over grazing, the rain forest has been replaced by some economic crops such as oil palm forest.

3 II. Materials and Method

The soil of the area is loamy with scattered pebbles (Gorrel, 1990). Thick vegetative covers has prevented soil erosion , however, erosion is prominent in the areas where road cuts, forest clearing and over cropping have opened up the soil to erosion elements

4 b) Data Collection

Data was acquired from field work, laboratory investigations and libraries. Topographic and geologic maps on a scale of 1: 250,000 was obtained from Nigeria geological survey department, Enugu. Spring out crops, geological boundaries landuse especially waste dump sites were visited and examined.

A total of 6 water samples were collected for organic and inorganic analysis Analysis was carried out using Atomic absorption spectroscopy for Ca 2+ , Na + , Mn 2+ , Cl -, Pb, Cd, Zn and Cu were analyzed with the aid of spectrophotometer while K+ was determined using flame photometer method. pH was measured with standard pH meter while the concentrations of total Iron (Fe) were determined calorimetrically using Spekker absorption meter. Total dissolved solids (TDS) was determined using glass fiber filter. The concentrations of Ca 2+ , Mg 2+ and Na + in milli equivalent / litre were used to obtain sodium absorption ratio (SAR).Turbidimetric method was used to assess turbidity. Physical parameters like pH and dissolved oxygen were measured insitu in the field with the appropriate standard meters. While anions like HCO 3 were estimated by titrimetric method. All details of analytical procedures are reported in Omidiran (2000). Clean plastic containers were used to contain the water samples. They were rinsed several times with the same water samples to be analyzed , then covered with air tight cork and carefully labeled and sent to the laboratory for analysis, within 24 hours of collection. The parameters analyzed are Temperature, dissolved oxygen, turbidity, conductivity, total dissolved solid iron (Fe 2+) Calcium (Ca 2+) Chloride (Cl -), bicarbonates (HCO3 -), total hardness and Sodium (Na +) etc. Coliform count was analyzed as to estimate possible bacteria presence. Physical parameters such as oxygen, pH , conductivity and temperature were measured insitu in the field.

5 III. RESULTS AND DISCUSSION

The result of water analysis of the 6 water samples compared with **??**HO (1984) The result of biochemical analysis is shown in table 4. It shows the examination of the total coliform count that indicates absence or presence of bacteria in water **??**Martin 1977). The result of the organic analysis of the ground water samples of table 4 indicates that there were no faecal coliform found in the water samples, therefore no pathogens in the water. On the whole, the high values of turbidity may be due to sediments from erosion and algae growth, urban runoff and flooding as a result of climatic change **??**Offodile 1988). The high level of iron (Fe2+) could be as a result of corrosion of steel pipes **??**Barnes and Clarke 1980). The possible effect of high iron are red or yellow strining of laundry and house hold fixtures (Palme et al 1997). The possible health effects are high concentration of iron stored in the pancreas, livers, spleen (Oteze 1991). High concentration of iron in the body can cause liver and lung problems (Offodile, 1987). From the piper plot, the ground water in Ehime Mbano and environs is portable and of calcium bicarbonate type (CaH Co3)

The comparison of chemical analysis of Ehime Mbano subsurface water with American water works association standard (1991) for industrial water is shown in table 5 With reference to table 5, the groundwater in the area should be treated for iron before they are used for some industries eg. Laundry. In employing the pollutional index scale of Horton (1995), it is possible to calculate the pollution index of the area as to assess the extent of pollution. The Horton scale is shown in fig 4 **??** Unity value of (1) indicates a tolerable standard, but above this value (1) the water is polluted and below this (1) the water is not polluted. The pollutional index is calculated using the formular propounded by Horton (1995) (Horton 1995) The pollutional index of 3.336 within Nsu area (S1) shows that Ezeoke Nsu axis is the most polluted in Ehime Mbano NE area. The suitability of water for domestic purposes is based on total hardness, total dissolved solids (TDS) and portability (Davis and Dewest, 1996). The average value 8.86mg/l for total hardness and 14.3mg/l for TDS indicates that the water belongs to fresh and soft class. **??**Hem 1970 **??** Carrol, 1962). The water therefore has no laxative effects (Oteze, 1991). The ground water in the area is slightly acidic (6.90). Acid level in water is an indication that there will be more of reduction than oxidation. (Raymond 1979). This implies dissolution of metals leading to high TDS and consequent destruction of metal pipes. High pH causes bitter taste, while water, using appliances become encrusted **??**Hem, 1970). A comparison of the chemical result of the 6 water samples to American water works association **??**1991) shows that iron (fe2+) is 0.1 -1.0 mg/l, mn2+ (20 -250mg/l), total hardness as Caco3 (0 -250mg/l, pH (6.5 -8.3), chlorides (20 -250mg/l) and TDS 50 -1500mg/l). This indicates that ground water in the study area is suitable for use in most industries. From the organic analysis carried out, there were no bacteria presence in water. Thus the water can be consumed without fear of water borne diseases.

6 IV. CONCLUSION AND RECOMMENDATION

In conclusion, the exploratory survey of the geochemical aspects of underground water in Ehime Mbano shows that the water has high turbidity, high iron, slightly acidic soft and suitable for domestic, industrial and irrigation purposes. Above all the water has no laxative effect and no bacterial presence (hence no water borne diseases). Pollutional index of Horton indicates slight pollution. The pollutional index of 3.336 within Ezeoke Nsu shows that the NE section of Ehime Mbano is most polluted.

To solve the minor problems of water standard, in the area, high turbidity can be solved by distillation and filtration. Problems of High iron can be solved by aeration, while the pH can be elevated slightly using alkaline fertilizer.

Borehole owners should be encouraged to test their water periodically. Water chemistry examination should be carried out seasonally, since groundwater is subject to surface geological changes (Offodile, 1987). Government should standardize the activities of various water agencies and drilling companies and ensure strict compliance to specified methods of water borehole construction. Water treatment facilities should be made available and accessible to the public. There should be good public orientation and awareness programme, enlightening the masses on the importance of portable water quality standards as well as the adverse effects of contaminated water. [1] [2] [3] [4] [5] [6] [7]

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Figure 1: Fig. 1 :

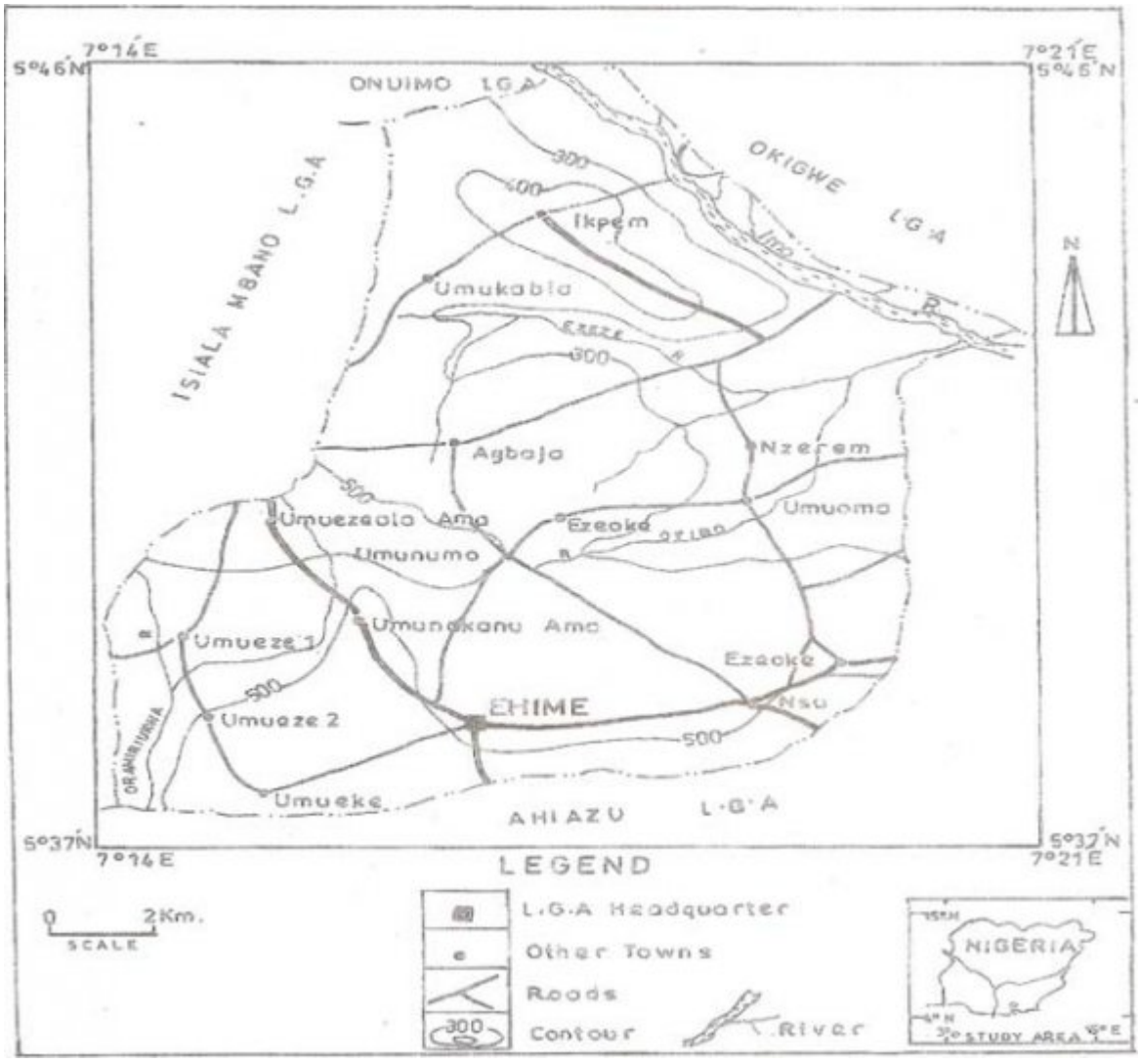

Figure 2:

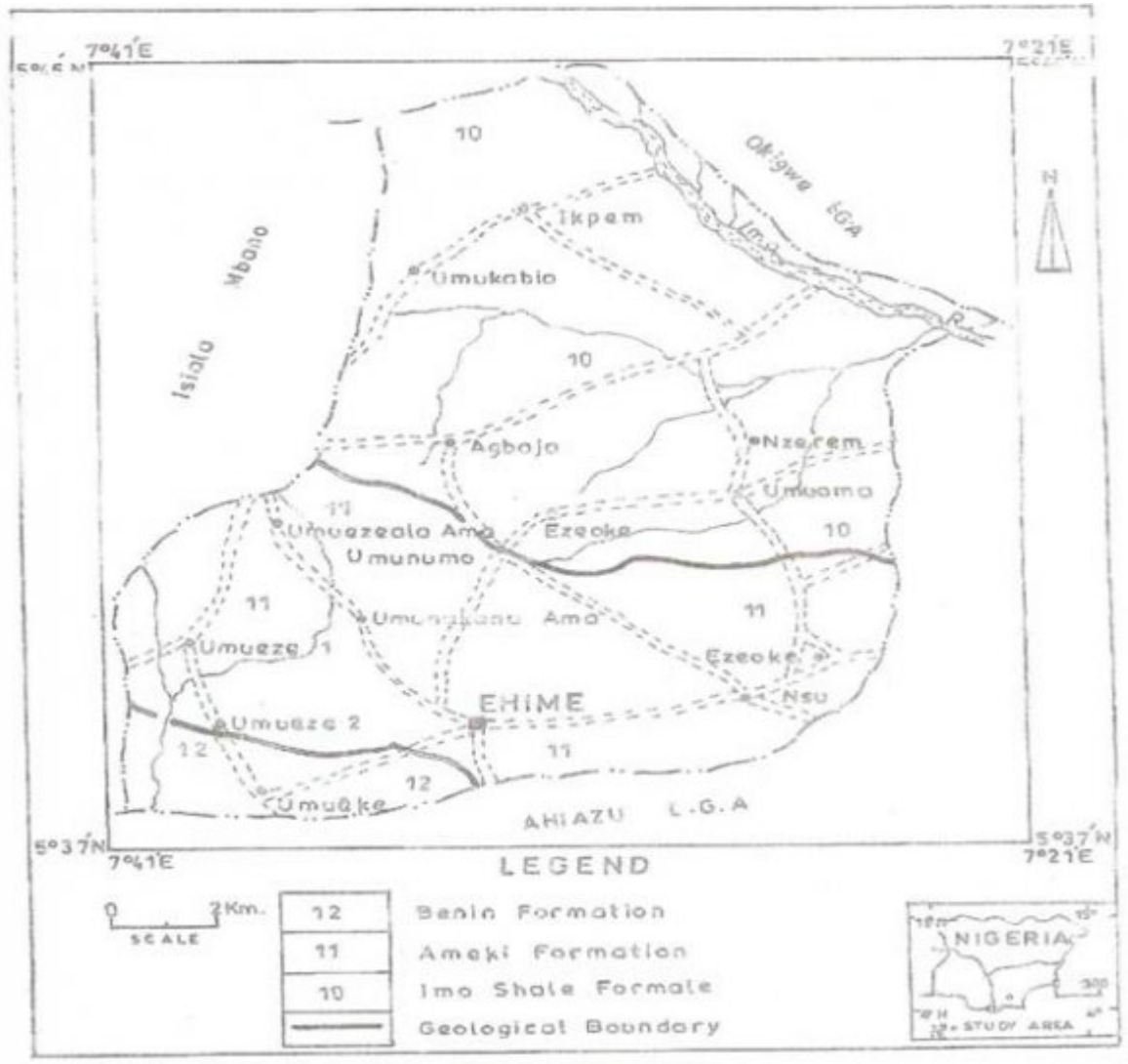

Fig 2: Geological map of the study area

Figure 3:

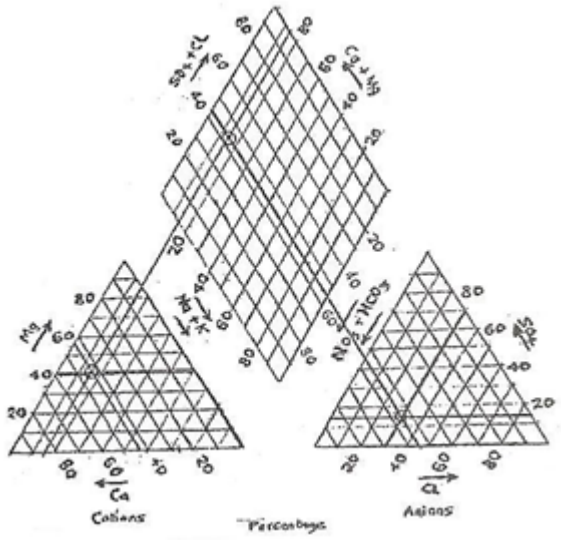

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Figure 4: Fig. 3

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a) Description of Study Area Ehime Mbano is located within Anambra / Imo sedimentary basin of South-ea

Neogene	Recent
	Miocene-
	Pieostocene
	Oligocene ?
	-Miocene
	Ledian
	Bartonian
Paleogene	Lutetian
	Ypresian
	Paleocene
Upper Cretaceous	Danian
	Maestrichtian
	Campanian
	Coniacian-
	Santonian
	Turonian
	Cenomanian
Lower Cretaceous	Albian

Figure 5: Table - I

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Figure 6: table 2 .

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Parameters	S1	S2		BH	BH	3	0.54
Sodium (Na +)	1.83	1.64		2			
	3.30	0.80		0.82			
	7.20	BH		2.13			
Potassium (K +)		1		6.90			
		3.41					
		1.11					
		7.01					
pH (at 29°C		6.80					
TDS	28.56	21.03	7.40	12.54	9.03	7.45	

Calcium (Ca 2+) Magnesium (Mg 2+) 6.41 9.64 Total Hardness 16.05 12.01 5.03 8.02 3.68 3.99 1.35 Chlor

absorption ratio SAR = (meq/L????..(1) (Ca 2+ + Mg 2+) ½ Na +

Figure 7: Table 2

Figure 8: ,

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CATIONS						
Component Cations	Conc Mg/l	Atomic Weight	Charge ?	Equiv Mass (EM)	Conc Mg/l	% of Component
Ca 2+	5.65	40.08	2	20.40	.2819	43.56
Mg 2+	3.21	24.31	2	12.156	.2641	40.81
Na +	0.06	22.98	1	22.989	.0461	7.12
K +	2.15	39.10	1	39.102	.0550	8.51
		Total			0.647	100
ANIONS						
Hco 3 -	9.95	61.02	1	61.02	.1658	
No 3 -	1.09	62.0	1	62.0	.0176	
So 4 2 -	2.28	96.06	2	48.03	.0475	
Cl -	3.50	35.45	1	35.5	.0981	
		Total			.3296	100.002

Figure 9: Table 3

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Figure 10: Table 3 was

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April 2011
Volume XI Issue IV Version I
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Sample	Total Hetertropic plate count	Dilution	Organism	Faecal coliform count	Faecal stereoto coccii	E.coli count	cl. Welchi count
S 1	95	10 2	9.5 x 10 2	-	-	-	-
S 2	80	10 2	8.0 x 10 2	-	-	-	-
BH 1	75	10 2	7.5 x 10 2	-	-	-	-
BH 2	18	10 2	1.8 x 10 2	-	-	-	-
BH 3	24	10 2	2.4 x 10 2	-	-	-	-
BH 4	25	10 2	2.5 x 10 2	-	-	-	-

Figure 11: Table 4

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Parameters	Average value of sample analyzed	AWWA (1991) accepted standard
TdS	14.3	50-1, 500mg/l
Toral hardness	8.66	0-250mg/l
Iron (Fe+)	0.20	0.1-1.0mg/l
PH	6.90	6.5-8.3
Chlorides	3.50	20-250mg/l
Manganese	-	0-0.5mg/l

Figure 12: Table 5

Figure 13:

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	Parameter mg/l pH at 29 0 C	-	Ai	7.20	-1	1	Wij	3	4	Ai/W				
	Turbidity (NTU)	3	23.40				6.5-8.5			Pol-luted	4.680			
			-2	Not polluted			5.0 2							
	Conductivity (MS)		26.80				100				0.268			
	TDS		28.56				500				0.057			
	Iron (Fe+)		0.019				0.3				0.063			
	Calcium Ca 2+		9.64				75				0.129			
	Magnesium mg 2+		6.41				<30				0.214			
	Potassium (K +)		3.30				200				0.017			
	Sulphate (So4 2-)		3.61				250				0.014			
	Phosphate (Po4 2-)		7.70				-				-			
	Nitrate (No 3 -)		1.26				10				0.126			
	Chloride (Co 3 2-)		16.41											
	Total Ai/Wij										0.595			
	Total parameter										6.584			

Figure 14: Table 6

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