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RESEARCH ARTICLE

EXTENT OF POLLUTION OF RIVER BENUE IN JIMETA- YOLA FROM BWARANJI TO GERIO

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ABSTRACT

The physic-chemical and biological characteristics of River Benue from Bwaranji to Gerio in Adamawa state of Nigeria were monitored for a period of three months in the dryseaso(February–April). The range of mean values of the various parameters are as follows: temperature (22.3 – 23.8°C), electrical conductivity (45.5 – 112.0 µs/cm), velocity (3.3 - 43.3cm/s), total dissolved solids (510.0 – 960 mg/l), TS (1500.0 – 2680.0 mg/l), pH (7.6-7.9), calcium (9.0-20.4 mg/l), magnesium (9.0-20.6 mg/l), iron(0.2-0.3 mg/l), chromium (0.04 – 0.026 mg/l), lead (0.3 – 0.6 mg/l), zinc (0.2 -0.3 mg/l) phosphate (7.3-11.5 mg/l), nitrate (2.9 -5.2 mg/l) DO (23.0 -30.1 mg/l), BOD (2.8 – 4.2 mg/l), COD (6.3 – 8.0 mg/l) and *Escherichia Coli* (180.3 – 261.0 cfu/100ml). The TDS at the various locations were above the set standards for drinking water of 500.0 mg/l. The mean values of lead were above the set standards for public supply and marine aquatic life of 1.0 mg/l and 0.05 mg/l respectively. The mean concentrations of phosphate at all locations were also above the set standard of 0.0001 mg/l for marine aquatic life. The possible causes of pollution were agricultural activities, domestic and solid waste discharges into the river.

INTRODUCTION

Increasing municipal, agricultural, industrial and solid waste in Nigeria has deteriorated the quality of many rivers including River Kaduna (Shyllon1989). River Benue may have been equally polluted but no work has been reported on the location variation of the river. The pollution of River Benue could affect the food obtained from irrigated farms, fish and other edible aquatic animal, water for public supply, recreational purposes and commercial uses.

The major river that passes along Jimeta – Yola in Nigeria is River Benue which is the second largest river in Nigeria (Adebayo and Tukur 1999). The river is used mainly for aquatic life, public supply, agricultural activities, recreational and commercial uses. The predominant activities in the study area include commercial, crop production, fishing, water works, dumping of refuse, rearing of animals, repairs of cars and motor cycle, abattoir and sewage disposal through drainage system to the river. These activities in the study area are the source that causes pollution of the river.

Therefore, there is a justification for the present study, to monitor the extent of pollution of the River Benue in Jimeta-Yola from Bwaranji to Gerio caused by these activities along the river bank. The parametric indicators of pollution considered were physical, inorganic chemical, organic chemical and biological characteristics.

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MATERIALS AND METHODS

Water samples were collected from five different locations (Table 1) based on the human activities along the river. Figure 1 gives the map of the study area.

Table 1 Sampling Points and Locations

Sampling points	Locations
BWW	Bwaranji Water Works
JWW	Jimeta Water Works
SIA	Shinko area between the bridge and Ibrahim Kashim Way Round About
SHD	Shinko drainage
GER	Gerio

Grab method of sampling was used for the collection of samples. The dry season results were measured from February to April. The samples were collected in the morning between 6:00am to 9:00am on each sampling day, two times in a month for the duration of three months. For taking the samples, the plastic and glass containers were washed with the river water at each sampling point three times before the sample was finally taken in each container. The samples were preserved in a cooler to ensure proper preservation according to the standard method (Standard Methods 1998). Immediately after collection, the water samples were analyzed. The temperature was measured using a thermometer; electrical conductivity by conductivity meter; velocity using corn stork, measuring tape and stop watch and pH by glass electrode pH meter, Total solids (TS) was measured using Greenfield dryer and Total dissolved solids (TDS) was determined with Whatman No.5

filter and Greenfield dryer. For inorganic chemical characteristics, Pye Unican Sp 9 atomic absorption spectrophotometer was used to determine the concentration of calcium, magnesium, chromium, iron, lead and zinc. The B. Bran 722 – 2000 spectronic – 20 was used to determine the concentration of nitrates and phosphates. For organic chemical characteristics, dissolved oxygen (DO) and biochemical

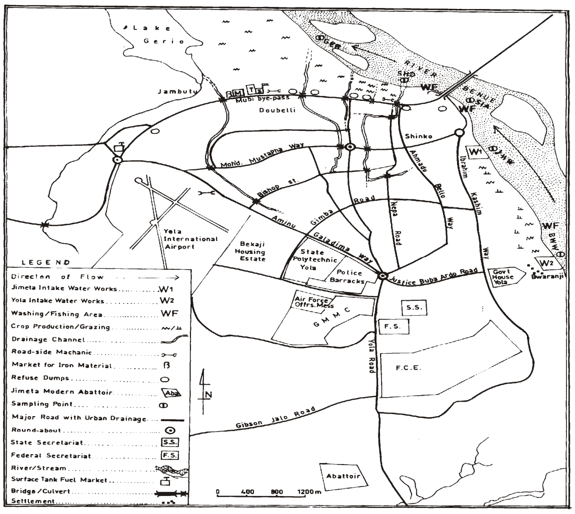

Figure 1 Map Showing the Study Area

oxygen demand (BOD) were determined using Winkler's method of titration whereas chemical oxygen demand (COD) was determined using a strong oxidizing agent (potassium permanganate), sulphuric acid and heat. For biological characteristics, membrane filter technique was used for estimation of *Escherichia coli* (E. coli).

RESULTS AND DISCUSSION

The mean values of the various water quality parameters along the river course for the five locations during the dry season are presented in Figures 2 – 9. Temperature, electrical conductivity (EC), total solid (TS), total dissolved solid (TDS) and velocity are presented in Figures 2, 3, 4 and 5 respectively; heavy metals (Ca, Mg, Fe, Pb, Cr and Zn), PO_4^{3-} and NO_3^- are presented in Figure 6; while pH, COD, BOD_5, and E. The mean values of the various water quality parameters along the river course for the five locations during the dry season are presented in Figures 2 – 9. Temperature, electrical conductivity (EC), total solid (TS), total dissolved solid (TDS) and velocity are presented in Figures 2, 3, 4 and 5 respectively; heavy metals (Ca, Mg, Fe, Pb, Cr and Zn), PO_4^{3-} and NO_3^- are presented in Figure 6; while pH, COD, BOD_5, and E.

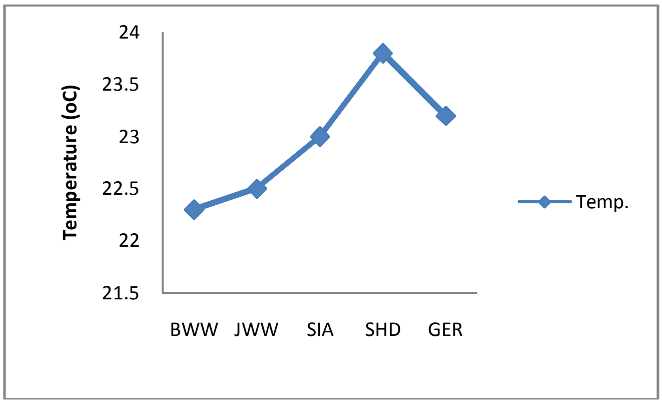

Figure 2 Variation of Temperature with Sampling Points

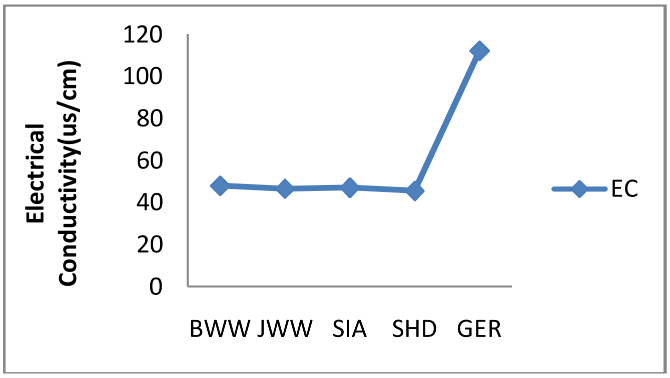

Figure 3 Water Quality Behavior along River Course for EC

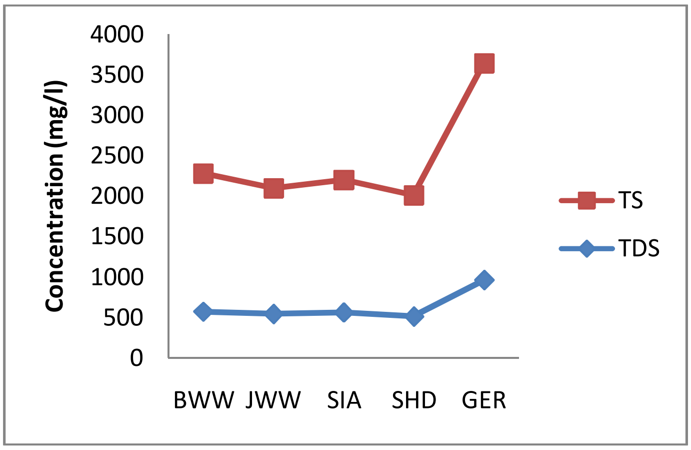

Figure 4 Water Quality Behavior along River Course for TS and TDS

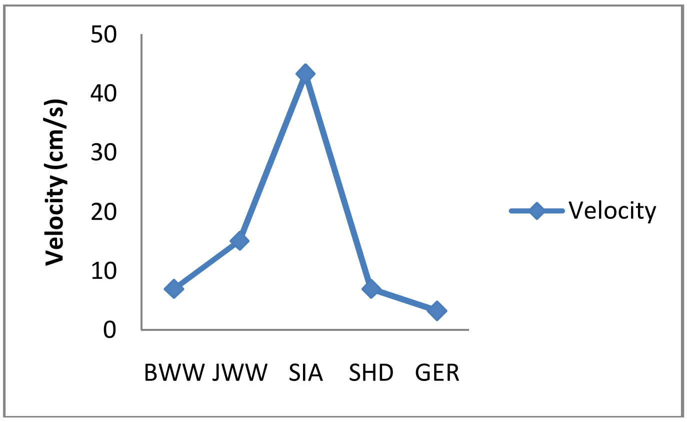

Figure 5 Water Quality Behavior along River Course for Velocity

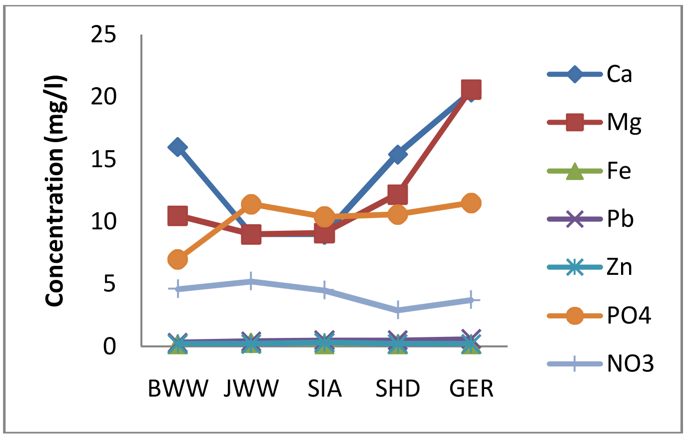

Figure 6 Water Quality Behavior along River Course for Ca, Mg,Fe, Pb, Zn,PO_4^{-3}, and NO_3

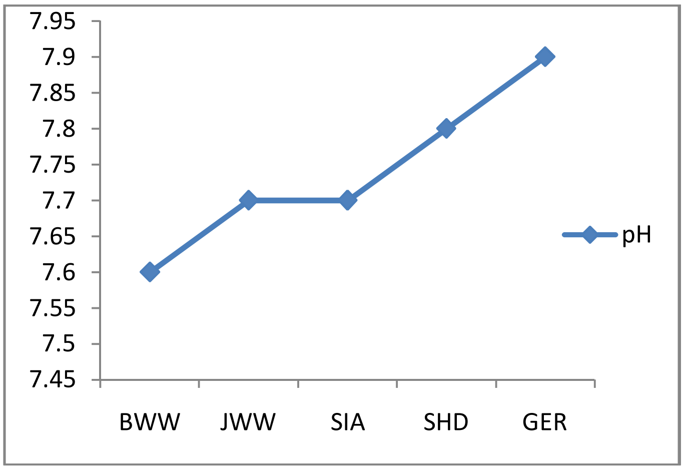

Figure 7 Variation of pH with Sampling Points

Figure 8 Water Quality Behavior along River Course for DO, COD and BOD

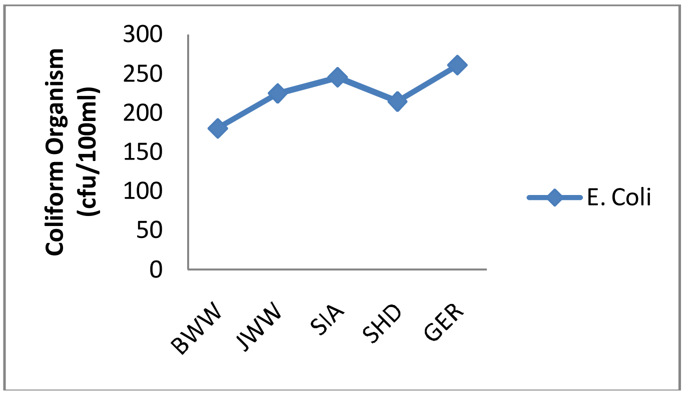

Figure 9 Water Quality Behavior along River Course for Coliform Organism

Temperature value was higher at SHD compared to other sampling points which might be due to discharge of domestic waste from households in Jimeta-Yola city channeled through Shinko on hourly bases.

Most parameters: EC, TS, TDS, Ca, Mg, Pb, pH, PO_4^{3-} and E.Coli generally increases while DO decreases along the river indicating an increasing level of pollution downstream of the river between BWW and GER. These can be explained by the gradual cumulative effect of pollution sources from the city increasing gradually downstream (Lijklema *et al.,* 1993)

Lower mean values of TDS, TS and NO_3 were measured at SHD as shown in Figures 4 and 6. The results obtained are: 510.0mg/l, 1500.0 mg/l and 2.9 mg/l respectively. These results are attributed to neutralization reaction which might occur at the SHD location due to various kinds of domestic waste such as bathing water, garbage and solid waste discharge into the river and dumping of refuse closer to the location (Nathanson 2003).

Velocity was generally higher in SIA than other locations. This might be due to geological characteristics of the location (Krajca and Joseph 1989). The various water quality parameters are more moderate at JWW and BWW than other locations. This might be due to less level of activities such as rearing of animals, crop production, intensive washing, dumping of refuse, recreational activities and commercial activities observed in the two locations.

The mean values of TDS obtained at all locations were above the Federal Ministry of Environment (FM ENV) and World Health Organization (WHO) set standard of 500.0 mg/l for drinking water (Shyllon 1989 and Salvato *et al.,* 2003). The mean values of lead at all the five locations also are above the FM ENV set standard of 0.05 mg/l for drinking water during dry season. This might probably be due to exhaust from motor vehicles, lead paints, car battery salvage operations, soil dust, cosmetics and agricultural sprays from the study area channeled into the river which is intensive during the dry season (Salvato *et al.,* 2003, Metcalf and Eddy 2003).

In addition, at all the various locations the mean values of PO_4^{3-} were above FM ENV set standard of 0.0001 mg/l for marine aquatic life as shown in Figure 6. The results might be due to the increased number of inhabitants using the river for washing and irrigation during the dry season because some of the soap, detergent and fertilizer used contain phosphate based substances (Nathanson 2003 and Visilind et al 1988). At all the five locations the values of DO recorded showed that less physicochemical and biological process are going on in the river within the catchment area of study (Stirling 1985). The DO values are suitable for irrigation, public supply but above the FM ENV maximum permissible limit for marine aquatic life as shown in Figure 8. From Figure 8 low mean values of DO were recorded at Gerio compared to other locations. This might be due to high biological pollution load at Gerio location.

The mean values of NO_3^- at BWW, JWW, SIA and GER are 4.6 mg/l, 5.2 mg/l, 4.5 mg/l and 3.7 mg/l respectively, which are above the maximum value of 3.0 mg/l as shown in Figure 6. This indicates significant man-made contribution (Salvato *et al.,* 2003). It also implies that the values of NO_3^- recorded is due to activities such as application of nitrate based fertilizer during crop production and from human and animal faeces and urine which are contributed by the inhabitant within the study area.

CONCLUSION

From the above results it could be concluded that there is an increasing level of pollution downstream of the river between Bwaranji and Gerio. Gerio location has higher discharge of pollutants compared with other locations along River Benue. The various water quality parameters are moderate at Jimeta Water Works and Bwaranji Water Works than other locations.

There is also need for the Adamawa state government to sensitize its populace of the inherent danger of the amount of some substances in the water that exceeded the limits set by

FME (Federal Ministry of Environment) and WHO. The water from the river is not safe for direct consumption due to the presence of *Escherichia Coli.*

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