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SEASONAL VARIATIONS OF METALS AND OTHER MINERAL CONSTITUENTS OF RIVER YOBE

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ABSTRACT

Water samples were collected from River Yobe during the rainy and dry seasons at Nguru, Gashua,Azbak, Dumsai and Wachakal. The samples were analyzed for their mineral constituents including Zn, Pb, Fe, Mn and Mg using the Atomic Absorption Spectrometry (AAS) while Na, Ca, and K were analyzed using Flame Emission Spectrometry (FES). The ranges of metal concentrations obtained are; Zn (7.06 mg/dm^3 – 13.44 mg/dm^3), Pb (0.05 mg/dm^3 – 0.135mg/dm^3), Fe (0.052 mg/dm^3 – 0.53 mg/dm^3), Mn (0.102 mg/dm^3 – 0.383 mg/dm^3), Ca (28.50 mg/dm^3 – 87.52 mg/dm^3), Mg (7.34 mg/dm^3 – 29.4 mg/dm^3) , Na (13.95mg/dm^3 – 22.98 mg/dm^3) and K (40.08mg/dm^3 – 78.2mg/dm^3). From the levels of metals analyzed, it can be concluded that concentrations of Zn, Pb, Fe and Mn were all above WHO and SON permissible limits in all sampling areas. This indicates an increase in metal pollution load, probably due to fertilizer movement, agricultural ashes and sewage-effluent run-off wastes. Water samples sourced from this river may however be used for agricultural and irrigation purposes but unfit for human consumption.

Keywords: Metal, Pollution, WHO, Yobe, Waste

INTRODUCTION

The effects of metals in water and waste water range from beneficial through troublesome to dangerously toxic (APHA, 1985). For such reasons it is very important to know the concentration levels of these metals in water samples that may result in an alarming rate when consumed or used by humans and animals (Bryan and Langston, 1992). The Nguru- Gashua wetland was noted for rural agricultural practices for subsistence and medium scale commercial farming (Doody, 2000). There are no portable water supplies in some of these catchments areas, hence the dependence on water sources mainly from river for domestic, irrigation and livestock activities. The chemical status of these rivers would have its influence on the receiving land, which might possibly reflected on the water and the produce cultivated on such land. During rain, surface water with soil, mud and humus enter into the river, and other water bodies (Lokhande, 1999). Inorganic minerals like, Na, K, Ca, Mg and other heavy metals such as Zn, Pb, Fe and Mn when present above the permissible limit are harmful (Karnataka, 2002).Agricultural pollution is mainly caused by fertilizers, insecticides, pesticides, farm animal wastes and sediments. Research findings indicate that application and heavy doses of fertilizers pollute ground water through leaching of nitrate from nitrogenous fertilizers and of cadmium from single super phosphate and of fluoride from rock phosphates (Karnataka, 2002). Careless deposits of animal wastes close to the wells and ponds at the backyards cause pollution of water through leaching (Clesceri, 1998). The pathogenic organisms of these wastes are as well leached to the water and pose problems (Karnataka, 2002). This work is aimed at evaluating the metals and mineral constituents of River Yobe through the analysis of water samples within its ecosystems along Nguru – Gashua wetlands.It is expected that the findings of this work will help to provide useful data to tackle the problem of water borne diseases in the area.

EXPERIMENTAL

Water samples were collected seasonally (dry and rainy) about 30 meters from the river – bank. Triplicate samples (water) were collected 100 meters apart from the five sampling sites (Azbak,Gashua,Nguru,Dumsai and Wachakal) within the period of March and August, 2007. The samples were preserved using 5cm^3 concentrated nitric acid (S.G 1.42,70%), cooled and stored in polyethylene bottles. Nitric acid digestion was carried out on the samples, and were analyzed using AAS and FES determinations respectively (APHA, 1985).

RESULTS AND DISCUSSION

The introduction of dry season farming has contributed to the negative effect of River Yobe. Seasonal river flows have always been essential to the livelihoods of the people living in the basin. The resulting change in the pattern of river flows from seasonal to perennial trigged a process of sediment deposition in the river channel (Doody, 2000). Analysis of water revealed that River Yobe water in the North – East Arid Zone of Northern Nigeria is contaminated by certain heavy metals. Although, the quality of the River may be classified as good based on its inorganic mineral contents for irrigation, in contrast the heavy metals were above the WHO (2004) and SON (2003) permissible limits in all sampling areas. This indicates an increase in metal pollution load, probably due to fertilizer application, agricultural ashes and sewage – effluent run-off wastes (Obodo, 2001).

The Concentrations of Zn, Pb, Fe ,Mn, Ca, Mg ,Na and K Metals as the studied analytes across five sampling sites of Nguru-Gashua wetlands and their environs in relation to seasonal changes for Water are as shown in Figure 1 respectively. The results obtained for water analysis in this work were higher than the recommended permissible limits set by WHO (2004) and SON (2003). This may result a threat to the end users of the river. Therefore, metal concentrations with respect to water in relation to the seasonal changes from Azbak, Gashua, Nguru, Dumsai and Wachakal sampling points of River Yobe environment would be discussed as follows; High level of Zinc,13.44 $\pm$ 0.11 were observed in the dry season in Azbak area and was least,7.06 $\pm$ 0.29 at Wachakal, but the Zinc during the rainy season were high in all sampling areas with the highest,12.61 $\pm$ 0.19 recorded in Dumsai (Figure 1).

The Lead levels 0. 136 $\pm$ 0.12 were highest during dry season at Wachakal sampling area with the least Pb,0.005 $\pm$ 0.16 at Azbak the level during the rainy season was averagely the same in all the sampling sites with least in Wachakal (Figure 2).

Season wise, iron level showed greater value,0.53 $\pm$ 0.12 during dry season at Nguru and Wachakal areas with the least,0.052 $\pm$ 0.10 in Dumsai Fe levels were highest at Nguru and Wachakal during rainy season with the least Fe concentration,0.08 $\pm$ 0.11 in Azbak (Figure 3) the highest.

Mn during dry season at Gashua showed greater level while the least level is at Nguru. Other sampling areas were having the same Mn level (Figure 4). Similarly Dumsai area, recorded the highest Mn level during rainy season.

Ca level during dry season in Gashua sampling area Figure 5 while the least Ca level was observed during rainy season in Nguru.

Azbak sampling site show highest Mg level during dry season while the three other sampling site show the same level for the metal concentration with the least concentration recorded at Wachakal (Figure 6).

Sodium levels were found highest in both the dry and rainy seasons at Nguru and Gashua areas. Although the seasonal differences of Na level did not be differ much (Figure 7)

Potassium levels were highest during dry season in Nguru sampling site while the least K concentration was observed in Dumsai sampling site. The metal concentration recorded highest during rainy season in Azbak and Dumsai sampling sites (Figure 8) However, the K metal concentration in Nguru and Gashua were higher than the permissible limits by WHO (2004) and SON (2003) for drinking water.

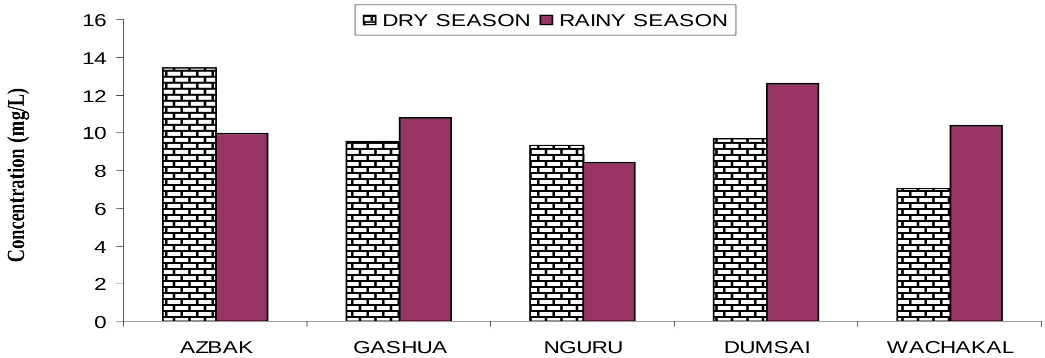

Fig 1: Seasonal Relationship of Zinc Metal Concentration in River Water

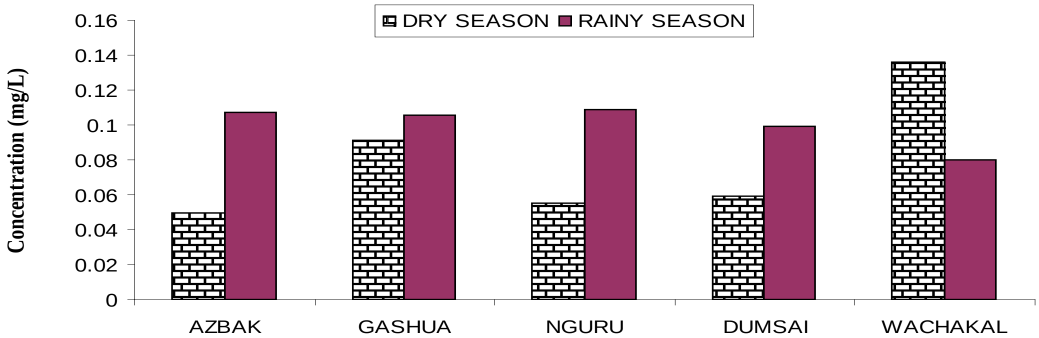

Fig 2: Seasonal Relationship of Lead Metal Concentratio in River Water

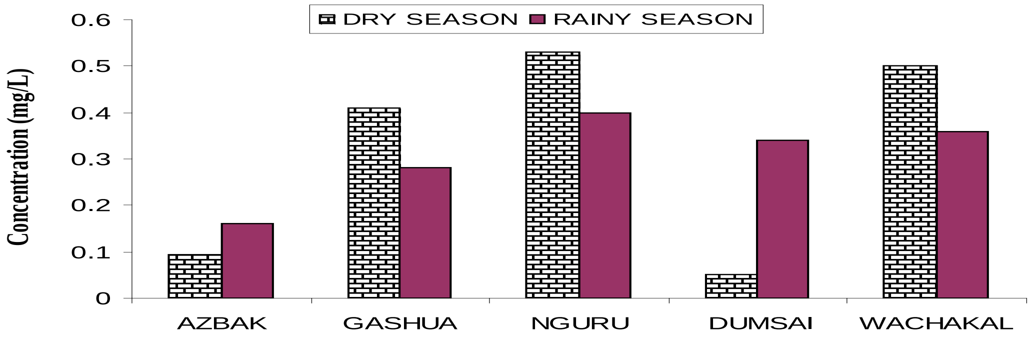

Fig 3: Seasonal Relationship of Iron Metal Concentration in River Water

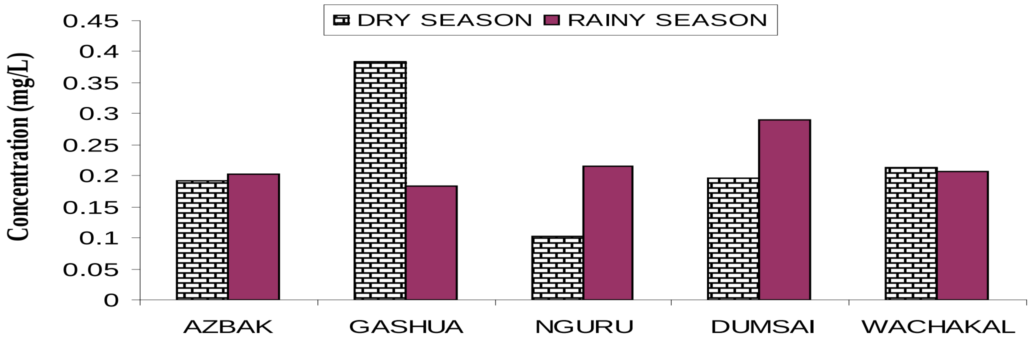

Fig 4: Seasonal Relationship of Manganese Metal Concentration in River Water

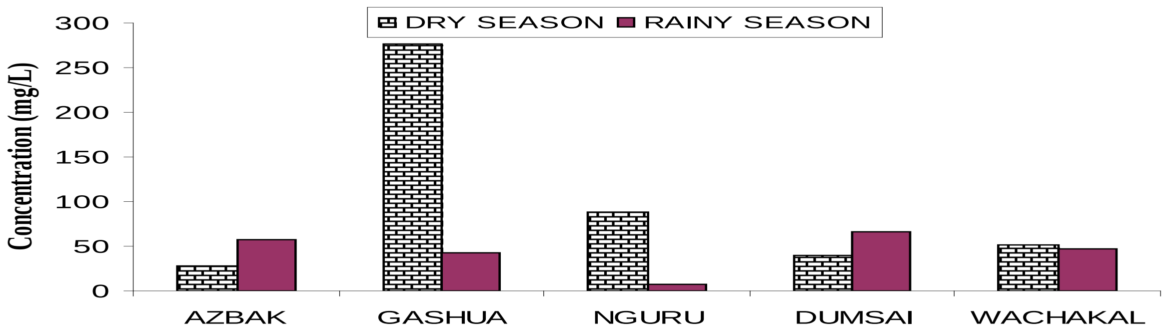

Fig 5: Seasonal Relationship of Calcium Metal Concentration in River Water

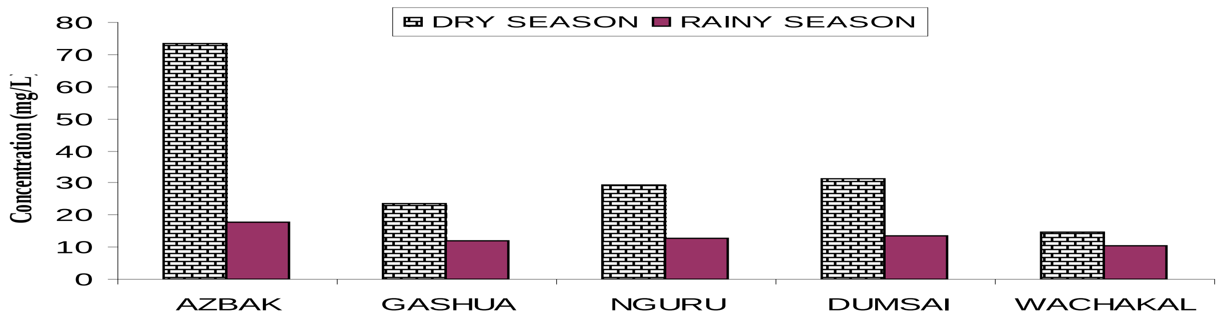

Fig 6: Seasonal Relationship of Magnesium Metal Concentration in River Water

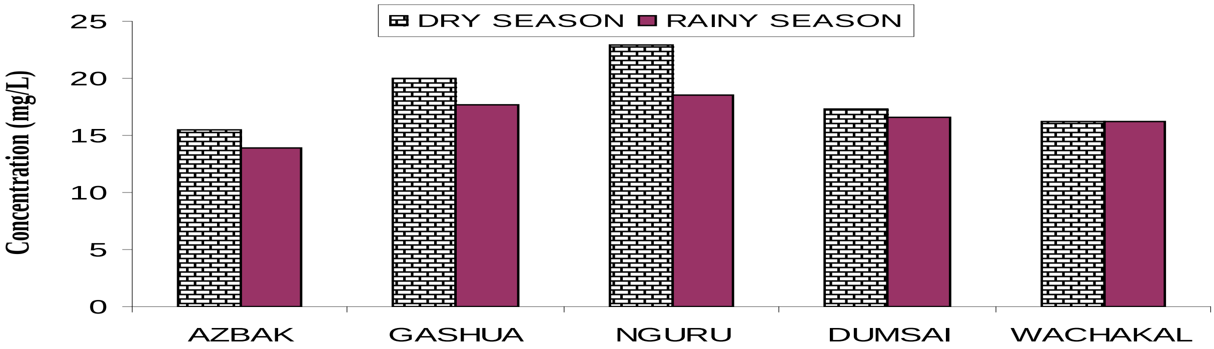

Fig 7: Seasonal Relationship of Sodium Metal Concentration in River Water

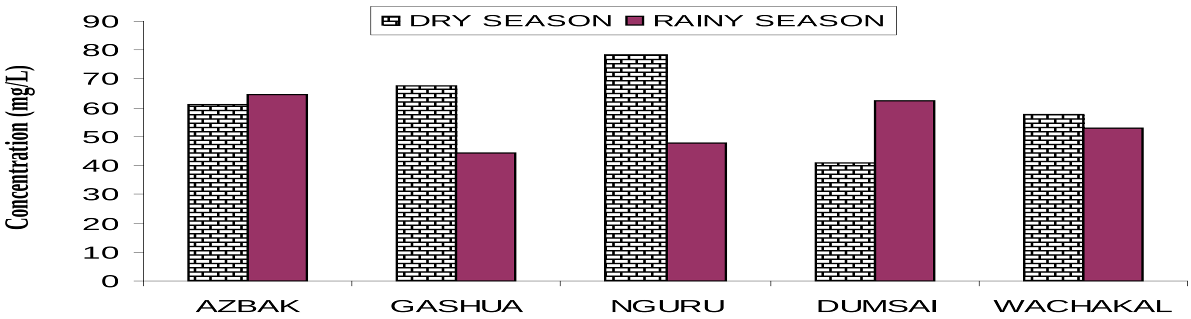

Fig 8: Seasonal Relationship of Potassium Metal Concentration in River Water

CONCLUSION

The results of this work have revealed that, the water samples of study as unfit for drinking purpose. The concentrations of eight metals; Zn, Pb, Fe, Mn, Ca, Mg, Na and K were higher than the recommended permissible limits of,5.0mg/dm^3, 0.05mg/dm^3, 0.3mg/dm^3, 0.05mg/dm^3, 75mg/dm^3 and 30mg/dm^3 respectively as set by world Health Organization, WHO (2004) and Standard Organization of Nigeria, SON (2003) for drinking water. Consequently prolonged consumption of this water could lead to accumulation of metals with adverse health implications in humans, since most of the metals have adverse health implications to human and other end users (Fostner and Witman, 1983).

RECOMMENDATIONS

The quality of Nguru-Gashua wetlands water should be monitored at time intervals for its metal concentrations, so as to update the existing data with respect to continued environmental changes.

In addition, stringent measures including punitive actions for violators should be effected while stake holders (Federal, State and Local government) should check the rate at which these metals are discharged into such water bodies.

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Table I: The Results for the Mean, standard deviation Concentrations (mg/dm^3), and coefficient of variations (%) of metals in River water

Sample	Zn	Pb	Fe	Mn	Ca	Mg	Na	K	X ± SD	RSD
A	13.44 ± 0.11	0.05 ± 0.16	0.095 ± 0.00	0.193 ± 0.02	28.50 ± 0.09	734 ± 0.11	15.50 ± 0.03	61.2 ± 0.12	15.79 ± 0.08	0.51%
B	9.54 ± 0.19	0.091 ± 0.20	0.41 ± 0.11	0.383 ± 0.03	277 ± 0.10	23.5 ± 0.02	19.95 ± 0.29	67.8 ± 0.01	18.68 ± 0.12	0.64%
C	9.30 ± 021	0.055 ± 0.11	0.53 ± 0.12	0.102 ± 0.02	87.52 ± 0.00	29.4 ± 0.10	22.98 ± 0.00	78.2 ± 0.03	28.51 ± 0.07	0.24%
D	9.68 ± 0.19	0.059 ± 0.00	0.052 ± 0.10	0.196 ± 0.01	40.4 ± 0.12	31.2 ± 0.09	17.31 ± 0.22	40.8 ± 11	15.21 ± 0.11	0.72%
E	706 ± 0.29	0.136 ± 0.12	0.50 ± 0.00	0.213 ± 0.03	52.22 ± 0.19	14.53 ± 0.06	16.20 ± 0.0.6	57.8 ± 0.12	18.58 ± 0.11	0.59%
F	9.92 ± 0.19	0.107 ± 0.14	0.16 ± 0.13	0.2030.00	57.20 ± 0.03	17.80 ± 0.03	13.95 ± 0.19	64.6 ± 0.19	20.50 ± 0.11	0.54%
G	10.78 ± 0.11	0.053 ± 0.19	0.28 ± 0.11	0.183 ± 0.06	42.03 ± 0.11	11.92 ± 0.11	17.70 ± 0.23	44.2 ± 0.20	15.9 ± 0.14	0.88%
H	8.42 ± 0.19	0.109 ± 0.11	0.40 ± 0.14	0.216 ± 0.07	6.7 ± 0.13	12.71 ± 0.00	18.50 ± 0.28	47.6 ± 0.14	18.960.13	0.69%
I	12.61 ± 0.19	0.099 ± 0.19	0.34 ± 0.10	029 ± 0.00	66.5 ± 0.00	13.51 ± 0.03	16.60 ± 0.03	62>4 ± 0.00	21.54 ± 0.07	0.32%
J	10.40 ± 011	0.08 ± 0.00	0.36 ± 0.00	0.206 ± 0.07	47.1 ± 0.10	10.61 ± 0.11	16.20 ± 0.00	53.0 ± 0.22	17.24 ± 0.06	0.35%
X ± SD	10.12 ± 0.22	0.105 ± 0.61	0.31 ± 0.08	0.22+0.03	51.29 ± 0.09	15.50 ± 0.06	17.50 ± 0.13	57.80 ± 0.11	19.09 ± 0.10	0.52%
RSD	2.2%	9.52%	25.8%	13.64%	0.2%	0.4%	0.74%	0.19%	0.52%	

Key:
A-E: Samples Collected During Dry Season
F-J: Samples Colleted During Rainy Season
SD: Standard deviation
RSD: % coefficient of variation or relative standard deviation