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Alternative Source of Water Supply for Owerri Area

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ABSTRACT

Alternative source of water supply for Owerri area has been studied. This is due to population explosion caused by Boko Haram refugees with the result that the aquifer is adversely affected. Parameters such as organic, inorganic and bacteriological composition of the water were analyzed. Water analysis was carried out using atomic absorption spectroscopy for Ca^{2+}, Na+, Mg^{2+}, Cl-, Pb^{2+} and Cadmium. Zinc and copper (Zn^{2+} and Cu^{2+}) were analyzed with the aid of spectrophotometer, while K+ was determined with flame photometer method. PH was determined with standard PH meters while the concentration of total iron (Fe3+) was determined using Spekker absorption meter. Total dissolved solid (TDS) was determined using glass fiber filter. Trimetric method was used to access turbidity. PH and dissolved oxygen were analyzed institu in the field with appropriate standard meters. Anions like HCO_3^- were estimated by titrimetric method, while bacterial presence was estimated by most probable number technique (MPN). The result shows that the water is acidic (ph 5.43). Turbidity and colour are high (122.65 and 546.3). The average temperature is high (29.67oc). The biological oxygen demand is high (4.75). Nutrient level is high. Fe^{3+} is high (0.32mg/l). It was discovered that the water is contaminated with high level coliforms. Therefore, PH, turbidity and iron exceeded the safe drinking limit. The remarkable high level in the nutrient (N and P-K), might affect the water quality due to the influence of methemoglobinamea resulting from nitrites. It is therefore, recommended that proper remediation of the water is imperative before Nworie River is appropriate as a source of municipal water supply.

KEYWORDS: River Nworie in Owerri, Boko Haram, Anambra-Imo Sedimentary basin, water quality, south east Nigeria.

INTRODUCTION:

Population increase of Owerri area in recent times (2013 – 2015), mounts much pressure on the underground water resources used by the inhabitants of Owerri area. This phenomenon calls for alternative search of water supply in the area to relieve the aquifer system which is hitherto being exploited through water boreholes. Nworie River and its source in Owerri environment has been selected and investigated as an alternative source of water supply for the area.

Rock types their weathered products and precipitation from rainfall, contributes greatly to the chemistry and pollution trend of surface and ground water (Wilson, 1981). Mans activities such as dumping of refuse, agricultural practices and animals also determine the pollution of surface and ground water (Horton, 1995). Ground water 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 materials derived from chemical waste disposal sites of factories and mining industries also contribute possible pollutants. The introduction of

contaminants 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 ground water pollution may result from the location of a disposal pits, ponds or lagoons, mines or industrial wastes. These may be infiltrated direct into an unconfined aquifer system. Diffused ground water pollution source are more complicated and hence difficult to identify and remediate, since it is difficult to locate the areas and origin of impact of the contamination (Raymond, 1979). Water related diseases from subsurface have been reported in the past. Feachem et al 1998 reported high incidence of water related diseases in tickly populated settlements with their sources traced to wells. Also Palmer and Holman (1995), 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. Therefore, the aim of the study is to examine the source ground water quality level of Nworie River within Owerri area of Imo State South Eastern Nigeria as an alternative to production of public water supply. In the strength of these, the assessment of the source groundwater quality of the study area becomes important following the unprecedented population explosion due to the influx of people from Northern parts of Nigeria occasioned by the movement of the people due to the increasing massacre of innocent citizens by Boko Haram insurgents in Northern parts of Nigeria.

In southern Nigeria, especially in areas underlain by sedimentary formation, groundwater is usually present in abundance. This is partly because of the prevalence of equatorial climate that fosters abundant rainfall and hence ensures adequate aquifer recharge; coupled with impervious sediments that fosters the storage of recharging water.

According to Wilson 1981, ground water pollution is mainly due to presence of industrialization and urbanization. Leachate migration from waste dumps posses a high risk to groundwater resource if not adequately managed. This condition is met in Owerri where there is population explosion.

MATERIALS AND METHODS

DESCRIPTION OF THE STUDY AREA

The area is located within Anambra/Imo sedimentary basin of south eastern Nigeria. It is bounded by latitude $5^{O}28N$ to $5^{O}30N$ and longitude $5^{O}59E$ to $7^{O}01E$. (Fig. 1a and 1b).

The drainage pattern is dendritic typical of sedimentary rock with uniform resistance and homogeneous geology (Dever and James, 1985). The area has a tropical climate and experiences two air masses, equatorial maritime air masses associated with rain bearing south west winds from Atlantic Ocean around March to September (Iloeje, 1981). The other is dry and dusty hamattan wind from Sahara desert blowing around December to February. The annual total average rainfall is about 230mm, while temperature ranges from $29^{O}C$ during dry season to about $33^{O}C$ in rainy season, then relative humidity has between 65% and 75% (Iloege, 1981). 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 rainforest which is prevalent in 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. The soil of the area is loamy with scattered pebbles

(Gorrel, 1990). Thick vegetative covers have prevented soil erosion. However, erosion is acute where forest clearing and over cropping have

Opened up the soil to erosion elements (Stephen, 2004).

FIG 1[B] DRAINAGE MAP OF THE STUDY AREA

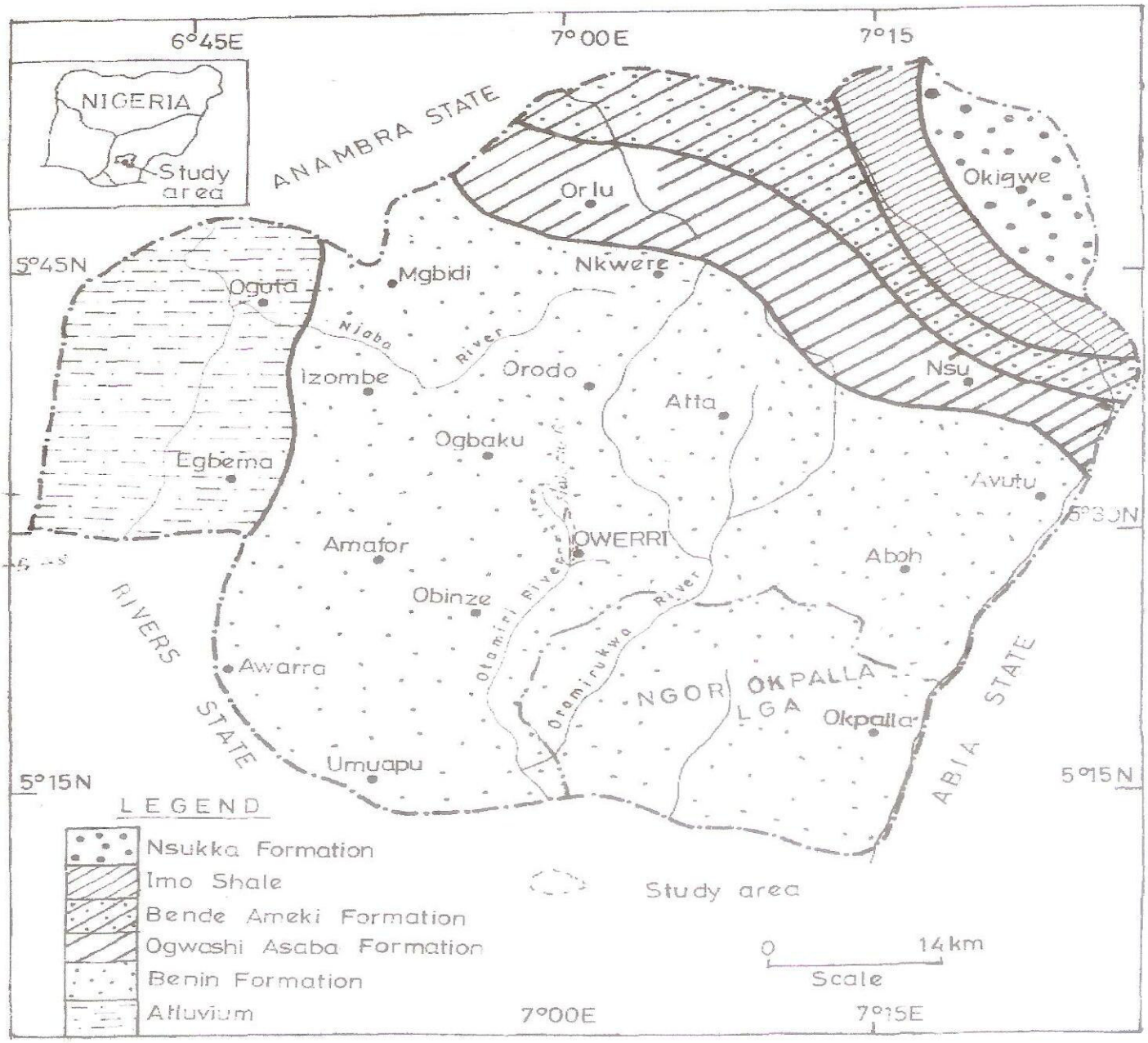

FIG. 1[A]: GEOGRAPHICAL MAP OF IMO STATE SHOWING THE STUDY AREA

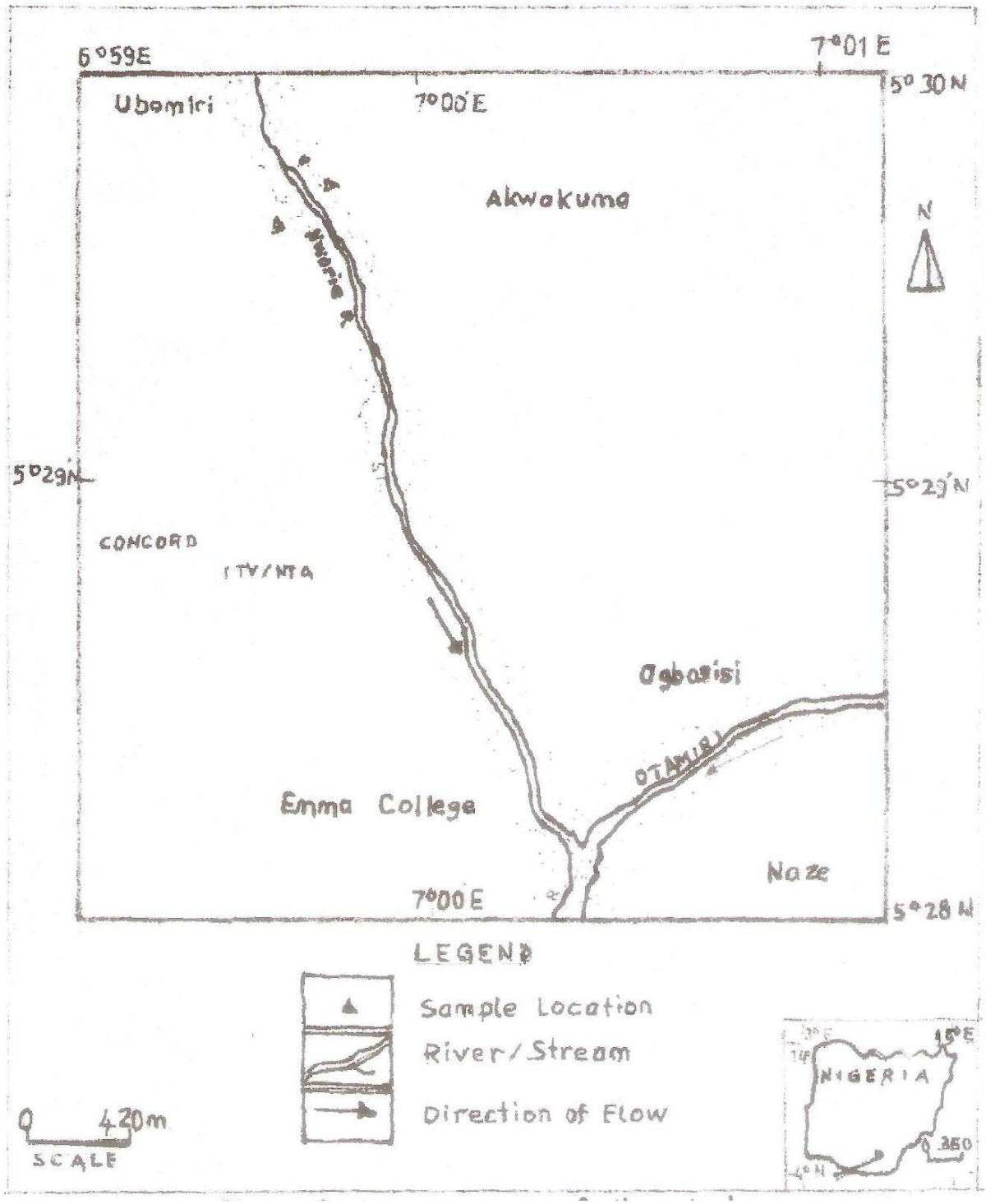

FIG 1[B] DRAINAGE MAP OF THE STUDY AREA

The presence of Benin Formation is a contributory factor to soil erosion especially where they are exposed unprotected by vegetation (Ahiarakwem and Onunkwo – Akunne 2001). Owerri area and environs within Anambra/Imo sedimentary basin of south-eastern Nigeria, is underlain by Benin formation (Miocene to recent) and youngest in the study area. This is underlain by Ogwashi Asaba formation (Reyment, 1965). Table 1 shows the stratigraphic sequence of the area. The major aquiferous formation is Benin formation (Parkinson, 1970).

Table 1: Stratigraphic Succession of Rocks in Owerri – Imo State and Environs (Short and Stauble, 1967)

AGE	FORMATION	LITHOLOGY
Miocene	Benin Formation	Sands with clay lenses
Oligocene – Miocene	Ogwashi Asaba FM	Sands clay ignite seams
Eocene	Bende – Aneki FM	Clayey sand stone, sandy clay stone
Paleocene	Nanka Sands Imo Shale	Sands laminated clayey shale

DATA COLLECTION

Data was acquired from field work, laboratory investigations and Library. Topographic and geologic maps on a scale of 1:250,000 were obtained from Nigeria geological survey department, Owerri. Spring out crops (Source water), land use elements especially waste dump sites were visited and examined. Underground water sources of Nworie River were collected at Station 1 Egbeada upper section of the river (source) Station 2 – source near Mobial filling station, Onitsha Road Owerri area, and station 3 – source near Federal medical centre, Owerri.

The water sample of Nworie sources were collected and analysed for organic and inorganic elements. Analysis was carried out using atomic absorption spectroscopy for ca^{2+}, Na^{+}, Mn^{2+}, Cl^{-}, Pb and Cd. Zn and Cu were analysed 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) were determined using glass fiber filter the concentrations of ca^{2+}, Mg^{2+} and Na^{+} in milli equivalent/litre were used to obtain sodium absorption ration (SAR). Turbimetric method was used to assess turbidity. Physical parameters like PH and dissolved oxygen were measured institu in the field with appropriate standard meters. Anions like HCO_3 were estimated by titrimetric method. All details of analytical procedures are reported in Omidran (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 (HCo_3^{-}), total hardness and Sodium (Na^{+}) etc. Coli form count was analyzed to estimate possible bacteria presence. Physical parameters such as Oxygen, PH conductivity and temperature were measured insitu in the field.

RESULTS AND DISCUSSION

The laboratory results are shown in the tables below physical parameters of River Nworie at Station A, B, C as discussed before are shown below.

Table 2: Sample Stations – A, B, C (Physical Parameters)

Parameters	A	B	C	Range	WHO Standard (2004)
Temperature	29.7	29.7	29.6	29.67	20-30
PH	5.3	5.8	5.2	5.43	6.5-8.5
Turbidity (cm)	50.80	19.7	298.05	122.85	10
Colour (pcm)	212	32	1395	546.3	15

Table: 3 Chemical Parameters of River Nworie

STATION (A, B, C)

Parameter	A	B	C	Range	Standard
Conductivity (us /cm)	50	124	102	92	100
Alkalinity mg/L	45	20	85	50	200
Carbonate (mg/cl)	160	280	180	206.6	-500
Bicarbonate mg/L	12.0	240	160	137.3	250
Calcium hardness (mg/L)	12.6	6.2	10.3	9.7	150
Magnesium hardness (mg/L)	0.13	0.02	0.16	0.10	150
Dissolved Oxygen (mg/L)	8.9	8.8	8.1	8.6	-
BOD mg/L	3.7	2.9	7.6	4.73	3.0
Tds mg/L	32.5	80.6	66.3	59.8	250
Tss (mg/L)	18	7.2	28.5	17.9	50

Table: 4 Nutrient Levels of River Nworie (Source)

STATIONS (A, B, C)

Parameter	A	B	C	Range	WHO, 2004
	45.0	31.5	9.4	28.63	40
$NO_3 - N_2$ (mg/L)	10.2	7.1	21.2	10.49	0.08
Total Phosphate mg/L	0.3	2.4	3.5	2.07	0.08
P_2O_5 mg/L	0.7	5.5	8.1	4.77	-10
Total Chlorine (mg/L)	0.17	0.06	0.13	0.12	0.2 – 2.5
Potassium mg/L	30	20	160	70	-200
Iron mg/L	0.30	0.04	0.62	0.32	0.30
Copper mg/L	0.11	0.07	0.18	0.12	1.0
Zinc mg/L	0.20	0.10	0.36	0.22	5.0

Table: 5 Bacteriological Analysis of River Nworie (Source)

STATIONS (A, B, C)

Parameter	**A**	**B**	**C**	**WHO, 2004**
Total Bacteria Count (cfu/ml)	19.0×10^7	7.9×10^6	4.0×10^3	0 – 10
Total Coliform Count cfu/ml	6×10^4	4×10^4	1×10^4	10
Total Facial Count (cfu/ml)	4×10^3	0	2.3×10^4	–
Total Escherichia Coli Count (cfu/ml)	1×10^3	0	1.3×10^3	0

DISCUSSION

From the results, the average water temperature of the sampling station of the source of Nworie River amount to 29.67, while WHO standard (2004) is 20-39^{0}C. Average PH is 5.43, while WHO standard is (6.5-8.5). The water is therefore acidic (WHO, 2004).

Turbidity and colour are extremely high 122.85 and 546.3, while the WHO, 2004, standard is 10. This value is very high (Gorrel 1990). The range of conductivity value is 92, while the WHO standard is 100. The alkalinity values amount to 50 while the WHO, 2004 standard is 200. This is low considering the standard measures. The Carbonate and Bicarbonate values of 206.6 and 137.3 were recorded, against 500 and 250 values specified by World Health Organization. The Calcium and Magnesium hardness of 9.7 and 0.5 values were obtained, while the WHO standard was 150 respectively. BOD is high with an average value of 4.75 while the WHO recommendation is 3.0. The TDS and TSS amount to 59.8 and 13.9. The value of TDS and TSS specified by WHO, 2004 is 250 and 50 values. Other values of Nutrient and Bacterial levels can be seen in Table, 3 and 4

Nworie River is the major surface water system in Owerri and environs as it provides water for domestic, Agricultural and Industrial activities. The appraisal of the physic-chemical and bacteriological contents of the river (source) was undertaken to ascertain the quality of the river source as to consider it for an alternative source of water supply for Owerri residents due to the present population explosion.

The average water temperature is within the WHO unacceptable range (29.67^{0}C).

However, the average PH of water was acidic (5.43) and above the WHO, 2004 permissible range of (6.5-8.5). PH is an indicator of water quality and the extent of pollution Jonnalagadola and Where 2009. The water quality is poor. However, the increase in acid rain in to the river may be due to effect of flow station/gas flaring at the nearby oil station at Oguta, Ahiarakwem and Onunkwo-Akunne 2011. The consumption of acidic water could lead to acidosis which results in peptic Ulcer (Nnaji and Duru 2006). As a result of untreated effluent load into the river, there is an increase in values of turbidity (122.85). The turbidity value of 122.85 and colour value of 546.3 exceed the WHO standard of 10 and 15. High turbidity leads to reduction in water colour (Adekunle et al 2004). This indicates high input of sediment.

The nutrient level – Phosphate, Nitrate and Chloride is very high. They are the indication of agrochemical usage on land surrounding the river. According to (Ahmed and Tanko 2000), consumption of Nitrate polluted water could result in gastro-intestinal irritation and infantile methaemoglobinemia. The heavy metals identified in the river include Iron (Fe), Zinc (Zn^{2+}) and Cupper (Cu^2). The mean value of Iron 0.32 exceeded the value of World

health Organization 0.30. This could be due to illegal dumping of waste, Nwagbara et al (2013). This determines adversely the suitability of the water for domestic and Industrial uses.

The bacterial content of the water is undesirable (fable 4), this is due to indiscriminate human and animal defecation and very poor waste disposal practices. This can cause such diseases as Cholera, Dysentery and Typhoid (Alinnor and Obiji 2010).

CONCLUSION

The result of this study showed that most of the investigated physicohemical variables such as ph, turbidity and Iron exceeded the safe limits set by WHO Standard. The remarkable high level in the nutrients (N and P-K) in the river indicated that it mighty adversary affect its use for human consumption. The mean standard of iron is above the WHO, 2004 safe limits. The water is highly polluted by high total Coliform and total E.coli count. The implication of these findings may indicate that people dependent on the river waters for domestic use –cooking, bathing, washing, drinking or agricultural use may be exposed to health risks. Long term consumption of water from Nworie River could be toxic to humans.

The area therefore shows ground water of high TDS and low PH. these attributes are typical regions of high rainfall (Iloeje, 1981) which ensures continues leaching of the sediments and high rainfall recharge. In down slope area (valleys and plains) where groundwater is relatively static, there is always increase in TDS which may be a case with Nworie river plain. Deductions for the study indicate that the groundwater is acidic probably due to the nearby gas flaring station at Oguta. Nevertheless, as has already been observed, appropriate PH remediation and microbial disinfection are needed to upgrade the water quality for human consumption. Nitrite pollution of ground water arising from long term use of Nitrogen fertilizers have been widely reported Todd, 1959). The environmental health effect in such district is a drastic rise in cancer mortality (Wilson 1981). Reduction in nitrogen rich fertilizer application to the minimum is needed and this may help to reverse this pollution trend.

It is therefore recommended that, proper treatment of the water is imperative for River Nworie to be appropriate as a source of municipal water supply; otherwise the alternative use of Nworie River as a source of municipal water supply is not advisable.

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REFERENCES

Adekunle, L.V. Sriahar M, Ajayi, A.A, Oluwade, P.A and Oluwayi, J.F.(2004). An assessment of the health and social – Economic implication of sachet water in Ibadan, Nigeria a republic health challenge. African J. Biomed. Res PP 758

Ahmed, K and Tanko, A.I. (2000). Assessment of water quality changes for irrigation in river Hadejia Catchment. Journal of Arid agriculture, to PP 89-94.

Ahiarakwem, C,A and Onunkwa A,A (2011). Hydrocarbon and the environment. Cape publishers 17 Alaenyi Street Owerri, pp 17-20.

Alinnor, I.J. and I.A. Obiji, 2010. Assessment of trace metal composition in Fish samples from Nworie River pak. J. Nutr., 9:PP81-85.

Dever, C.C. and James K.N (1985). Evaluation of Kano State Environmental management programme – 1995 on industrial pollution: case Study of Challawa and Sharada industrial areas, post graduate dissertation, Dept. of geography Bayero University Kano PP 25-30.

Elis, G.K (1988). Industrial effluent and water pollution in Kakuri area Kaduna South, Nigeria journal of industrial pollution and control PP 10-15.

Faechem, E.T., Ekeye, E, Esoka, D.C and Ibeh K, (1998). Improvement priorities sewage treatment in Latvian small and medium sized towns, Water Science Technology 37(8) PP 16-20.

Gorrel, C. (1990). Domestic water pollution among local communities inNigeria – Cause and Consequences. European journal of Scientific Research 52(4) PP 25-28.

Horton, C.K. (1995). Eutrophication. Geography review, 7(4) PP 31-37

Ileoje, N.P. (1981). A new geography of Nigeria William Clowes (Beccles). Limited, Beccles London PP 85-120.

Ogustayimbo, S.S. (1987). Association of water borne diseases morbidity pattern and water quality in parts of the Ibadan City, Nieria. Tanzania Journal of Health Research, 11(40) 189-195.

Parkinson, T.C. (1970). Prevance of water infections Iretrospective Study. Journal of public health and Epidemiology 3(8) PP 382-285.

Raymond C.L. (1979). Land application of wastes. Vol 1 John Wiley and Sons publisher, London PP 150-160.

Reyment R.A. (1965). Aspect of the geology of Nigeria, Ibadan Universitypress PP 25-38.

Short, K.C and Stauble A.J. (1967). Outline of geology of Niger Delta. American Association of Petroleum geologists Bull. Vol. 51(5) PP 761-729

Todd, D.K. (1959). Ground water hydrology. John Wiley and Sons Inc.Indian PP 35-40.

Wilson, 9(1981). U.N. Water global annual assessment of Sanitation and drinking water implement by World Health Organization. Genera PP 8-12

WHO (2004). Guide for drinking water quality 3rd Ed. Health Criteria and Supporting information Genera. PP 5-10.

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