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Full Length Research Paper

Evaluation of ground water quality of Mubi town in Adamawa State, Nigeria

Priscilla Alexander

Department of Chemistry, Adamawa State University, Mubi, Adamawa State, Nigeria.
E-mail: priscillaalexander21@yahoo.com. Tel: +2348077727958.

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The ground water quality of Mubi Town in Mubi North Local Government Area of Adamawa State was studied to examine the suitability or otherwise of their use of the groundwater for drinking and domestic purposes. Ten ground water samples from boreholes and dug wells were randomly collected each during raining seasons in the months of June, July and August, 2007. The samples were analyzed with reference to the World Health Organization (WHO) standards and Bureau of Indian Standards (BIS). Physico-chemical parameters were studied and concentrations of heavy metals were determined. Results of the analyses revealed that the water samples were slightly acidic to slightly alkaline (near neutral) (pH 6.30±0.01 to 7.52±0.05), and that the water samples were good for drinking and domestic purposes.

Key words: Ground water, quality, Mubi, boreholes, dug wells.

INTRODUCTION

Normally, the water required for domestic consumption should possess a high degree of purity and it should be free from suspended and dissolved impurities, bacteria, etc. Both dug wells and boreholes waters are expected to be less contaminated. However, there are possibilities of introduction of contaminants, depending upon management and the temperature gradient of the water environment (Frederick, 1990).

The quality of ground water is the resultant of all the processes and reactions that act on the water from the moment it condensed in the atmosphere to the time it is discharged by a well or spring and varies from place to place and with the depth of the water table (Jain et al*.,* 1995). Ground waters have unique features, which render them suitable for public water supply. They have excellent natural quality, usually free from pathogens, colour and turbidity and can be consumed directly without treatment (Jain et al*.,* 1996a). Ground water is widely distributed and can frequently develop incrementally at points near the water demand, thus avoiding the need for large-scale storage, treatment and distribution system. Ground water is particularly important as it accounts for about 88% safe drinking water in rural areas, where population is widely dispersed and the infrastructure needed for treatment and transportation of surface water does not exist (Kumar, 2004). Nevertheless, there are various ways ground waters may suffer pollution e.g. land disposal of solid wastes, sewage disposal on land, agricultural activities, urban runoff and polluted surface water (Jain et al*.,* 1995).

This study was aimed at determining the physico-chemical parameters and heavy metals' levels in the boreholes and dug water wells which are the chief sources of water supply in Mubi Town of Mubi North Local Government Area of Adamawa State. Again there is no record of water quality studies in Mubi Town. Even if there exists, there is also the need for routine studies of the water qualities which will serve as checks to forestal the prevalence of epidemics of water borne disease in the area under study.

MATERIAL AND METHOD

The study area (Figure 1) lies between latitude 9^{o} 30 and 11^{0} North of the Equator and longitude 13^{o} and 13^{o} 45' East of the Greenwich Meridian. Mubi region is bounded in the north by Borno State and in the west by Hong and Song Local Government Areas and in the south and east by the Republic of Cameroon (Adebayo, 2004).

Ten ground water samples were collected randomly from the study area during the raining season in the months of June, July, and August, 2007 at monthly intervals. The samples were collected from boreholes and dug wells which are being used extensively for drinking and other domestic purposes. The water samples were collected using previously cleaned 1000 cm^3 polythene bottles. The bottles were first rinsed with the water being sampled and then filled

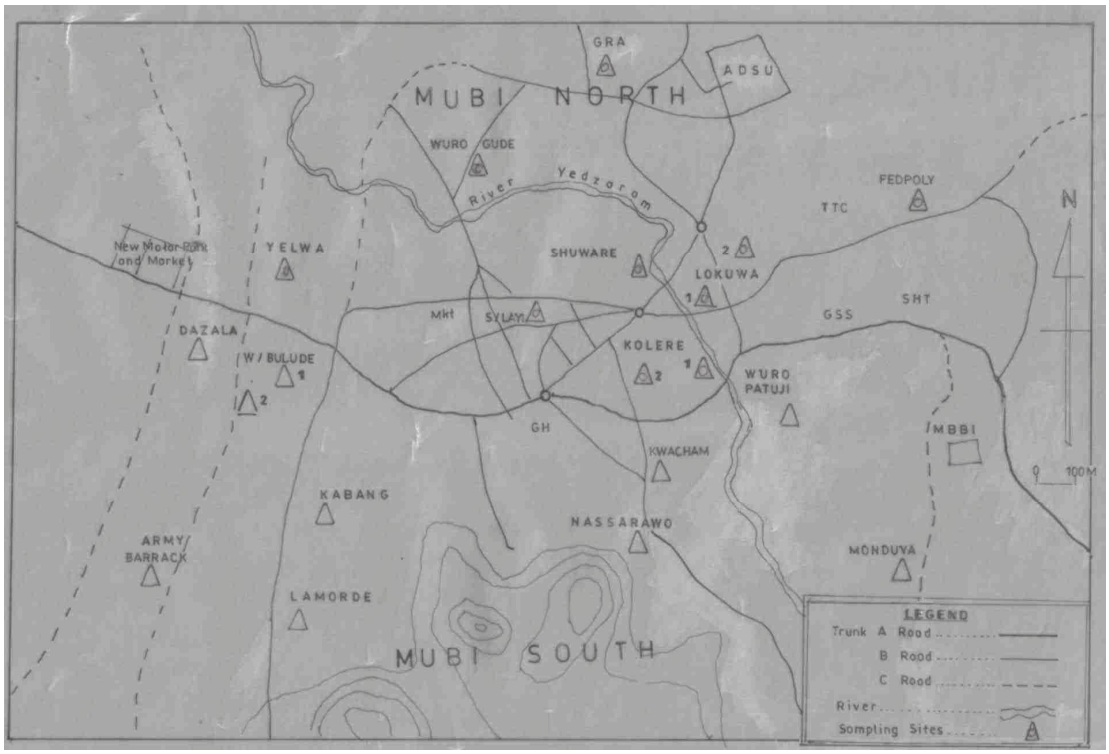

Figure 1. Map showing study area in Mubi town Adamawa State, Nigeria.

Table 1. Physico-chemical parameters of ground water quality of Mubi town in Adamawa State, Nigeria.

Location	Source	pH	Turbidity	Acidity	Chloride
Lokuwa 1 Emir's Palace	BH	6.59±0.01	4.50±0.01	0.20±0.03	15.01±0.04
Lokuwa ward 2	DW	7.52±0.05	5.50±0.02	0.15±0.04	14.01±0.03
Sabon Layi	DW	7.20±0.18	7.80±0.11	0.15±0.04	25.00±0.05
Kolere Ward 1	BH	6.88±0.09	7.51±0.02	0.15±0.04	21.15±0.08
Federal Polytechnic	DW	6.51±0.05	7.41±0.04	0.20±0.03	13.01±0.02
Kolere Ward 2	DW	6.97±0.01	5.11±0.05	0.10±0.04	13.01±0.02
Wuro Gude	DW	7.15±0.08	7.00±0.03	0.11±0.03	10.21±0.08
Yelwa Ward	DW	7.18±0.04	8.00±0.03	0.25±0.02	10.30±0.09
Shuware	DW	6.30±0.01	7.50±0.04	0.23±0.02	10.00±0.04
GRA	DW	6.51±0.05	7.41±0.04	0.15±0.04	10.21±0.08
BIS		**6.5-8.5**	**5-10**		**250**

All values are mean and standard deviation of ten replicate readings in mg/l (except pH).
BH = Bore hole; DW = dug well; ND = not detected; BIS = Bureau of Indian Standards (1991).

to the brim with it and the water samples were preserved with trioxonitrate (v) acid. The depth of the dug wells and boreholes were measured at the time of sample collection. The boreholes depths ranged between 600 and 650 m below the surface, while the dug wells' depths ranged from 8 to 12 m deep from the earth's surface. The pH was immediately measured at the point of collection of sample using Jenway 3505 pH meter as described by AOAC (2000). The physico-chemical parameters essential to determine the quality of drinking water were analyzed as per the method described in APHA (1995). The heavy metals concentrations were determined using Atomic Absorption Spectrophotometer (PYE UNICAMP SP.9) as described by Mendham et al. (2002).

RESULTS AND DISCUSSION

The results of various physico-chemical parameters are tabulated in Table 1 and the heavy metals in Table 2. The pH values in column 3 of Table 1 in the study areas are confined mostly in the range from 6.30±0.01 to 7.52±0.05 indicating the slightly acidic to slightly alkaline (near neutral) nature of the ground waters and are well within the limits prescribed for various uses of water including drinking water supplies (BIS, 1991; WHO, 1996).

Table 2. Hardness and metals concentration of ground water quality of Mubi town in Adamawa State, Nigeria.

Location	Source	Total hardness	Mg	Ca	Na	K
Lokuwa 1 Emir's Palace	BH	81.5±0.036	39.90±0.11	41.62±0.09	10.52±0.14	0.01±0.005
Lokuwa Ward 2	DW	64.30±0.09	22.30±0.14	42.01±0.04	0.10±0.04	0.08±0.004
Sabon Layi	DW	94.20±0.20	40.50±0.10	40.51±0.11	15.01±0.06	ND
Kolere Ward 1	BH	85.50±0.20	40.50±0.10	52.30±0.14	10.30±0.21	0.03±0.003
Federal Polytechnic	DW	80.40±0.11	30.00±0.08	50.00±0.05	10.10±0.05	ND
Kolere Ward 2	DW	12.02±0.04	2.92±0.11	9.10±0.05	0.09±0.04	0.08±0.004
Wuro Gude	DW	75.20±0.08	30.56±0.30	40.50±0.12	10.50±0.20	0.01±0.005
Yelwa Ward	DW	81.00±0.04	19.52±0.12	61.50±0.14	0.87±0.24	0.02±0.003
Shuware	DW	76.30±0.07	40.62±0.12	52.00±0.06	11.50±0.27	0.04±0.004
GRA	DW	75.00±0.04	30.50±0.12	52.00±0.06	10.00±0.06	ND
WHO		-	10.5-60	50-55	30.50-35.50	0.6-10
BIS		**300**	**30**	**75**	**20**	**20**

All values are mean and standard deviation of ten replicate readings in mg/l.
BH = Bore hole; DW = dug well; ND = not detected; WHO = World Health Organization (1996); BIS = Bureau of Indian Standards (1991).

Table 3. Heavy metals of ground water quality of Mubi town in Adamawa State, Nigeria.

Location	Source	S	F	Cd	Cu	Fe	Zu	Pb	Ni
Lokuwa 1 Emir's Palace	BH	ND	ND	ND	0.001±0.0003	0.002±0.0003	ND	ND	ND
Lokuwa Ward 2	DW	0.01±0.004	ND	ND	ND	0.02±0.003	ND	ND	ND
Sabon Layi	DW	0.01±0.003	ND	ND	0.02±0.003	0.02±0.003	ND	ND	ND
Kolere Ward 1	BH	0.01±0.003	0.01±0.003	ND	ND	0.02±0.003	ND	ND	ND
Federal Polytechnic	DW	ND	ND	ND	ND	0.02±0.003	ND	ND	ND
Kolere Ward 2	DW	0.01±0.003	0.01±0.003	ND	ND	0.01±0.003	ND	ND	ND
Wuro Gude	DW	ND	ND	ND	0.01±0.003	ND	ND	ND	ND
Yelwa Ward	DW	ND	ND	ND	0.08±0.005	ND	ND	ND	ND
Shuware	DW	ND	ND	ND	ND	0.02±0.003	ND	ND	ND
GRA	DW	ND	ND	ND	ND	0.04±0.004	ND	ND	ND
WHO		0.1-2.00	0.01-1.0	6.01-0.1	0.05-1.5	0.1-1.0	0.05-2.5	0.01-0.1	0.02-0.20
BIS		**150**	**0.6-12**	**0.013**	**0.05**	**0.3-1.0**	**-**	**0.015**	**-**

All values are mean and standard deviation of ten replicate readings in mg/l.
BH = Bore hole; DW = dug well; ND = not detected; WHO = World Health Organization (1996); BIS = Bureau of Indian Standards (1991).

It is known that calcium and magnesium along with their carbonates, sulphates and chlorides naturally confer temporary and permanent hardness. A 300 mg/l has been recommended as a desirable limit and 600 mg/l as the maximum permissible limit for potable water (BIS, 1991). The total hardness values in the study area ranged from 12.02±0.04 to 94.20±0.20 mg/l. Distribution of hardness values clearly indicates that all the samples lie within the desirable limit. The desirable limit for calcium and magnesium for drinking water is 75 and 30 mg/l, respectively (BIS, 1991). The ground water of the study area, the value of calcium and magnesium ranged from 9.10±0.05 to 61.50±0.14 and 2.92±0.11 to 40.62±0.12, respectively. Samples from Kolere Ward 2 have their calcium and magnesium concentrations very low. This low concentration may be attributed to the dilution effect of rain water, since study was carried are in the raining season. Distribution of calcium and magnesium clearly indicates that almost all the samples lie within the permissible limit of drinking water.

The chloride content ranged from 10.00±0.04 to 25.00±0.05 mg/l. The limits of chloride have been laid down primarily from taste considerations. A limit of 250 mg/l chloride has been recommended as desirable limit and 100 mg/l as maximum permissible limit for drinking water (BIS, 1991; WHO, 1996). However, no adverse health effects on humans have been reported from intake of waters containing even higher concentrations of chloride. Chloride distribution in the samples indicates that it lies within the desirable limits for drinking water. The con-

centration of sodium in the study area varies from 0.09±0.04 to 15.01±0.06 mg/l. If sodium concentration is more than 50 mg/l it makes the water unsuitable for domestic use. All the water samples have their sodium concentration within this desirable limit for drinking water. Potassium concentration in the ground water varied from ND to 0.08±0.004 mg/l.

The concentration of sulphate in the study area ranged from ND to 0.01±0.003. One observation of the study was that fluoride was not detected in all the water samples except samples from Kolere Wards 1 and 2 with values of 0.01±0.003 each. It is likely that this deficiency in fluoride or its low concentration might have affected the dental health of the consumers. From the Indian Standards (BIS, 1991), 0.6 to 1.5 mg/l is the desirable limit of fluoride in drinking water and low fluoride level below 0.6 mg/1 may cause dental caries and above 1.5 mg/l leads to fluorosis. Cadmium, zinc, lead and nickel were not detected in all the water samples analysed.

Conclusion

The physico-chemical parameters studied were all within the desirable limit for drinking water quality recommended by WHO (1996) and BIS (1991) except for fluoride. From this study, it is concluded that the Boreholes and dug well waters in Mubi town in Mubi North Local Government Area of Adamawa State are generally suitable for drinking and domestic purposes. However, there is the need for routine checks to ascertain the suitability or otherwise of these water sources so as to forestall outbreak of water borne diseases.

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