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The Physico-chemical Quality of Groundwater in Geidam, Nigeria.

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***Abstract*—** The objective of this work is to give out information on the physical and chemical properties of groundwater in Geidan in order to appreciate the impacts of anthropogenic actions on the quality of groundwater. This has been carried out by collecting fifteen water samples from boreholes and analyzed using DR 2000 spectrophotometer, flame photometer and titrimetric method. The results indicate that the mean concentration of Chromium hexavalent exceeded WHO standards. This was attributed to groundwater coming into contact with sewage and waste sourced from human activities. The study indicates that the water is not suitable for human consumption without treatment.

***Keywords*—**Groundwater quality, Geidam, Physic-chemical, parameters.

I. INTRODUCTION

DRINKING water has always been a major issue in many developing countries, in Nigeria, many of the rural populace do not have access to adequate water and therefore, depend on other alternatives like wells for domestic use. The assessment of groundwater quality status is important for socio-economic development of any region of the world. The determination of groundwater quality for human consumption is important for the well-being of the ever increasing population. Good quality water will ensure the sustainability of socio-economic development, as the government priority is shifted to other sectors of the economy, rather than channeling the resources towards combating outbreaks of water borne diseases due to consumption of contaminated groundwater. Groundwater quality depends, to some extent, on its chemical composition [1] which may be modified by natural and anthropogenic sources. Rapid urbanization, especially in developing countries like Nigeria, has affected the availability and quality of groundwater due to waste disposal practice, especially in urban areas.

Once groundwater is contaminated, its quality cannot be restored by stopping the pollutants from source [2]. As groundwater has a huge potential to ensure future demand for water, it is important that human activities on the surface do not negatively affect the precious resource [3]. Poor environmental management creates havoc on the water supply and compounds public health [4]. It was emphasized [5] on the importance of groundwater globally as a source for human consumption and changes in quality with subsequent contamination can, undoubtedly, affect human health. Groundwater quality is mainly controlled by the range and type of human influence as well as geochemical, physical and biological processes occurring in the ground [6]. It therefore becomes imperative to regularly monitor the quality of the water and device ways to perfect it [7].

Water quality index or catalog is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers [2,7]. It, thus, becomes important to assess the quality of water for monitoring and management purposes. Water quality indicators reflect the composite influence of different water quality parameters. This is calculated from the point of view of the suitability of groundwater for human consumption. In many developing countries, availability of water has become a critical and urgent problem and it is a matter of great concern to families and communities depending on non-public water supply system. Increase in human population has exerted an enormous pressure on the provision of safe drinking water.
Unsafe water is a global public health threat, placing persons at risk for a host of diarrheal and other diseases as well as chemical intoxication [8]. Unsanitary water particularly has devastating effects on young children in the developing world. Studies had also shown that the principal objectives of municipal water are the production and the distribution of safe water that is fit for human consumption. This study examines the physio-chemical quality of borehole water in Geidam town of Yobe state in Nigeria.

II. STUDY AREA

Geidam is one of the seventeen local governments of Yobe State in Nigeria. It is located on latitude 120 54'33"N and longitude 110 55' 21"E. Geidam town is its capital with a population of about 89,595 (9). The major climatic seasons are rainy season which begins in March or April and ends in October and the dry season which begins in November and ends in March or April. Farming is the main occupation of the people and groundwater is the main water source for both irrigation and domestic uses during dry seasons. The degradation of the water sources due to human activities does not cause any concern to the rural populace as they are hardly aware of the negative impacts of his actions on the sources of water supply.

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III. METHODOLOGY

Fifteen (15) water samples were collected from boreholes in the study area (Fig. 1). The sample containers were rinsed two to three times in the field with the representative groundwater according to Rajkumar [9]. The samples were collected from existing boreholes for water supply according to Chilton [10] method. Positions of the monitoring boreholes were determined using the global positioning system (Table 1.0). The field parameters such as: pH, EC and TDS were measured in the field using PH meter (Wagtech), and conductivity/TDS meter (HACH). The chemical parameters were analyzed using spectrophotometer (Model DR2000, USA), flame photometer (ELE International) and titrimetric method. The water samples were analyzed at water quality control laboratory of the Yobe State water corporation. All the samples were analyzed within 48 hours of collection.

TABLE I
GPS READINGS OF THE SELECTED FIFTEEN SITES IN THE STUDY AREA

Location Name	Code	N	E	Elevation (m)
Filin Idi*	BH1	12053.853’	11056.225’	334.3
Fulatari M. D. Mosque*	BH2	12053.337’	11056.218’	325.8
G.T.C. Admin*	BH3	12054.387’	11056.354’	324.0
G.T.C. Quarters*	BH4	12053.058’	11056.465’	326.7
General Hospital Main*	BH5	12053.266’	11055.260’	301.8
Hausari Kankare*	BH6	12053.408’	11055.690’	327.0
Kusurmari Main*	BH7	12052.933’	11055.753’	324.4
Low-course Main*	BH8	12052.682’	11055.450’	331.1
Maikeli Fulatari	BH9	12053.231’	11055.950’	326.3
Alhaji Sani	BH10	12052.888’	11055.911’	327.1
Mohammed Babin	BH11	12053.259’	11055.635’	315.8
Filin Ajari*	BH12	12053.919’	11055.727’	327.0
Musa Tashan Maini	BH13	12053.939’	11055.354’	322.5
Ngadala Primary School*	BH14	12054.340’	1105.496’	334.4
Nuri 1	BH15	12053.633’	11055.125’	331.4

IV. RESULTS AND DISCUSSIONS

A survey of physical and chemical parameters is presented on table 2, with the standards of the World Health Organization [11]. Assessment of water quality by its chemistry includes measures of elements and molecules dissolved or suspended in water. Chemical measures can be used to directly detect pollutants and imbalances within the ecosystem. Most chemicals from water sources are of health concern in humans as a result of exposure through drinking. Commonly measured chemical parameters include arsenic, cadmium, calcium, chloride, copper, fluoride, total hardness, nitrate, and potassium [12]. From the results, the ranges and means of the physical and chemical parameters revealed temperature range from 29.500C to 340C and mean of 31.60C, pH ranges from 6.5 to 7.3 with average of 6.8 thus indicating acidic to neutral, and mean value indicates a very slight acidic condition. TDS and Electrical conductivity vary from 60mg/l o 150mg/l and 120µS/cm to 300 µS/cm with mean values of 98.67mg/l and 196 µS/cm respectively. Hardness ranges from 20mg/l to 100mg/l with mean value of 54.8mg/l. Hardness ranging from 0-75mg/l is classified as soft; 75-150mg/l as moderate; 150-300mg/l as hard and above 300mg/l as very hard [13]. Based on the above classification the water can be classified on the average as soft.

The results of the cat ions indicate that Sodium and Potassium concentrations vary from 28.6 to55.60 mg/l and 11.70 to 41.50 mg/l with mean values of 37.9 and 23.5 mg/l respectively. Exposure to increased concentration (>100 mg/l) of potassium leads to disruption of heart and muscular function, irritation of the mucous membranes and also causes nausea and vomiting [14].Calcium and Magnesium vary from 0.0 to 0,1 mg/l and 0.4 to 0.68 mg/l with mean values of 0.011 and 0.52 mg/l respectively. All the mean values of the cat ions were below the WHO limits. High calcium concentration above 10 mg/l leads to the development of kidney stones in sensitive people [14].

TABLE II
SUMMARY OF PHYSICAL AND CHEMICAL PARAMETERS

Parameters	Minimum	Maximum	Mean	Standard Deviation	WHO, 2004
Temp	29.50	29.50	29.50	.	
pH	6.50	7.30	6.83	0.26095	6.5-9.2
TDS	60.00	150.00	98.66	26.62348	0-500
EC	120.00	300.00	196.00	54.22177	0-500
Hardness	20.00	100.00	54.86	25.65392	0-1.0
Calcium	0.00	0.10	0.011	0.02748	0-75
Magnesium	0.40	0.68	0.521	0.08348	0-50
Sodium	28.60	55.60	37.96	7.08848	0-200
Potassium	11.70	41.50	23.49	9.34976	0-200
Chloride	8.60	22.40	14.29	4.06720	0-200
Sulphate	9.00	49.00	18.80	11.23261	0-250
Nitrate	0.00	0.30	0.102	0.11416	40-70
Fluoride	0.00	0.80	0.260	0.27723	0-1.5
Iron	0.00	7.50	2.413	2.15965	0-1.0
Bicarbonate	80.00	180.00	114.53	27.46392	0-500

The value of the anions revealed that Chloride and Sulphate concentration varied from 8.6 to 22.4 mg/l and from 9.0 to 49.0 mg/l with mean values of 14.3 and 18.8 mg/l respectively. The mean values were below the recommended limits. Its high concentrations impart a salty taste to water and accelerate corrosion of metals. In fresh water, its concentration is less than 10 mg/l. Health effects such as nausea and vomiting may occur at concentration above 1200 mg/l in sensitive individuals [14]. Bicarbonate and Nitrate concentrations ranged from 80 to 180 mg/l and 0.0 to 0.30 mg/l with mean values of 114.5 and 0.102 mg/l respectively. The mean values were below the desirable limits. The values of Chromium hexavalent and Iron range from 0.01 to 0.80 mg/l and 0.00 to 7.5 mg/l with mean values of 0.14 and 2.41 mg/l respectively. The mean value of Chromium hexavalent is above the

recommended limits. This elevated level may have been due to inflow of contaminated water into groundwater. The mean value of Iron is below the WHO recommended limits. Fluoride concentration varied from 0.0 to 0.8 mg/l with mean value of 0.26 mg/l. the mean value is below the WHO recommended limits. Prolonged intake of fluoride (>1.5 mg/l) can damage the skeleton, cause brittle bones and lead to crippling [14]

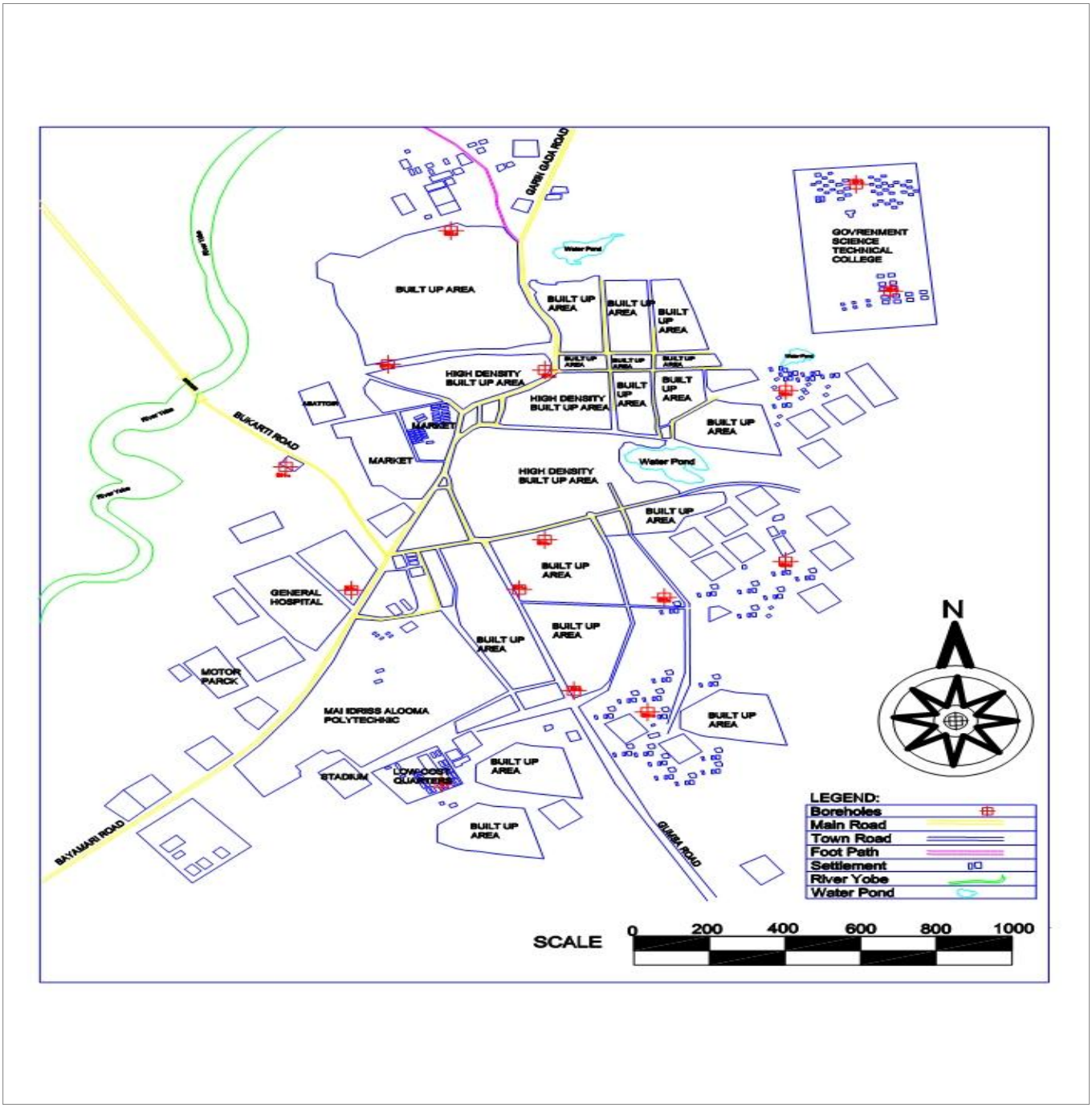

Fig. 1.0 Sketch Map of Geidam Town showing the borehole locations

V.CONCLUSION

The following conclusions can be drawn from this Study;

1. The concentrations of physical and chemical parameters were mostly below the WHO permissible limits.

2. The concentration of chromium hexavalent is above the recommended limit on the average. The elevated levels can be linked to anthropogenic sources such as domestic and public wastes as well as sanitary conditions in the area.

3. Improvement on sanitation and controlled waste disposal practice can minimize groundwater quality degradation in the area.

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