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AN ASSESSMENT OF SOME ANION LEVELS OF RIVER GONGOLA IN ADAMAWA STATE, NIGERIA

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ABSTRACT

The assessment of anion levels of River Gongola in Adamawa state was carried in ten sampling areas. Sampling was done in the months of February, March, and April 2007, representing dry season, while the months of July, August and September 2007, represent the wet season. Water samples were collected and analysed using DR/2010 spectrophotometer (LaMotte Co. 2000). The mean concentration of chloride ranged between 58.00 ± 1.22 and 90.83 ± 3.77mg/l for dry season and 53.33 ± 3.21 and 71.67 ± 5.21mg/l for wet season, sulphate was between 16.00 ± 3.02 and 37.67 ± 4.11mg/l for dry season and 48.33 ± 3.42 and 65.33 ± 8.21mg/l for wet season; while that of total nitrate is between 2.20 ± 0.51 to 5.14 ± 0.77mg/l for dry season and 18.0 ± 2.02 and 32.50 ± 4.32mg/l for wet season. The mean seasonal variation of NH_3-N, NH_4^+, NH_3, NO_3-N, NO_3^- were reported with highest value of 32.50±0.00 observed in nitrate and lowest value of 0.20±0.05 was observed in phosphate. The values for the wet season were higher than that of dry season which may be due to run-off from farms as a result of fertilizer and herbicide application and animal faeces around the sampling area. All the values were within the current permissible limits of the WHO and NAFDAC. The percent ion concentrations were in the following order $Cl^- > CO_3^{2-} > SO_4^{2-} > NO_3^{--}$ > total nitrate > PO_4^{3-}. The seasonal variations of the showed that the levels of anions were higher during the wet season than the dry season.

Keywords: *Season, River Gongola, Assessment, Anion levels, Pollution.*

INTRODUCTION

Adamawa state is situated in the northern part of Nigeria latitude 9^o11^lN to 9^o20^lN and longitude 12^o23^lE [1]. It is largely covered by short-grass savanna and is drained westward by the Benue River and its tributaries, including the Gongola, Taraba, and Pai rivers. River Gongola is the principal tributary of the Benue River. It rises in several branches (including the Lere and Maijuju rivers) on the eastern slopes of the Jos Plateau and cascades (with several scenic waterfalls) onto the plains of the Gongola Basin, where it follows a northeasterly course. It then flows past Nafada and takes an abrupt turn toward the south. Its lower course veers to the southeast and, after receiving the Hawul (its chief tributary, which rises on the Biu Plateau), it continues in a southerly direction before joining the Benue, opposite the town of Numan, after a journey of 531 km. During the dry season, however, the upper Gongola and many of its tributaries practically disappear, and even the lower course becomes unavailable [2].

Almost all of the Gongola Basin lies in a dry savanna area. The basin has been enlarged by the Gongola's capture of several rivers that formerly flowed to Lake Chad—the sharp southerly bend east of Nafada is the result of the capture of the upper Gongola, and the Gungeru, another tributary from the Biu Plateau, is also a captured stream. The Gongola's floodplains are covered with a fertile black alluvial soil. Cotton, peanuts (groundnuts), and sorghum are grown for export to other parts of the nation; but millet, beans, cassava, onions, corn (maize), and rice are also cultivated.

The government built the Kiri Dam (completed 1984) on the river near Numan to provide irrigation and electricity for its Gongola state sugar plantation project. The basin is also used as grazing ground for livestock.

The water quality of river Gongola is been influenced by the inputs derived from land use and anthropogenic activities in the surrounding region. The land uses include agriculture, animal farming and residential developments. Surface water canals and streams flow into the river. Surface runoff from these areas carries animal wastes, pesticides, fertilizers herbicides and salt into the river. Many workers have been reported to have potential health risk from nitrate in drinking water above threshold of 45 mg/l, which may give rise to a condition known as methaemoglobinemia in infants and pregnant women[3].
The anion like NH_3-N, NH_4^+, NH_3, NO_3-N, NO_3^- etc have been chosen as the indicator in this investigation to determine the water quality.

This research is aimed at assessing the anion levels of surface water samples in river Gongola in Adamawa State. This is also aimed at ascertaining the quality, quantity and the causes of physical and chemical pollutants in the water bodies and their effects on human, animal and aquatic animals.

MATERIALS AND METHODS

The study areas include:

(a) **River Gongola:** Bare, Dasso, Behind Kiri dam west bank Kiri dam west bankI, and Kiri dam East bank I behind Kiri dam East bank, kiri dam east bank II, Kiri dam west bank II, Kiri, Bobere.

(b) **All the areas mentioned above are in Adamawa State, Nigeria (Figure 1)**; As stated earlier these bodies of water are the main source of water for irrigation, fishing, domestic and industrial purposes in the state. The water samples were collected from the above-mentioned locations. The sample locations and codes are presented in table1

(c) **Water Sampling:** Ten sampling areas were chosen as shown in table 1**.** Samples were collected in the months of February, March, April (dry season) and July, August and September (wet season) in 2007.

Table 1 Sample location and codes for River Gongola.

1	River Gongola Bare water	RGBW
2	River Gongola Dasso Water	RGDW
3	River Gongola Dam Behind west bank Water	$RGD_{bw}W$
4	River Gongola Dam West bank 1Water	$RGD_{w1}W$
5	River Gongola Dam East bank1 Water	$RGDe_1W$

6	River Gongola Dam Bobere Water	RGD_BW
7	River Gongola Dam East Bank II Water	$RGD_{E2}W$
8	River Gongola Dam Behind dam East bank Water	$RGD_{BE}W$
9	River Gongola Dam West bank II Water	$RGD_{WB2}W$
10	River Gongola Dam Kiri Water	RGD_kW

Samples which are representatives of the water bodies were collected and examined. These samples were collected at designated areas as shown in figure 1. Water samples were collected by lowering pre-cleaned plastic bottles into the bottom of the water body, 30cm deep, and allowed to over flow before withdrawing. Twenty sampling points were used and the sampling points are approximately 100m away from each other for each of the ten sampling areas in table 1. A total of 200 samples were analyzed.

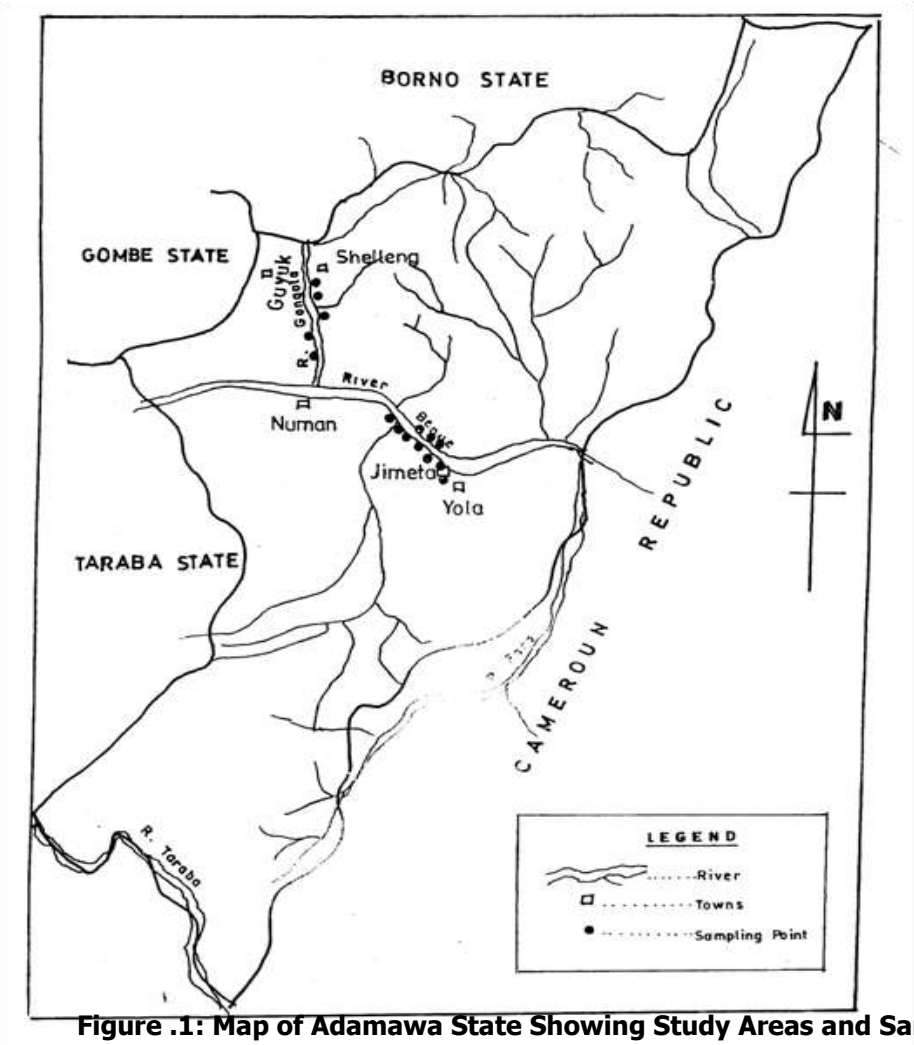

Figure .1: Map of Adamawa State Showing Study Areas and Sampling Points

Storage and preservation

Since changes occur frequently in water samples, analysis was done immediately after collection. Where analysis could not commence immediately, samples were stored at 4^{o}C

or relevant preservatives were added depending on the parameter to be determined and duration of the preservation as described by [4].

Methods of Analysis

The water samples collected were analysed by determining the amounts of nitrates, sulphates, and total hardness using DR/2010 spectrophotometer [5]. Phosphate was determined using Hach Direct Reading 2000 Spectrophotometer. Standard procedures of analysis as described by [6,7,4], were used for the determination 0f NH_3-N, NH_4^+, NH_3, NO_3-N, NO_3^-

Data Analysis

Results were presented as mean ± SD. The Pearson's correlation analysis, Analysis of Variance (ANOVA) with Scheffe post hoc test and the student t-test were used for the statistical analyses of results obtained at 95% confidence level using Microsoft Excel 2007 package.

Results and Discussion

Figure 2 is the histogram of mean concentration of chloride, sulphate and total nitrate for River Gongola. The values for the chloride were between 58.00 ± 1.22 and 90.83 ± 3.77mg/l for dry season and 53.33 ± 3.21 and 71.67 ± 5.21mg/l for wet season, sulphate was between 16.00 ± 3.02 and 37.67 ± 4.11mg/l for dry season and 48.33 ± 3.42 and 65.33 ± 8.21mg/l for wet season, while that of total nitrate is between 2.20 ± 0.51 to 5.14 ± 0.77mg/l for dry season and 18.0 ± 2.02 and 32.50 ± 4.32mg/l for wet season (appendix 1).

Similarly figure 3 is the histogram of the mean seasonal variation of NH_3-N, NH_4^+, NH_3, NO_3-N, NO_3^- for River Gongola. The values ranged between 1.42 ± 0.21 and1.97 ± 0.42mg/l dry season for NH_3-N and 1.70 ± 0.02 and 2.57 ± 0.58mg/l in wet season, NH_4^+ was between 1.49 ± 0.45 and 2.25 ± 0.51mg/l for dry season and 2.22 ± 0.06 and 3.32 ± 0.88mg/l for wet season, NH_3 were between 1.4 5± 0.33 and 2.06 ± 0.46mg/l for dry season and 1.92 ± 0.14 and 3.11 ± 0.69mg/l for wet season, NO_3-N were between 0.38 ± 0.29 and 1.30 ± 0.10mg/l for dry season and 0.56 ± 0.11 and 0.88 ± 0.06mg/l for wet season, while that of NO_3^- were between 2.20 ± 0.82 and 5.14 ± 0.45mg/l for dry season and 1.80 ± 0.24 and 3.25 ± 0.21mg/l for wet season as in apendix1.

The values for the wet season for River Gongola were higher than that of dry season (figure3) which may be due to run-off from farms as a result of fertilizer and herbicide application and animal faeces around which is in agreement with the result reported by [3]. All values for river were within the permissible limits of the WHO[[8] and NAFDAC (2001)[9]. The percent ion concentrations were in the following order Cl^-> CO_3^{2-} >SO_4^{2-} >NO_3^{--}> total nitrate >PO_4^{3-}. The seasonal variations of the nutrients showed that the levels were higher during the wet season than the dry season figure2.

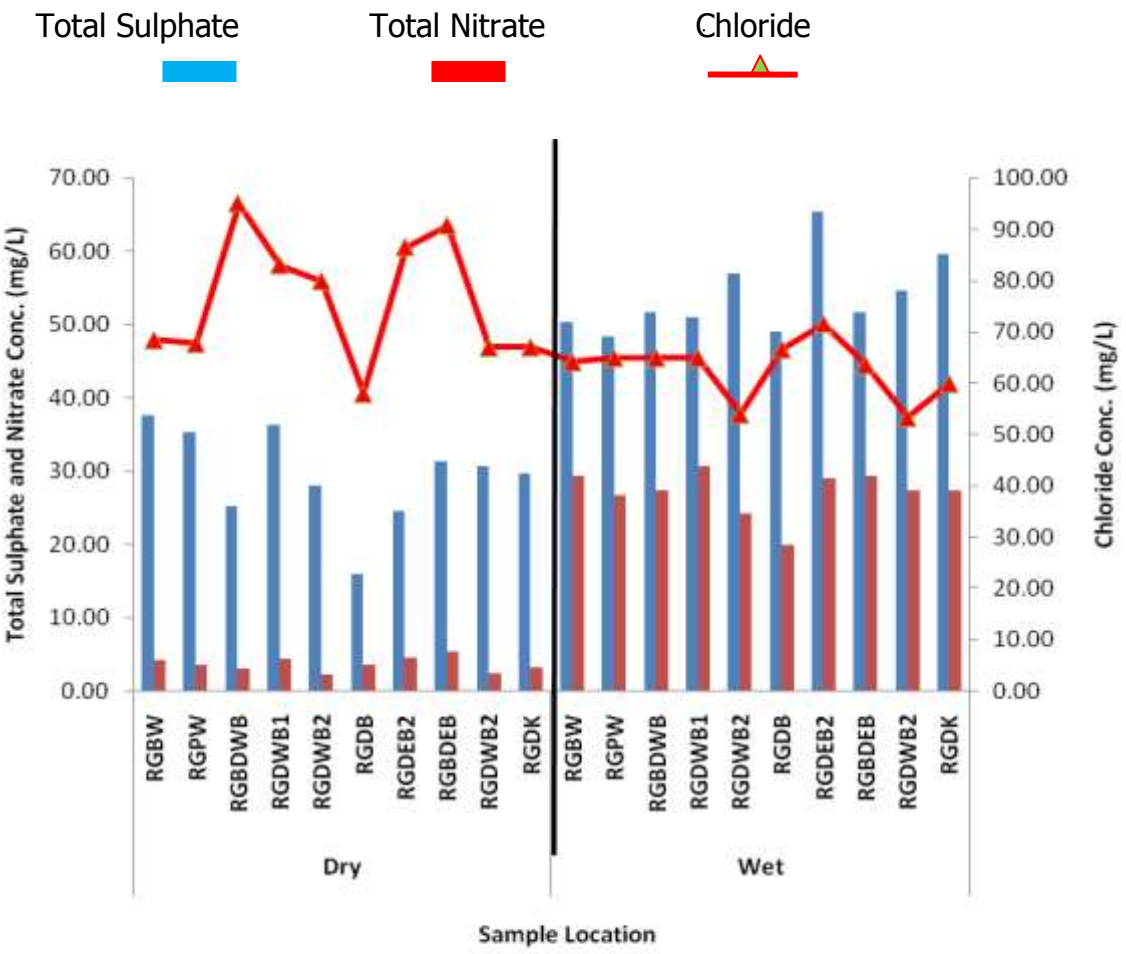

Figure 2: Mean Variations of Total Sulphate, Total Nitrate and Chloride of River Gongola

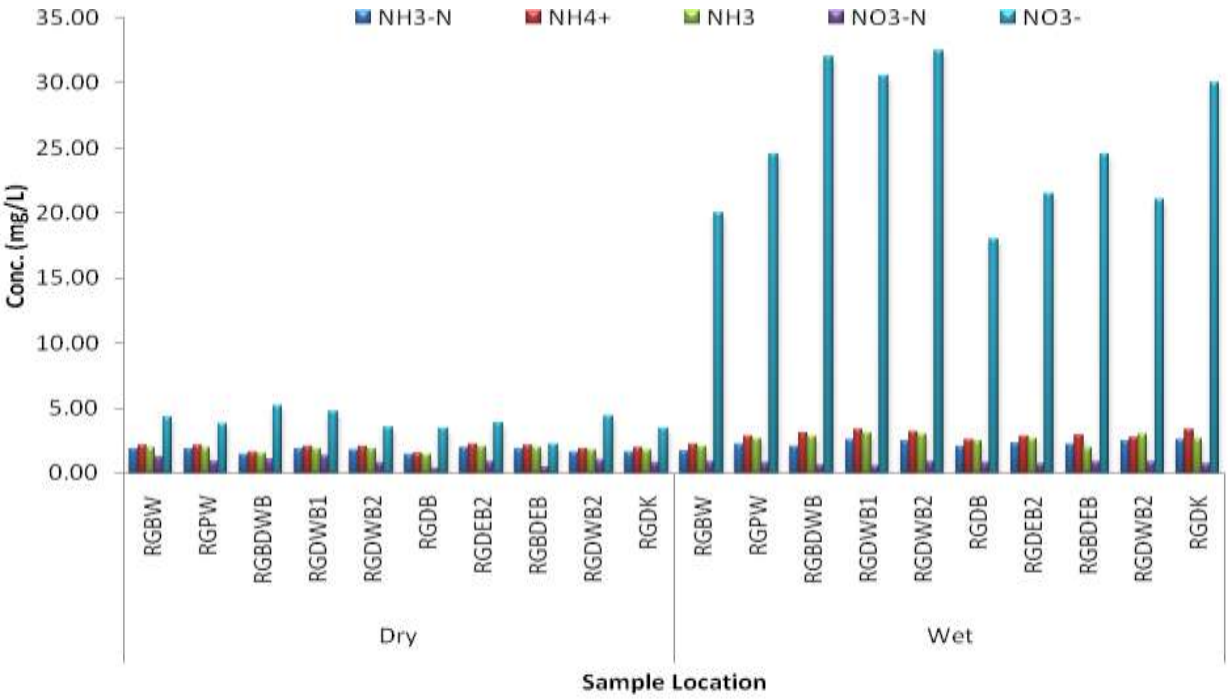

Figure 3. Mean Variations of NH_3-N, NH_4+, NH_3, NO_3-N; NO_3- of River Gongola

CONCLUSION

The results of some anions determined in the surface water of River Gongola in Adamawa state, is higher compared to other studies in the region. From the result the increasing order of concentration of these anions can be observed for the different locations as follows:

Cl^-> CO_3^{2-} >SO_4^{2-} >NO_3^{--}> total nitrate >PO_4^{3-}. It can be observed that they all follow the same pattern. The seasonal variations of the anion levels were higher during the wet season than the dry season. This is due to the high agricultural activities in the area during wet season.

From the results, only NO_3^- concentration showed significant high concentration as that of Cl^- in all the locations. The concentrations of ions were all within the permissible limits of the WHO (2006) and NAFDAC (2001). The seasonal variation showed higher concentrations in the wet season than the dry season, which agrees with Maimuna, (2006).

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APPENDIX 1: Mean ± SD Variations of Anions in River Gongola

Season	Code	Total Sulphate (mg/l)	Total Nitrate (mg/l)	Total Carbonate (mg/l)	Chloride (mg/l)	NH_3-N (mg/l)	NH_4^+ (mg/l)	NH_3 (mg/l)	NO_3-N (mg/l)	NO_3^- (mg/l)	PO_3^{3-} (mg/l)
Dry	RGBW	37.67±4.21	4.25±5.39	55.77±0.94	68.50±4.38	1.88±0.28	2.10±0.28	1.98±0.24	1.28±0.54	4.32±1.05	0.86±0.04
	RGDW	35.33±8.33	3.60±7.77	51.12±1.78	67.77±7.11	1.86±0.25	2.11±0.21	1.98±0.20	0.92±0.20	3.81±0.61	0.85±0.52
	RGDbwW	25.33±6.09	3.20±3.89	85.73±4.89	95.10±6.67	1.45±0.05	1.64±0.01	1.55±0.02	1.06±0.20	5.14±1.24	0.20±0.05
	RGDw1W	36.33±2.98	4.41±5.53	55.73±7.73	83.10±3.45	1.82±0.18	2.03±0.15	1.90±0.19	1.30±0.18	4.76±0.55	0.65±0.06
	RGDe1W	28.00±5.43	2.39±6.06	83.08±5.49	80.00±12.0	1.79±0.01	2.05±0.04	1.90±0.02	0.79±0.10	3.48±1.49	0.65±0.01
	RGD_BW	16.00±3.39	3.57±8.42	83.21±8.33	58.00±3.23	1.42±0.21	1.49±0.45	1.45±0.33	0.38±0.34	3.47±0.51	0.23±0.11
	RGDe2W	24.67±9.42	4.57±4.33	42.11±4.44	86.60±8.02	1.97±0.42	2.25±0.51	2.06±0.46	0.87±0.29	3.85±1.28	0.22±0.51
	RGDbeW	31.33±11.02	5.47±4.83	64.90±3.89	90.83±5.01	1.84±0.13	2.11±0.19	1.97±0.12	0.50±0.11	2.20±0.47	0.59±0.05
	RGDw2W	30.67±8.45	2.52±4.65	58.49±2.89	67.00±10.0	1.57±0.15	1.83±0.17	1.80±0.06	1.00±0.10	4.43±0.45	0.52±0.06
	RGD_KW	29.67±4.33	3.35±6.54	79.99±6.43	67.10±5.20	1.56±0.06	1.95±0.00	1.80±0.01	0.78±0.08	3.43±0.33	0.84±0.05
Wet	RGBW	50.33±9.41	29.33±3.42	33.53±3.66	64.17±10.54	1.70±0.02	2.22±0.06	2.08±0.03	0.88±0.11	20.00±0.08	0.50±0.04
	RGDW	48.33±4.33	26.67±4.89	87.45±2.89	65.00±1.58	2.17±0.04	2.78±0.03	2.62±0.02	0.81±0.14	24.50±0.50	0.73±0.00
	RGDbwW	51.67±2.89	27.33±1.97	61.71±6.54	65.00±6.65	2.07±0.43	3.05±1.11	2.85±1.07	0.61±0.06	32.00±0.02	0.93±0.21
	RGDw1W	51.00±3.21	30.67±0.87	47.79±3.78	65.00±2.28	2.57±0.58	3.30±0.74	3.11±0.69	0.56±0.32	30.50±1.50	0.83±0.04
	RGDe1W	57.00±6.53	24.33±3.29	39.01±8.65	54.00±5.62	2.46±0.15	3.17±0.19	2.99±0.18	0.88±0.10	32.50±0.50	0.98±0.00
	RGD_BW	49.00±5.55	20.00±4.49	48.89±4.33	66.67±2.00	2.07±0.05	2.54±0.18	2.51±0.49	0.81±0.14	18.00±0.40	0.77±0.21
	RGDe2W	65.33±6.90	29.00±10.22	44.84±8.67	71.67±8.29	2.27±0.29	2.80±0.49	2.61±0.14	0.76±0.09	21.50±2.44	0.69±0.04
	RGDbeW	51.67±5.76	29.33±4.44	53.98±4.56	63.67±4.19	2.23±0.77	2.94±1.06	1.92±0.85	0.86±0.13	24.50±3.04	0.81±0.08
	RGDw2W	54.67±3.25	27.33±3.87	66.17±2.90	53.33±1.66	2.50±0.72	2.73±0.47	2.95±0.46	0.87±0.33	21.00±5.22	0.56±0.01
	RGD_KW	59.67±4.78	27.33±0.99	74.35±1.35	60.00±1.01	2.52±0.60	3.32±0.88	2.64±0.30	0.72±0.05	30.00±1.43	0.69±0.03