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Evaluation of the groundwater quality in Pariya.

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Abstract: Groundwater is the main source of water supply in many areas in Nigeria. Anthropogenic activities frequently are the main source of groundwater contamination. The appraisal of the water quality of an area have the potential to alleviate long term negative impacts. Water samples were collected from motorized and non-motorized borehole sources in the study area using prepared sampling bottles and analyzed for the physicochemical parameters of pH, TDS, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Chloride, Sulphate, Lead, Fluoride, Iron, Bicarbonate and total coliforms. The results of physicochemical quality was compared with the WHO standards. It was found that the physicochemical quality was within the permissible limits. The bacteriological analyses indicated the occurrence of total coliforms above the standards. It was recommended to adopt basic treatment by boiling before ingestion to safeguard against water borne diseases.

1. Introduction

Nature has given us abundant resources which can be employed to sustain life and social development on the planet. Among the most essential resources available to us is water. Water has been available on the earth before even the evolution of living things and without which life existence cannot be. The obtainable quantity of water is not uniformly distributed. 97.5% of the earth's water is the ocean and requires advanced treatment before it can be utilized. The quantity of fresh water is only 2.5% and 70% of this amount is inaccessible because of being covered in glaciers and polar ice caps. Groundwater which represents 22.3% of the fresh water of the world is available in aquifers or as moisture in the soil.[1,2]. Generally, only 1% of the total fresh water on earth is accessible for anthropogenic and other uses. It has become paramount issue to search for potable, fresh and clean water for mankind's sustainability. During ancient times, when there was no industrial development, the water obtained from lakes, rivers and reservoirs was pure and usable for life without treatment. However, with the advent of industrial development coupled with modern approach of agriculture and other anthropogenic activities, the requirement for water has been growing proportionally, and leading to generation of tremendous quantity of wastewater containing different types of contaminants which are detrimental to mankind and the environment. [3-6].

Groundwater results due to the natural process when water from the surface infiltrate into the ground, saturating the soil and rocks or geological formations at some depths below the surface [3]. The groundwater is very essential in rural and urban areas for drinking, industrial and domestic activities and is frequently over exploited as a result of urbanization, industrialization and other anthropogenic influence on the environment. Equally, the neighborhoods population growth as a result of the improvement in the socio-economic activities as well as improved services facilitate in increasing the rate of waste generation, increased use of chemicals in agriculture and insufficient sanitary conditions had intensified pollution threat to the ground water quality as well as the ecosystem.[7].The appropriateness of a specific groundwater for provision of some particular service including water supply for agriculture, domestic and industrial demand is more or less influenced by the physical chemical quality of the water. Water quality has continued to raise the concern of stakeholders of water in the world especially as it influences disease contamination and at times even deaths which are more widespread in developing countries. Therefore the water supplied should meet the quality standards so as to mitigate ingestion of toxic substances or pathogenic organisms. Hence it is very significant to carry out the evaluation of the water quality for sustainable care of the water environment.

Groundwater quality is influenced greatly by its chemical composition [8] which could be varied by nature or anthropogenic degradation of the environment. Speedy urbanization, especially in developing societies has influenced the accessibility and contamination of groundwater due to indiscriminate waste disposal practices. Once groundwater is polluted, its purity may not be easily recovered by preventing the contaminants from source [9]. As groundwater has an enormous potentiality for future prospect of water demand, it is invaluable for anthropogenic actions on the ground surface not to inhibit the characteristics of the resource [10]. Unprotected water is a universal health threat, positioning individuals at risk for a multitude of diarrheal and other diseases as well as toxic chemical exposure [11]. Contaminated water particularly has devastating effects on young children in the developing world. Studies had also shown that the principal objectives of

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municipal water are the production and the distribution of safe water that is fit for human consumption. Inadequate environmental conservation may degenerate the water supply and jeopardize public health [12].

Ground water Pollution in some rural settlements in Nigeria can be attributed to lack of basic sanitation facilities that would enable the evacuation or safe disposal of waste generated in the environment or surroundings.[7] Indiscriminate waste disposal practices in close proximity to water sources are expected to increase the human health risks. Other researchers have shown that high coliform counts are common characteristics of rural ground water in Nigeria [13]. It consequently becomes essential to routinely monitor the quality of the water and design ways to achieve ideal condition [14]. The population in the study area is rural settlement and their eternal activities mostly rely on the use of groundwater. This study examines some water quality parameters of borehole water in Pariya Settlement.

2. Study area

Pariya is located at 9° 23' 0" North, 12° 42' 0" East and at an elevation of 197 meters above sea level (see fig.1). The administrative office or the local government head office is at Fufore town. The population is about three thousand. The area is located in the semi-arid climate zone of the country and having two major seasons; a relatively hot and dry season occurring from November to April and another wet or rainy season beginning from April up to October. The north east trade winds with a low relative humidity (31 to 35.4%) from the Sahara region brings the dry period popularly known as the harmattan season and makes the atmosphere hazy and fairly dusty. Temperature falls during the harmattan sub-season and may go as low between 19 to 22.9ºC and equally in contrast be as high up to 39.7ºC. The rainy season is advanced by the Atlantic maritime trade wind which has high humidity varying from 62.5 to 79% within the wet season. The annual rainfall has a mean of about 827.7 mm, and the annual mean evapotranspiration is also around 2384.6 mm [15]. The mainstay of the inhabitants is agriculture and the harvested crops in the area include maize, guinea corn,

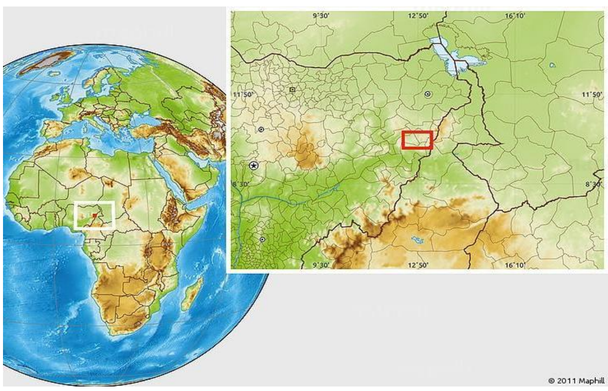

Fig. 1 Physical location map of Pariya [16].

groundnuts and green vegetable plants. Groundwater is the main water source for both irrigation and domestic uses during most of the seasons. The degradation of the water sources due to anthropogenic activities has raised some concern about its quality.

3. Materials and methods

Water samples were collected from 10 boreholes in the study area. The samples were collected using prewashed sample bottle (immersed in 10% dilute sulfuric acid for 12 hours and soaked again in distilled water for 12h before being rinsed using distilled water and dried). The sample containers were also rinsed two to three times in the field with the representative water sample. The field parameters; pH, EC and TDS were measured in the field using PH meter (Wagtech), and conductivity/TDS meter (Model HACH). Water samples were then taken immediately to the laboratory for further analysis The chemical parameters were analyzed using spectrophotometer (Model HACH DR2000), flame photometer (ELE International) and titrimetric methods. The water samples were analyzed in the laboratories of microbiology and Chemistry departments' of Modibbo Adama University of Technology, Yola and Adamawa State University respectively. All the samples were analyzed within 24 hours of collection. The microbial analyses samples were also procured from the boreholes, using sterilized bottles which were done by autoclaving at temperature of 1210C for 15 minutes. Each bottle was labeled according to sampling location and transported to the laboratory. Water quality parameter analyses were carried out in accordance to standard methods [17].

4. Results and discussion

A survey of physical, chemical and biological parameters is presented on Table 1, with the standards of the World Health Organization [18]. From the results, the ranges and means of the physical and chemical parameters revealed the temperature was at 320C, pH ranged from 7.8 to 8.1 with average of 7.9 thus indicating neutral to basic, and the mean value implies the water is within recommended standard, hence suitable for domestic activities. TDS and Total hardness (TH) vary from 80mg/l to 310mg/l and 146mg/l to 148 mg/l with mean values of 170mg/l and 146.9 mg/l respectively. Hardness is caused by the concentrations of calcium and magnesium. Hardness varying from 0 to 60mg/l is ranked as soft, 61 to 120mg/l is categorized as moderate, 121 to 180mg/l descried as hard and above 180mg/l classified as very hard. Hard water can cause scale deposit in pipes or boilers. Soft water on the other hand can cause corrosion. [19,20]. In general, based on hardness classification the water can be considered suitable for domestic uses.

The value of the anions revealed that Chloride and Sulfate concentration varied from 40 to 57 mg/l and from 13.02 to 90.0 mg/l with mean values of 48.0 and 52.7 mg/l respectively. The mean values were within the recommended limits. Chloride's high concentration imparts 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 [21]. Bicarbonate and Iron concentrations ranged from 20 to 120 mg/l and 0.30 to 0.40 mg/l with mean values of 85.3 and 0.30 mg/l respectively. The mean values were within the recommended limits. Fluoride concentration varied from 0.0 to 0.14 mg/l with mean value of 8.05 mg/l. The mean value is within the WHO recommended limits. Prolonged intake of fluoride (>1.5 mg/l) can damage the skeleton, cause brittle bones and lead to crippling [22]. Lead concentration varied from 0.001 to 0.01 mg/l with mean value of 0.005 mg/l. The mean value is below the WHO recommended limits. Microbial analyses revealed that total Coliform varied from 30 to 50(cfu/100ml) with mean value of 36.7(cfu/100ml). Total Coliforms are to a great extent indicators of pollution or faecal contamination of water. Indiscriminate waste disposal, poorly located and constructed pit latrines assisted by seepage may have contributed to the high level of the coliform organisms.

Table 1 Summary of physicochemical and bacteriological parameters

Parameters	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**WHO, 2011**
Temperature (^{0}C)	32.000	32.000	32.000	.	
pH	7.800	8.100	7.930	0.153	6.5-9.2
TDS*(mg/L)*	80.000	310.000	170.000	36.828	0-500
Total Hardness *(mg/L)*	146.000	148.000	146.900	1.007	0-1.0
Calcium*(mg/l)*	0.002	0.003	0.003	0.001	0-75
Magnesium*(mg/L)*	0.001	0.003	0.002	0.001	0-50
Sodium*(mg/L)*	7.000	7.500	7.170	0.289	0-200
Potassium*(mg/L)*	11.700	41.500	23.490	9.350	0-200
Chloride *(mg/L)*	40.000	57.000	48.000	8.544	0-200
Sulphate *(mg/L)*	13.020	90.000	52.700	38.553	0-250
Lead *(mg/L)*	0.001	0.010	0.005	0.005	0-0.01
Fluoride *(mg/L)*	0.000	0.140	0.047	0.081	0-1.5
Iron *(mg/L)*	0.300	0.400	0.360	0.054	0-1.0
Bicarbonate *(mg/L)*	20.000	120.000	85.330	56.616	0-500
Total Coliform *(cfu/100ml)*	30.000	50.000	36.700	11.540	0-10.0

5. Conclusion

The physicochemical quality of the water obtained from pariya is investigated. The results indicate that the pH, TDS, cations, anions, bicarbonate, iron and fluoride were all within the permissible limits. However, the results of total coliforms analysis indicated occurrence of microbial pollution, possibly from some organic wastes material. The research outcomes of this study contribute to the existing literature on water quality investigations, especially in developing countries. The community should be encouraged to observe basic disinfection process by boiling water meant for ingestion purposes so as to safeguard against outbreak of water borne diseases.

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