

# CHEMICAL AND MICROBIOLOGICAL ASSESSMENT OF SURFACE WATER SAMPLES FROM ENUGU AREA, SOUTHEASTERN, NIGERIA

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## ABSTRACT

The importance of good quality water cannot be over emphasized. This is because it is only next to air as a critical sustainer of life therefore it is appropriate to evaluate its quality and quantity. A total number of thirteen water samples were investigated in this study: Nine samples from different surface water bodies, two samples from two effluent sources, one spring and one tap water sample were collected and used in the analyses. The objectives of the study are to assess, ascertain and evaluate the level, degree and type of pollution that characterize the surface water resources of Enugu area of southeastern Nigeria in terms of physico-chemical and bacteriological constituents. Field measurements of physical parameters were preceded by chemical analyses of the samples for major ions concentrations and bacteriological content. Evaluation of the results showed that the waters are fresh and soft (Hardness ranges is 4.00 to 53.00mg/l). The pH range is from 4.32 to 7.11 and these value fall within the acceptable limit of water for domestic use. Major ion concentrations were low and within the WHO guidelines for drinking water indicating chemical suitability of surface water. All the water samples tested positive to total bacterial count and E – coli. and this is evidence of faecal contamination and should be treated/disinfected before consumption.

**KEYWORDS:** Freshwater, Chemical, Microbiological, Constituents, Enugu area, Nigeria

## INTRODUCTION

The study area is in the humid tropics lying within latitudes  $5^{\circ} 56' 42''\text{N}$  to  $6^{\circ} 27' 3.6''\text{N}$  and longitudes  $7^{\circ} 1' 30''\text{E}$  to  $7^{\circ} 43' 4.6''\text{E}$ . The study area comprises Enugu the state capital and areas like Ezeagu, Udi, Nkanu, Oji River and some parts of Awgu and Aninri local government areas of Enugu state. Surface water resources in the study area like elsewhere in the world is a crucial resource with great implications for economic development since people relies heavily on it for various uses such as domestic agriculture and industrial purposes. The study area is predominantly sedimentary terrain and is characterized with occurrence of numerous surface water bodies. In the rural community of the study area the people resort mainly to the rivers and streams for drinking water, swimming, fishing, yachting, fermenting of cassava/tapioca and washing of clothes e.t.c. These surface water bodies are prone to impacts from anthropogenic activities apart from geogenic solute inputs from dissolved minerals.

Major ion composition of surface water bodies are controlled by the interaction of precipitation with surficial geological and biological materials (Raymond et al. 1994). Therefore, knowledge of dissolved salts in such water bodies is a pre-requisite for making any decision on their proposed or potential use for any specific industrial, irrigational or domestic purposes.

The objective of this study is to assess and evaluate the degree and type of pollution obtainable in the surface water resources of the study area both in terms of chemical and bacteriological constituents. It

also aims at determining the portability of this valuable resource by looking at the constituents analytically. The study is also to appraise the planning and management of groundwater resources of the study area in order to suggest possible solutions to the problems of water supply.

## THE STUDY AREA

The geology of study area can be broadly classified into shales, False-bedded Sandstones and Coal Measures (Akamigbo, 1987). The geologic map of Enugu State is shown in figure 1. The formations encountered in the study area are the Imo Shale, Nsukka Formation, Ajali Sandstone, Mamu Formation and Enugu Shale. Others are Nkporo Shales, Awgu Shale, Eze-Aku Shale and Asu River Group (Abakaliki Shale). The Ajali, Mamu and Nsukka Formations Furnish the Study area with water. These formations are highly aquiferous. The area is drained by many rivers/streams flowing dendritically towards the major rivers. The rivers include Ekulu, Nyaba, Ajali, Oji, Atafo, Mamu, Asu, Iyoko, Idodo, and Nnam. Others are Adada, Awra, Aiddo, Iva, Karawa e.t.c. The presence of a north-south trending cuesta or escarpment that crosses the study area creates major surface and ground water divides for the two great drainage basins of Cross River and Anambra, east and west respectively. Some of the major rivers flow eastwards into the Cross River Basin while the rest flow westwards into Ajali and Mamu rivers and later into the Anambra River Basins. This indicates possible existence of water divide along the axis of the Enugu escarpment

The topography is a reflection of the tectonic

and geologic events that occurred over the years and mildly neo-tectonically continues today to shape the geomorphic landscape.(Egboka et al 1989). The landforms are categorized into cuesta, plains and lowland landscapes. The cuesta comprises the Nsukka-Okigwe cuesta; the Enugu and Awgu escarpments and the Udi-Nsukka Plateau (Akamigbo, 1987). At Enugu towards Udi, the escarpment rises to heights between 397 and 457 metres and north of Enugu the crests remain at between 459 and 549 metres with a gentle descent to the plains. The Udi-Nsukka Plateau fall gently

towards the lowlands along the Niger River. The study area is in the humid tropics with high amounts of rainfall and high temperatures throughout the year. The mean annual rainfall falls within the range of 1750 – 1890mm. The distribution is bimodal with peaks in July and September. The mean annual temperature range is 21 – 29<sup>o</sup>. Relative humidity does not fall below 60% except during the period of harmattan, a short period in the dry season during which the atmosphere is very dry and hazy usually from December or early January.

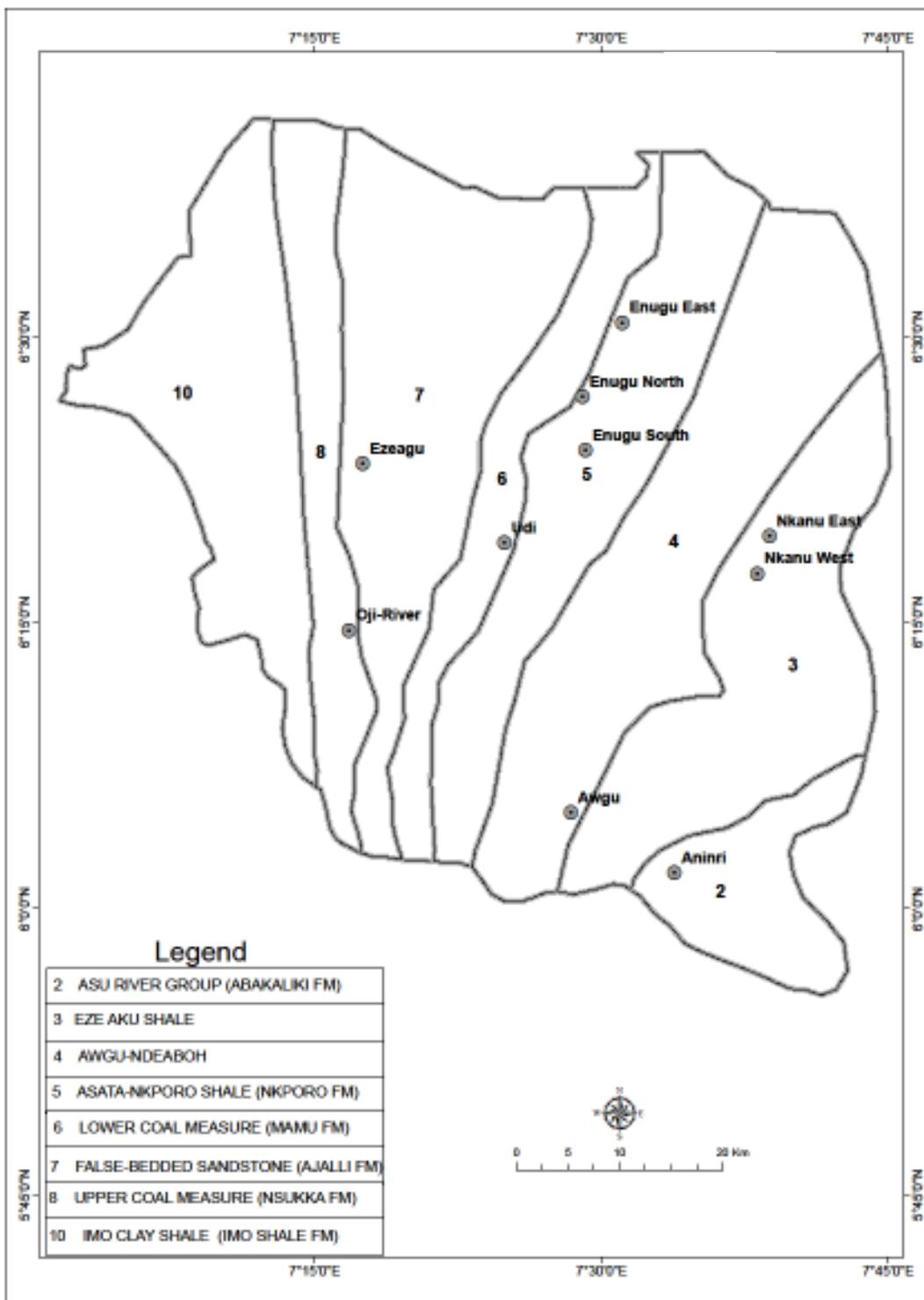


FIG.1 LOCATION AND GEOLOGIC MAP OF THE STUDY AREA(SOURCE:ANAMBRA STATE TASK FORCE ON SOIL EROSION CONTROL, 1987)

**METHOD OF STUDY**

Water samples for this study were collected from thirteen different locations within the study area (Figure 1). A total number of nine surface water samples, two samples from two effluent sources, one spring and one tap water sample were collected and used in the analyses. The major cations and anions were analysed

chemically using atomic absorption spectroscopy and ultraviolet spectrometric methods. The procedure adopted were in accordance with those stipulated in standard methods for examination of water and waste water (Alpha, 1971). Also bacteriological analysis was carried out on some samples using the Membrane Filter

technique and also in accordance with the standard methods for water and waste water (Alpha, 1971).

## RESULTS

Results of the chemical analyses are shown in Table 1 while those of microbiological analyses are shown in Table 2.

**Table 1:** Hydrogeochemical Analysis of Surface Water Samples from Enugu and Environs

Geochemical Parameters	Ekulu River At Emene	Nyaba R. At Awkunana w	Iva Valley River	Ajali R. At Imezi Owa	Adada R. At Amansiodo	Nike Lake At Abakpa	Iyoko River At Chum	Atafor River At Ozalla	Ngene-Iyi At Akagbe-Ugwu
PH	6.82	4.32	4.32	6.90	7.11	6.00	6.50	5.50	6.32
Turbidity	10.00	200.00	216.82	150.00	101.00	6.60	84.00	56.74	50.00
Colour(Hazen Units)	38.00	250.00	50.00	70.00	65.00	30.00	200.00	80.00	45.00
Electr. Conduct.(Ohms cm <sup>-1</sup> )	54.70	147.00	72.00	11.00	70.00	28.00	42.00	70.00	72.00
Total hardness(mg/L)	42.00	22.00	27.62	25.15	53.00	8.00	27.00	4.50	4.00
Ca-hardness(mg/L)	31.00	10.00	8.52	2.01	2.00	3.00	6.00	3.00	1.50
Mg-hardness(mg/L)	12.00	6.50	16.50	10.00	51.00	5.10	21.00	1.50	2.50
Silica as SiO <sub>2</sub> (mg/L)	18.32	32.00	10.00	15.00	15.20	8.10	20.00	10.00	20.00
Total Iron as Fe (mg/L)	0.41	0.05	8.90	1.24	0.10	4.10	1.36	0.97	0.19
Nitrate(mg/L)	0.05	–	0.25	0.24	–	–	–	0.50	–
Sulphate(Mg/l)	14.00	–	26.60	1.20	2.41	0.01	–	–	6.80
Sodium(mg/L)	5.60	8.00	4.52	1.90	10.00	4.21	–	–	–
Chloride as CL(mg/L)	4.00	8.12	2.46	1.42	1.42	2.80	4.04	2.34	12.76
Chloride as NaCl(mg/L)	–	–	–	–	–	–	–	–	21.05
Alkalinity(mg/L)	9.30	–	9.10	5.00	–	4.60	–	6	3.00
Total dissolved Solids(mg/L)	28.60	–	–	–	–	25.00	–	–	–
Temperature °C	26.00	27	27.00	27.00	26.00	27	26.00	27.00	26

**Table 2:** Bacterial Analysis Result of Surface Water Samples from Enugu and Environs

Source of Water	Coli Form Mpn/100MI	E-Coli Positive Or Negative	Plate Count Colonies	Remarks
Ekulu River: Treated	Nil	Negative	No growth	Excellent
Untreated	1800	Positive	150 colonies after 24hrs at 37 <sup>0c</sup>	Unsatisfactory
Nyaba River: Treated	Nil	Negative	No growth	Excellent
Untreated	1800	Positive	140 colonies after 24hrs at 37 <sup>0c</sup>	Unsatisfactory

Ajali River: Treated Untreated	Nil 240	Negative Positive	No growth 87 colonies after 24 hrs at 37 <sup>0c</sup>	Excellent Unsatisfactory
Iva River: Treated Untreated	Nil 1800	Negative Positive	No growth Over 200 colonies	Excellent Unsatisfactory
Adada River: Treated Untreated	Nil 260	Negative Positive	No growth 120 colonies after 24hrs at 37 <sup>0c</sup>	Excellent Unsatisfactory
Nike Lake: Untreated	300	Positive	40 colonies after 24hrs at 37 <sup>0c</sup>	Unsatisfactory
Oji River: Untreated	1800	Positive	160 colonies after 24hrs at 37 <sup>0c</sup>	Unsatisfactory
Effluents from Emenite Ltd: Untreated	1800	Positive	Over 200 colonies	Unsatisfactory
Effluents from Diamond Breweries: Treated Untreated	54 1800	Positive Positive	10 colonies Over 200 colonies	Unsatisfactory Unsatisfactory
Spring Water at Artesan Quarters, Enugu: Untreated	1800	Positive	95 colonies	Unsatisfactory
Tap at NOT	180	Positive	63 colonies	Unsatisfactory

## RESULTS AND DISCUSSION

### PHYSICAL AND CHEMICAL CONTITUENTS OF THE SURFACE WATER SAMPLES

The hydrogen ion concentration (PH) of surface water ranges from 4.32 to 7.11. These values fall within the acceptable limit for domestic use (WHO, 1971), and hence it is good for drinking and other domestic uses.

The colour mostly gave high values and varies from place to place. It ranges from less than 5.00 to 250.00 Hazen units. The variation in colour was as a result of nature of constituents dissolved in water and effects of sediments transported from different source areas by running waters(run off).

The total hardness ranges from 4.00 to 53.00mg/L and these values are acceptable. The range 4.00 to 53.00mg/L is soft based on Sawyer and McCarty (1967) hardness classification. If the hardness is less than this, other undesirable effects may be caused, for example, heavy metals may be dissolved out of pipes.

The chlorides content of the surface waters range from 1.42mg/L to 12.76mg/L. Based on WHO'S standards, these values are very low and could imply that the surface waters are pollution free from defecation.

The iron content of the surface waters ranges from 0.05 to 8.9mg/L. These values generally are high. These high values imply that adequate treatment should be given to water from the study area against abnormal concentration of iron before the water is supplied.

The EC and TDS values of the water samples ranged between 11.00 -147.00mhos cm<sup>-1</sup> and 25-28.60mg/L respectively suggesting low mineralized fresh water. Similarly, major ion concentration were low. All ionic concentrations are within the approved (WHO, 2006) standard for drinking water indicating chemically potable water.

### BACTERIOLOGICAL ANALYSES OF THE SURFACE WATER SAMPLES

Results of the bacteriological analysis of the water samples are presented in Table 2. All the

untreated sampled water from the study area tested positive to bacteria counts and E-Coli test and are therefore suspicious and not suitable for drinking and for domestic purposes and so, necessitate treatments before consumption. Also all the treated sampled water from the study area are all E-Coli negative, Nil or No Coli Form and therefore are excellent and suitable for domestic purposes. The untreated water samples showed very heavy growth of pathogens with colonies range of between 10 to over 200. The high coliform count obtained in the samples may be an indication that the water sources were faecally contaminated (Osunde and Eneuzie, 1999). None of the untreated water samples complied with EPA standard for coliform in water. The primary sources of these bacteria in water are animal and human wastes introduced into surface runoff, pasture and other land areas where animal wastes were deposited. Seepage or discharge from septic tanks, sewage treatment facilities and natural soil/plant bacteria may also contribute to bacterial contamination of water (EPA, 2002). The positive result implies that the water has been contaminated and most likely has hazardous effect. The water therefore, should be subjected to adequate treatment before being supplied.

### CONCLUSION

The chemical and microbiological assessment OF the surface water samples from Enugu area , southeastern, Nigeria have shown that the physico-chemical parameters of the surface waters fell within the (WHO, 2006) Guidelines for drinking water. These further depict that the waters are chemically potable. Evaluation of the results showed that the waters are fresh and soft (Hardness ranges 4.00 to 53.00mg/L). The pH range is from 4.32 to 7.11 and these value fall within the acceptable limit of water for domestic use. All the surface water tested positive to total bacterial count and E-coli and which are evidences of faecal contamination and should be treated/disinfected before consumption.

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