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An evaluation of the physical parameters of river Gongola in Adamawa State, Nigeria

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ABSTRACT

The evaluation of the physical parameter levels of river Gongola was done using Digital Spectrophotometer 2010. It revealed high pH (7.23±0.44) to 7.60 ± 0.35during dry season and low pH (6.61± 0.01 to 7.35 ± 0.04) in the wet season. The temperatures ranged from 26.25±1.28°C to 27.36±0.41°C in dry season and 20.21±0.52°C to 21.77 ±1.38°C in wet season. The total hardness and total carbonate were almost the same for both seasons but they differ in the wet season. Conductivities were higher than the total dissolved solids (TDS). These values were found to be within the permissible limits of the WHO and NAFDAC.

Keywords: Physical parameters, Season, Evaluation., Hardness

INTRODUCTION

Thermal pollution can occur when water is used as a coolant near a power or industrial plant and then is returned to the aquatic environment at a higher temperature than it was originally. Thermal pollution can lead to a decrease in the dissolved oxygen level in the water while also increasing the biological demand of aquatic organisms for oxygen. Temperature is the degree of hotness or coldness of a body. Water temperature is affected by natural processes and human activities. High water temperature has an adverse effect on aquatic organism because high temperature decreases dissolved oxygen in water and vice versa. Many industrial and power plants use rivers, streams and lakes to dispose of waste heat. The resulting hot water can cause thermal pollution. Thermal pollution can have a disastrous effect on life in an aquatic ecosystem as temperature increases the amount of oxygen in the water also decrease, thereby reducing the number of organisms that can survive there.

pH is the degree of alkalinity or acidity of a solution. Mathematically, pH = -Log H^+. It is one of the most important measurements carried out in natural waters. The changes in pH values in water is closely related to photosynthetic processes due to CO_2 uptake by water plants which leads to decomposition of organic matter. It is an important water quality indices. As acid precipitation falls into rivers, lakes, streams and ponds it can lower the overall pH of the waterway, killing vital plant life, thereby affecting the whole food chain. It can also leach heavy metals from the soil into the water, killing fish and other aquatic organisms. Because of this, air pollution is potentially one of the most threatening forms of pollution to aquatic ecosystems.

Acid precipitation is caused when the burning of fossil fuels emits sulfur dioxide into the atmosphere. The sulfur dioxide reacts with the water in the atmosphere, creating rainfall which contains sulfuric acid. As acid precipitation falls into lakes, streams and ponds, it can lower the overall pH of the water way, killing vital plant life, thereby affecting the whole food chain. It can also leach heavy metals from the soil into the water, killing fish and other aquatic organisms. Because of this, air pollution is potentially one of the most threatening forms of pollution to aquatic ecosystems.

Hardness refers to the ability of water to precipitate soap. It is undesirable for two reasons:-

- It requires much soap to form lather.
- It produces scale in industrial boilers, heaters, and hot water pipes.

Major contributors are calcium and magnesium ions. They combine with soap to form insoluble precipitate. Hardness is mainly derived from weathering of minerals such as limestone ($CaCO_3$) or dolomite ($CaCO_3.MgCO_3$) and gypsum $CaSO_4.2H_2O$. Hardness varies from place to place depending on geographical location. Total hardness is the sum of Ca and Mg concentrations expressed as $CaCO_3$ in mg/l or parts per million[1]

The aim of this study is to determine some physicochemical pollution indicator levels in River Benue. Determine physical pollution Indicators such as pH, conductivity, total hardness and temperature.

MATERIALS AND METHODS

The study areas include:
(a) River Benue: Boronji, Jimeta Water treatment Plant, Jimeta Bridge, Jambutu, Vinikilang, behind Jimeta Bridge, Fisheries, Bajabure I, Bajabure II and Jimeta car wash areas.

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 sample locations and codes are presented in Table 1.

Water Sampling

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. Forty three sampling points were used and the sampling points are approximately 100m away from each other. A total of 200 samples were analyzed. Samples were collected in the months of February, March, April (dry season) and August, September, October (wet season) in the year 2007.

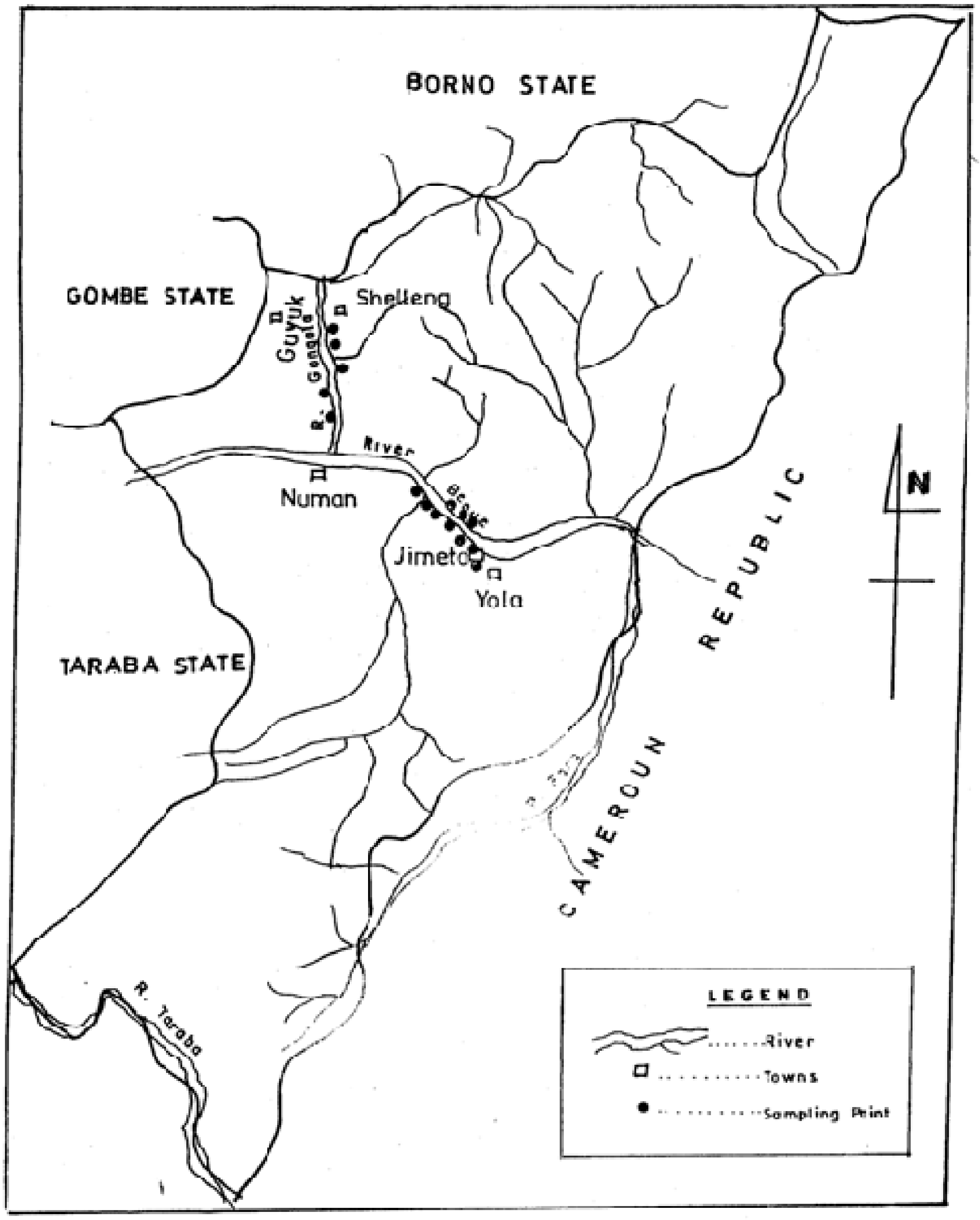

Figure 1: Map of Adamawa State Showing Study Areas and Sampling Points

Table 1: Sample location and codes for River Gongola

S/N	LOCAITON	CODE
1	River Benue Boronji Water	RBBW
3	River Benue Treatment Plant Water	RBTW
5	River Benue Bridge Water	RBB_dW
7	River Benue Jambutu Water	RBJW
9	River Benue Vinikilang Water	RBVW
11	River Benue Behind Bridge Water	RBB_bW
13	River Benue Fisheries Water	RBFW
15	River Benue Bajabore I Water	RBB_IW
17	River Benue Bajabore II Water	$RBB_{II}W$
19	River Benue Car Wash Water	RBC_wW

The water samples collected were analysed by determining the amounts of total hardness using DR/2010 spectrophotometer. Electrical conductivity (EC), temperature, and total dissolved solids (TDS) were measured using conductivity/ TDS meter. pH by a portable pH meter. The Temperature/pH meter (PHH-3X) was switched on for some time to allow time for stability, the probe was dipped in the 5% Na_2SO_4 solution and later removed and dipped in the water samples, and the readings were recorded. It was again switch to temperature after rinsing with distilled water and the reading recorded

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

The mean pH variation for River Gongola was between 7.23±0.44 and 7.60±0.35 for dry season and 6.61±0.01 to 7.35±0.04 for wet season as shown in Figure 2. The exceptionally low pH at location RGDbeW may be due to the low volume of water behind the dam and the high fishing activities taking place in the location. The mean temperature variation for River Gongola ranged between 26.25±1.28 and 27.36 ± 0.41^{o}C for dry season and 20.21± 0.52 to 21.77 ±1.38^{o}C for wet season as shown in table II.

Similarly Figure 3 is the mean variation of total hardness and total carbonate for River Gongola. The values for the total hardness ranged between 44.00 and 89.43mg/l for dry season and 46.07 to 89.74mg/l for wet season, while that of total carbonate ranged between 42.11 and 85.73mg/l for dry season and 33.53 to 87.45mg/l for wet season.

The mean TDS values for River Gongola was between 123.00 and 139.00mg/l for dry season and 105.45 to 116.83mg/l for wet season while that of conductivity ranged between 212.00 and 281.50mg/l for dry season and 211.13 to 242.47mg/l for wet season as shown in Figure 4.

The values for River Gongola were almost the same and they were within the allowable limits of the WHO [2] and NAFDAC [3] as shown in table II. The values for the total hardness were higher than that of total carbonate, because total hardness comprises all the salts that contribute to hardness in water.

Table II: Mean ± SD Variations of Some Physical Parameters in Surface Waters of River Gongola

Season	Code	Temperature (^oC)	Total Hardness(mg/l)	TDS(mg/l)	Conductivity (mg/l)	pH
Dry	RGBW	27.11±1.22	45.07±7.03	123.00±12.03	255.00±0.76	7.38±0.11
	RGDW	26.70±3.45	54.93±4.30	129.87±3.45	228.00±0.86	7.54±0.04
	RGDbwW	26.93±5.32	89.47±9.55	123.90±5.98	242.50±4.34	7.39±0.32
	RGDw1W	26.94±1.23	58.47±0.65	122.63±4.33	212.00±6.55	7.60±0.88
	RGDe1W	26.25±5.32	72.20±0.99	124.10±7.65	225.00±6.07	7.50±3.04
	RGD_BW	26.58±0.85	86.50±3.67	129.53±3.57	213.50±7.65	7.23±2.45
	RGDe2W	27.36±0.94	44.00±5.43	128.53±0.99	276.00±7.77	7.42±1.32
	RGDbeW	27.12±0.33	68.53±7.66	134.20±0.04	281.50±4.33	7.44±1.56
	RGDw2W	27.35±0.95	60.87±3.56	139.33±0.66	238.00±5.42	7.52±2.33
	RGD_KW	26.95±3.02	83.63±4.65	138.07±4.03	253.00±2.44	7.60±1.33
Wet	RGBW	21.02±3.49	46.07±3.21	109.97±4.06	242.47±10.04	7.25±2.55
	RGDW	20.30±2.45	127.63±1.22	108.97±4.99	222.53±2.56	7.15±0.95
	RGDbwW	20.49±0.99	86.53±8.02	108.07±3.66	211.13±23.01	7.32±0.96
	RGDw1W	20.21±0.34	61.33±4.04	105.47±3.05	235.73±0.9	7.30±0.05
	RGDe1W	20.97±8.33	62.87±3.99	110.93±2.11	221.87±4.33	7.24±0.04
	RGD_BW	21.04±9.34	80.63±0.75	116.83±5.33	211.53±6.05	7.21±3.02
	RGDe2W	20.67±0.55	59.37±0.22	107.97±4.43	222.07±7.65	7.18±2.04
	RGDbeW	21.37±2.43	86.30±0.74	111.73±0.56	223.33±5.67	6.61±0.20
	RGDw2W	21.63±5.32	91.30±7.33	110.57±087	226.33±1.11	7.35±0.04
	RGD_KW	21.77±1.43	104.80±4.98	109.40±7.43	229.67±2.11	7.24±0.01

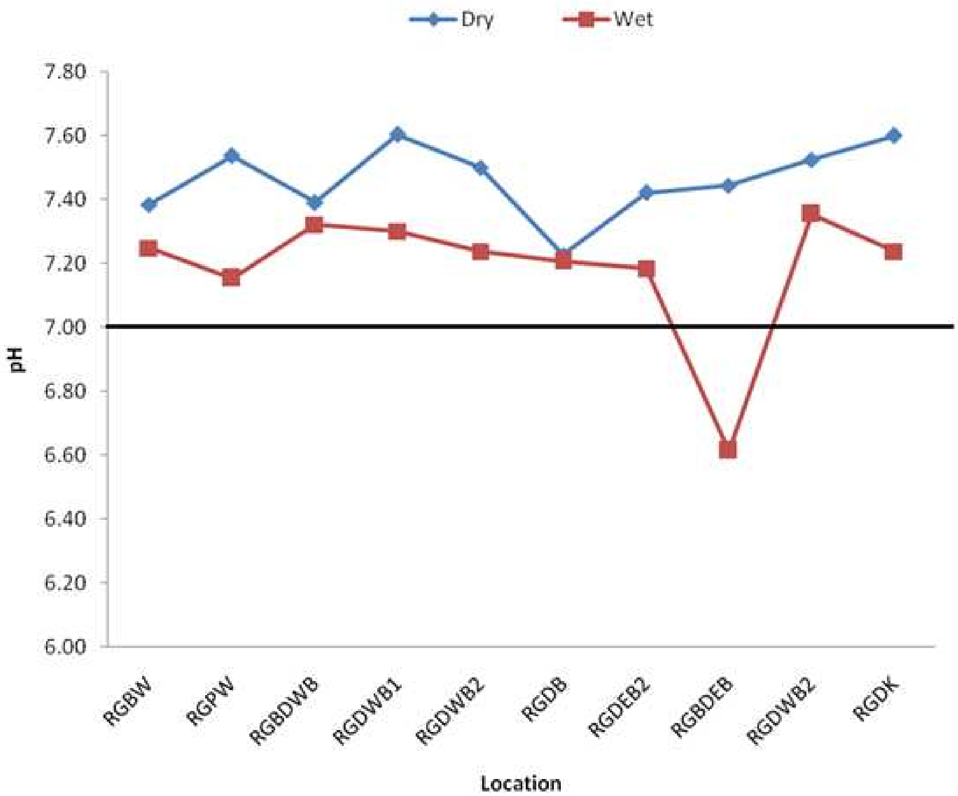

Figure 2: Mean pH Variations with Locations at River Gongola

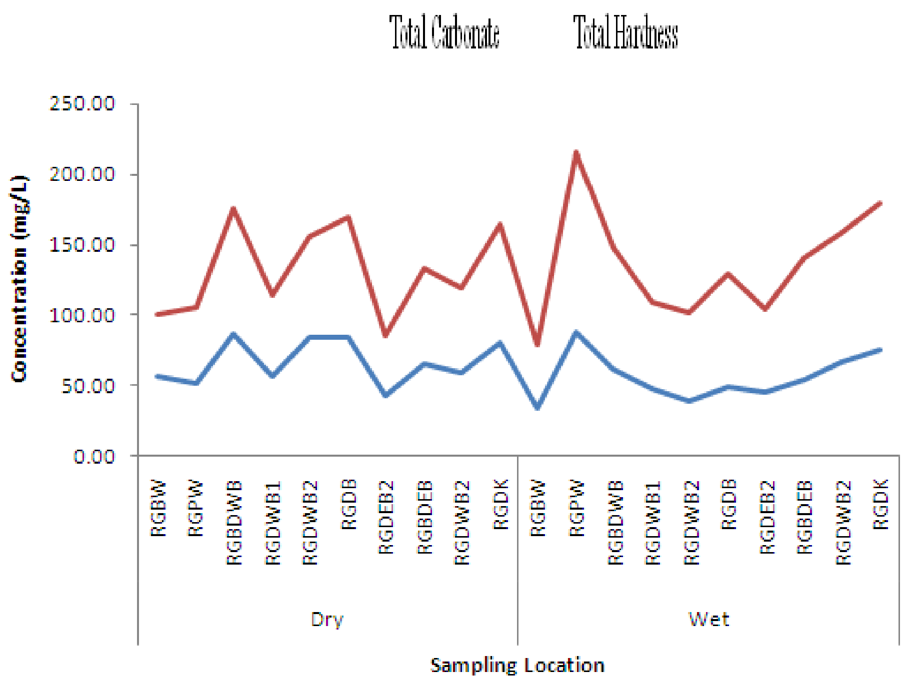

Figure 3: Mean Variations of Total Hardness and Total carbonate of River Gongola

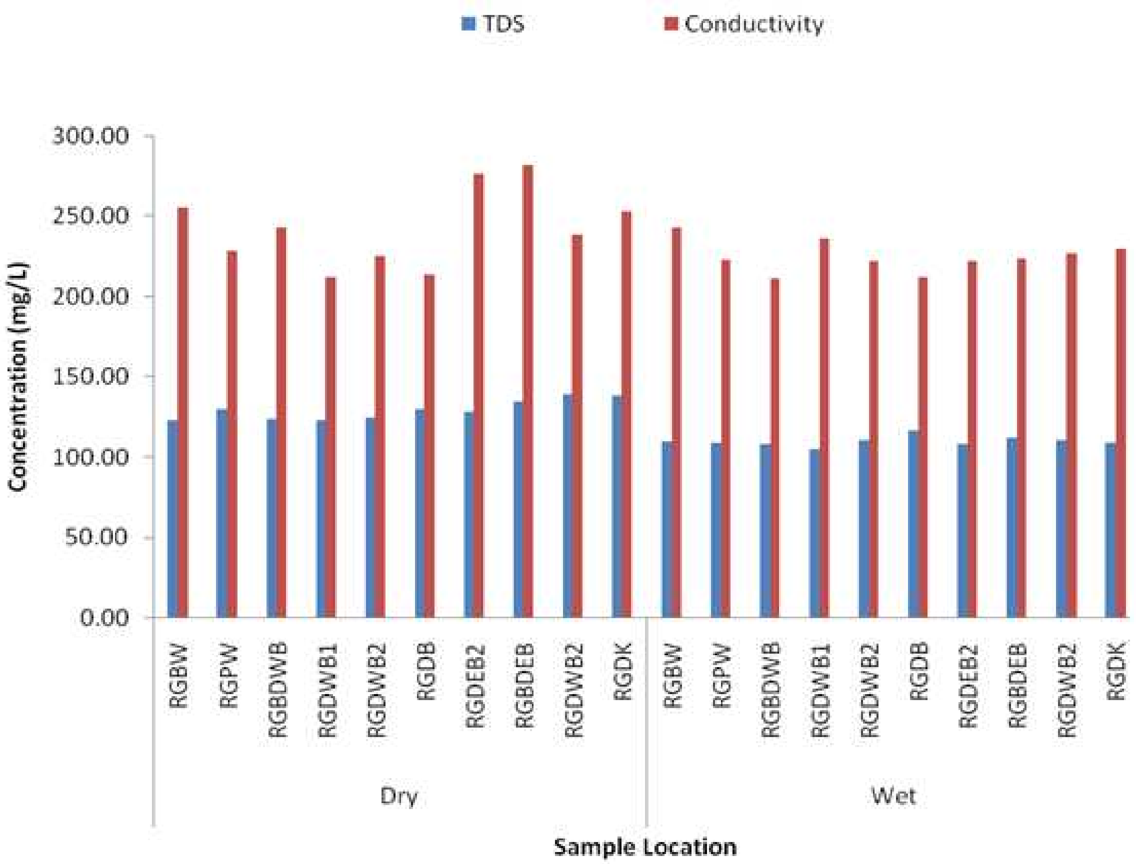

Figure 4: Mean Variations of TDS and Conductivity at Different Locations of River Gongola

For both TDS and conductivity for River Gongola, the values for the dry season were higher compared to wet season. This agrees with Radojevic and Bashkin [1], that water conductivity increases with temperature due to decrease in viscosity and increasing dissociation. In both rivers, all the values were within the permissible limits of the WHO[2] and NAFDAC[3].

It also shows high temperatures during dry season than wet season probably as a result of low volume of water in dry season, and the hot weather. Its correlation with Dissolved Oxygen (DO) was negative which agrees with other findings [4] . The values were within the permissible limits of WHO [2],but the river can be said to be moderately hard [5].

The dry season values are higher for River Gongola than that of wet season. In both rivers the values were within the permissible limits of the WHO [2] and NAFDAC [3].

CONCLUSION

The results of the physical parameters revealed high pH in the dry season and low pH in the wet season, this may be due to acid rain in the wet season and high temperature in the dry season compared to the wet season. It also showed that the total hardness was higher in value than the total carbonate and total nitrate. The values were within the permissible limits of WHO [2], but the river can be said to be moderately hard.

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