OJN Preprint
This version is NOT peer-reviewed

OJN Preprint No.: OJNPPes20041301

How to Cite:
Apeh, S., Ataguba, C. O, and Alhassan, Y. A. (2020). An assessment of self-purification of river Benue in Makurdi, Benue State, Nigeria. *OJN Preprints*, OJNPPes20041301 (v1)1-12

AN ASSESSMENT OF SELF-PURIFICATION OF RIVER BENUE IN MAKURDI, BENUE STATE, NIGERIA

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Abstract

Within Makurdi town, covering a distance of about 14KM, River Benue was monitored over a period of six (6) months in the year 2015 for self-purification capacity study of the river. Two samples were taken from Benue Brewery Limited (point source) upstream and Wadata, where there is heavy concentration of people (non-point source). The process of field sampling and laboratory analyses were used for the study. Parameters investigated in this study included: ***BOD, COD, pH, TDS*** *and* ***DO****. Other parameters include* ***Hardness, Total coliform, Conductivity, Nitrate*** *and* ***Iron****. Results obtained revealed that River Benue is capable of purifying itself with distance. The values obtained for the investigated parameters at downstream decreased from that obtained at upstream. For example, there was an improvement in the BOD from 227.7mg/l upstream to 138mg/l downstream in the month of July 2015. Similarly, the total coliform equally reduced from >1800 CFU/100ml of water upstream to 1600 CFU/100ml of water downstream in the month of July 2015. This study has revealed that River Benue in the reach of Makurdi is capable of purifying itself with distance.*

Keywords: Self-purification, upstream, downstream, water quality, River Benue.

1.0 Introduction

The quality of water is of paramount importance because of its role to human health, aquatic life, ecological integrity and sustainable economic growth. Indeed, without good quality water, sustainable development and environmental sound management of water resources will be meaningless.

The pollution of water directly or indirectly affects public health. Various studies have shown that some chemicals are so harmful that even in trace amounts they can cause illness or even death in humans. (Hertz man, 1995). Klein

(1969) reported that the consumption of water with excess TDS has laxative effects on humans. Pi et al. (2002) linked induction of oxidative stress in humans to chronic exposure to arsenic in drinking water. According to Claudio (2002), consumers of fish and crabs from river contaminated with polychlorinated biphenyls (PCBS) are prone to cardiovascular disease, endocrine disruption and cancers such as breast cancer and leukemia. Childhood brain tumors have been shown to be associated with water contaminated with nitrites and nitrates (Mueller et al, 2001).

Running water is capable of purifying itself with distance through a process known as self purification. This is the ability of a river to purify itself of sewage or other wastes naturally. It is produced by certain processes which work as rivers move downstream. This mechanisms can be in form of dilution of pollution waters with influx of surface and groundwater or through certain complex hydrologic, biologic and chemical processes such as sedimentation (behind obstruction), coagulation, volatilization, precipitation of colloids and its subsequent settlement at the base of the channel, or lastly due to biological uptake of pollutants. On the other hand, certain streams/rivers are capable of adding more materials as they flow downstream from riparian inputs (Ongley, 1991). The extent of self purification in any river depends on certain factors, some of which are: temperature; level of river; river velocity: amount of inorganic compounds in the stream and the flow: distribution and types of aquatic weeds along the channel.

It should be noted however, that a stream or river that is used for wastewater dilution depends on natural self-purification to assimilate waste and to restore its own quality. The capacity to recover from a waste discharge is determined by the character of the river, including its climatic setting.

Self purification of stable chemical waste is almost entirely dependent on stream flow. In passage down a river, the concentration decreases with greater run-off provided by the increasing drainage area. Many chemicals are reactive and dissipate by adsorption, reaction or biological decay. Three of the major determinants of self purification of micro-organisms are:

- Reduced food supply.
- Adverse temperature.
- Prey-predator relationship.

The pollution of water directly or indirectly affects public health. Various studies have shown that some chemicals are so harmful that even in trace amounts they can cause illness or even death in humans. Water pollution manifests itself in form of impairment of the quality of the water. Raven et. al, (1998) divided water pollutions into eight categories viz; Sediment pollution, sewage disease-causing agents, organic compounds and inorganic plant and algae nutrients (e.g. nitrogen and phosphorous). Others are inorganic chemicals, radioactive substances and thermal pollution, besides the discharge of specific pollutants in water. The construction of dams, reservoirs and river diversions can also degrade water quality.

Over the years, a considerable amount of time and effort have been devoted to the improvement of water quality in rivers employing a combination of heuristic and mathematical techniques or fore-casting which is an important ingredient in formulating water pollution control policies.

In Nigeria, recent attempts have been made to produce base-line information on the quality of some rivers. In a study of water quality along River Asa in Ilorin, Ajibade (2004) reported variations in stream water quality; he further observed that none of the water quality parameters met the WHO standard for drinking water.

Moses (1979) and Nawa (1982) studied aspects of the physicochemical characteristics of the Cross River and reported that water quality of the river was mainly influenced by natural regimes such as rainfall and discharges. Odokuma and Okpowasili (1997) monitored the organic pollution of the new Calabar River. However, no attempt was made to seek mathematical representation of the quality phenomenon.

Nwaogazie and Ogelle (1997) reported linear and non-linear relationships between pollution and consistent time trends in degree of pollution on the Obinna River basin. Aboiyar (2001) investigated the pollution of River Benue in Makurdi but the work was limited in scope. Also no attempt was made to seek mathematical relationship between the various parameters investigated.

1.1 The Problem

The river under study is subjected to various sources of pollution; industrial wastes from the Benue Brewery Limited (BBL) and Nigeria Bottling Company (NBC) all located along Gboko road are washed into the river, other sources of pollution of the river are faeces from humans defecating directly in the river, washed animals and human wastes from land to the river as well as fertilizer and other chemicals applied to the crops that are usually grown at the river banks.

The contamination of this river has led to incidents of water related diseases in the area. Notable among water related diseases in Makurdi are typhoid fever, amoebic dysentery and cholera (Akpen and Eze, 2006). River Benue is the main source of water supply for the inhabitants of Makurdi, for industrial, agricultural and domestic purposes. These informed the decisions to assess the surface water quality of the River Benue especially as it affects human health.

The objective of this research was to investigate the self purification capacity of River Benue at BBL (upstream reach) and Wadata (Downstream Reach) and to present the trend in the process.

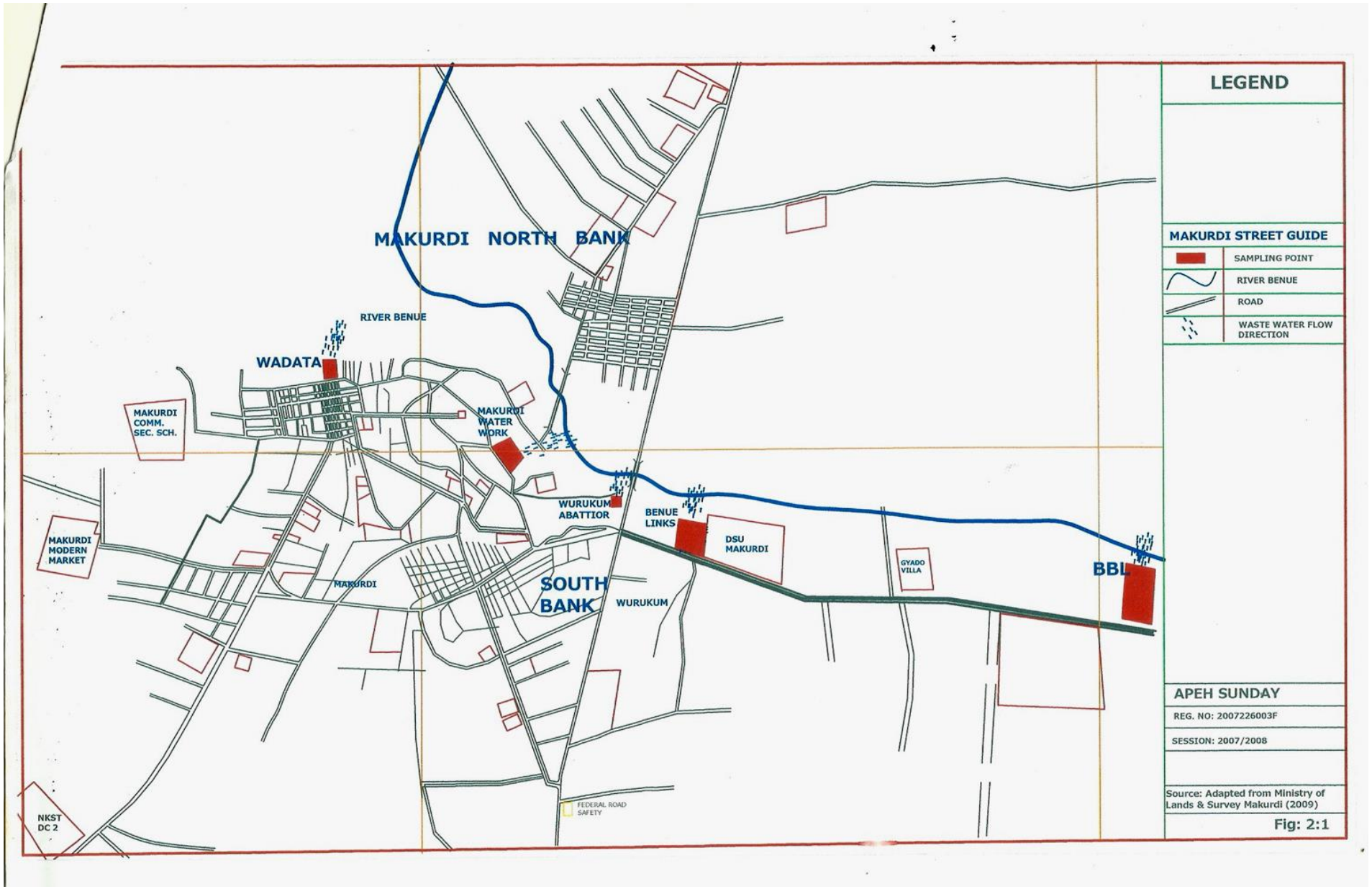
1.2 Study Area

River Benue is one of the two major rivers in Nigeria. It starts from the Cameroon Mountains and flows westwards through Makurdi to meet the river Niger at Lokoja in Kogi State. Its tributaries include but not limited to Rivers Dongo, Katsina-Ala, Bantayi and Larab. Along the Makurdi new bridge, the river is 1.194km wide with an average depth and cross sectional area of 7.82m and 4608.42m^2 respectively (Akpen and Eze, 2006).

The valley of the river which is covered with metal sediments consists of land areas below 300m above sea level. The flood plain, which is characterized by extensive swamps, is good for dry seasons irrigated farming.

Makurdi town, located in the Benue valley experiences a typical tropical climate with distinct dry and wet seasons. The wet season which lasts for seven months starts from April and ends in October, There is however usually one or more early heavy rain in January, February or March. The dry season begins in November and ends in March. Within

the same period, the area experiences two distinct weather situations; while harmattan, with cool and chilly weather is experienced from December to early February; hot weather and high temperatures are experienced between the later part of February and early April.


MAKURDI NORTH BANK
RIVER BENUE
WADATA
MAKURDI COMM. SEC. SCH.
MAKURDI WATER WORK
WURUKUM ABATTIOR
BENUE LINKS
DSU MAKURDI
GYADO VILLA
BBL
MAKURDI MODERN MARKET
MAKURDI
SOUTH BANK
WURUKUM
NKST DC 2
FEDERAL ROAD SAFETY
LEGEND
MAKURDI STREET GUIDE
SAMPLING POINT
RIVER BENUE
ROAD
WASTE WATER FLOW DIRECTION
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Source: Adapted from Ministry of Lands & Survey Makurdi (2009)
Fig: 2:1

2.0 Materials and Methods

Water samples were taken monthly at a distance of 0.4m from the surface of the water at a distance of 5m from the right bank at five sampling points, A,B,C,D,E, Point A is upstream of the point where effluents from BBL and NBC enter the river. Point B is downstream of A at a distance of 2km. But Point C, downstream of Point B is below the Makurdi new bridge a distance of 2.5km from B. Point D is at the Makurdi Waterworks 1.5km downstream of C. Point E is a point downstream of the New Garage market at a distance of 3km from D. The sampling period covered a period of six months from April-September 2015. Fig. 1 showed the map of the study area.

The parameters investigated were some of the physico-chemical and microbial properties of the water samples obtained from the upstream and downstream reach of the river under study in accordance with APHA (2012). These tests were carried out at the Greater Makurdi Waterworks Laboratory in Makurdi, Benue State. The average values for each of the parameters were calculated and presented in Table 1.

3.0 Results and Discussions

The results obtained from the physico-chemical and microbial tests have been presented in Table 1 and graphically presented in Figures 2 – 11. The results have shown that the measured parameters yielded improved outputs at the downstream (Wadata) when compared with that of the upstream (BBL).

From fig. 3, it could be observed that the water samples at the upstream had very high conductivity (1000 – 1223 s/m) which may be due to high concentration of ions from dissolved salts and inorganic materials. However, the conductivity of the water samples measured at the downstream have lower values (70 – 82 s/m) which showed that the flow of the river had reduced the conductivity of the river over the distance.

Table 1: Results of the Physico-chemical and Microbial Properties of River Benue Reach at Upstream and Downstream covering April – September 2015

Physico-Chemical/ Microbial Parameter	BBL (UPSTREAM)						WADATA (DOWNSTREAM)						DISTANCE (KM)
	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sept. 2015	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sept. 2015	
pH	6.14	6.19	6.3	6.4	6.43	6.63	7.94	7.926	7.69	7.76	7.59	7.43	14
Conductivity (ms)	1114	1223	1061.3	1007	1002.7	1000.5	72.7	80	81.66	71	76	73	14
Hardness (mg/L)	340	300	280	273.3	260	240	160	140	140	120	120	120	14
BOD (mg/L)	236	229	232.7	222.7	227	229	149	147.3	147.33	138	147	148.3	14
COD (mg/L)	473	459	464	445.3	455	458	286.7	276	294.66	276	295	301.3	14
DO (mg/L)	4.6	4.3	4.46	4.5	4.3	4.5	4.92	4.87	4.93	5	4.93	5.2	14
TDS (mg/L)	134	143	164.6	172	188.7	144.7	10	22.33	25.7	39	39.47	37.7	14
Total Coliform (cfu/100ml H_2O)	1800	1800	1800	1800	1800	1800	1243	1146.66	1372.33	1600	1666.7	1666.7	14
Nitrate (mg/L)	152.9	155.4	161.5	151.3	150	147.5	43.4	45.76	45.13	41.3	45.9	49.4	14
Iron (mg/L)	1.2	1.19	1.26	1.24	1.16	1.21	0.27	0.246	0.23	0.25	0.29	0.3	14

It could also be observed from the results that the pH, hardness, BOD, COD, TDS, nitrate and iron content of the water samples tested have lower values at the downstream than at the upstream. This implied that the concentration of the pollutants (both organic and inorganic) at is higher at the upstream than at the downstream and that the process of dilution over the distance observed might have contributed to the change in the concentration of the water tested. The very high Total Coliform in the water samples at upstream as shown in Fig. 9 showed the presence of fecal matter from animals and humans in the flow.

The results obtained from the Dissolved Oxygen test (Fig.7) showed that the dissolved oxygen values are higher at the downstream than at the upstream. These results have shown that the water at the downstream has more oxygen in it and proved healthier to support aquatic life than at the upstream.

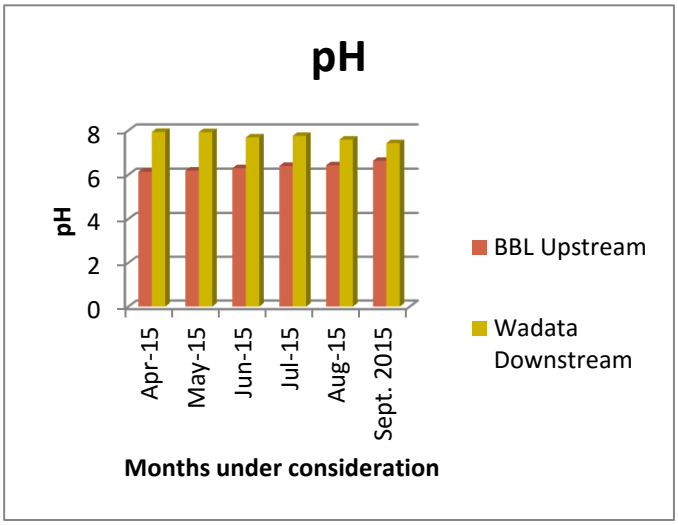


Fig. 2 Plot of the pH for the water samples

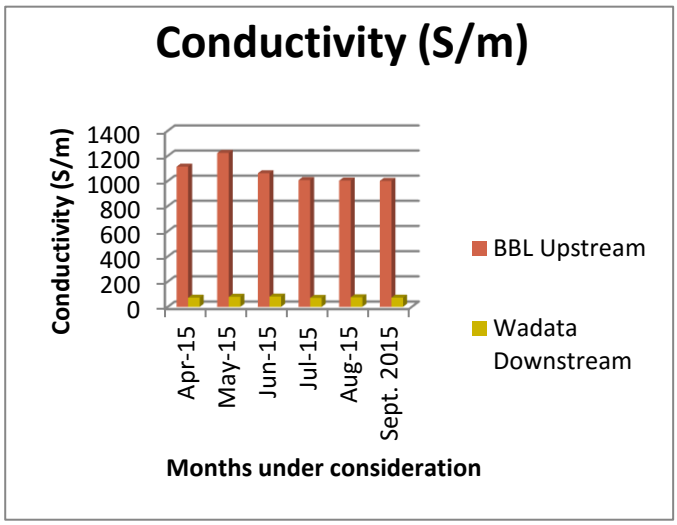


Fig. 3 Plot of the Conductivity of the water samples

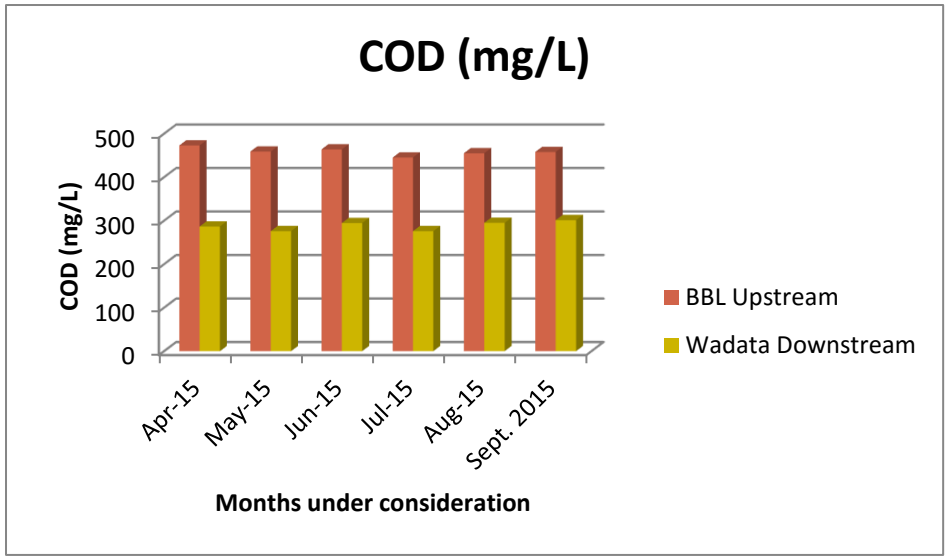


Fig. 4 Plot of the Chemical Oxygen Demand for the water samples

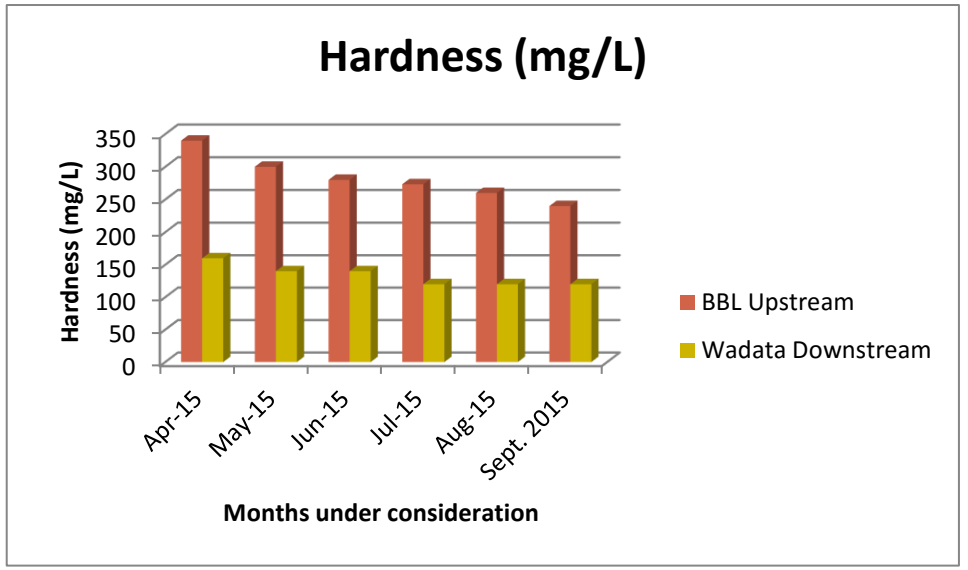


Fig. 5 Plot of the Hardness Test for the water samples

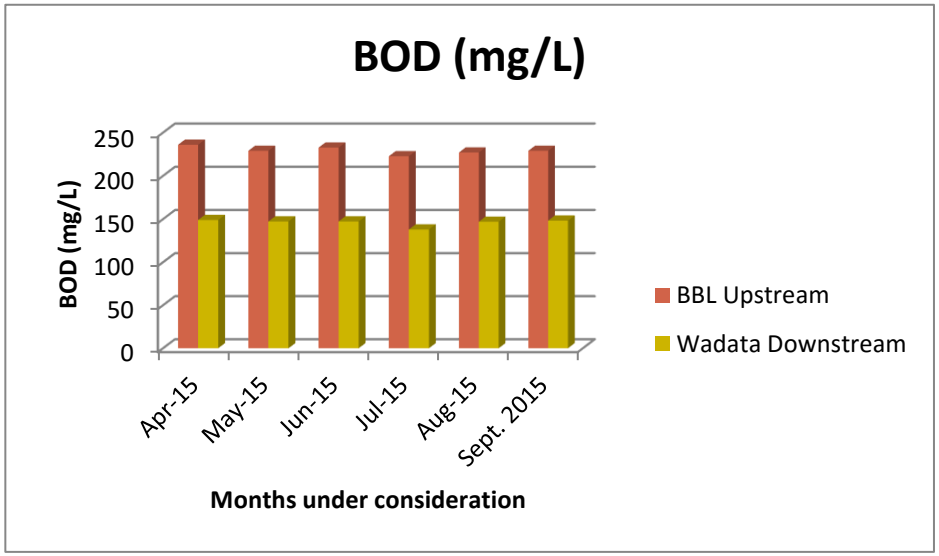


Fig. 6 Plot of the Biological Oxygen Demand for the water samples

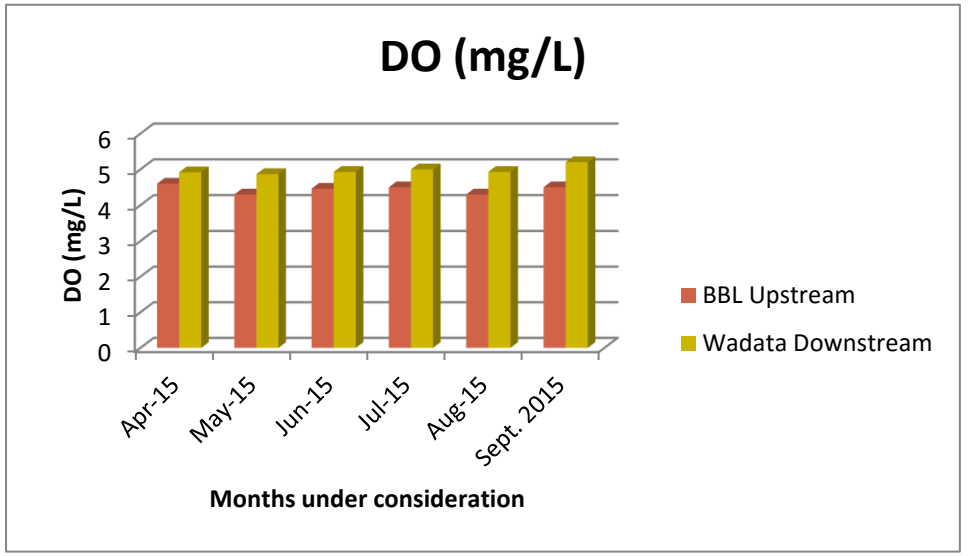
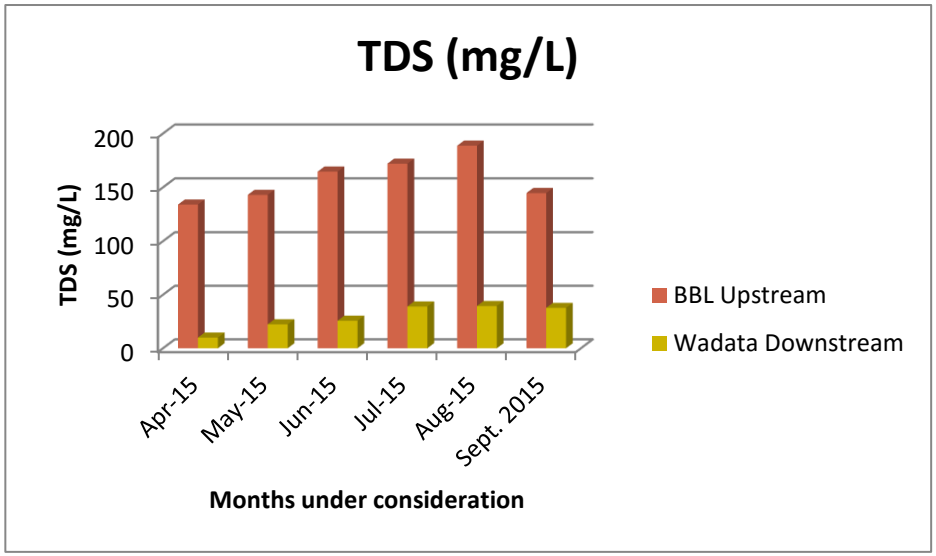
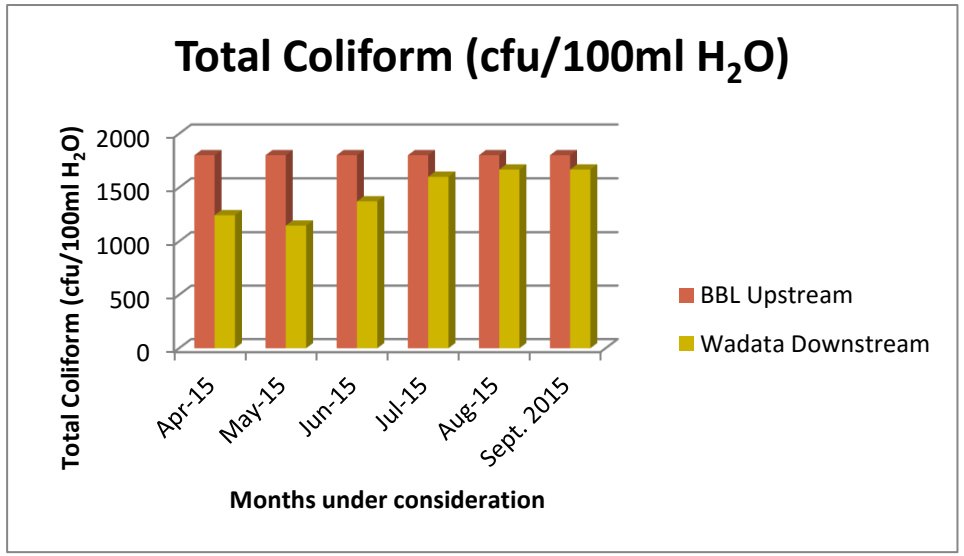
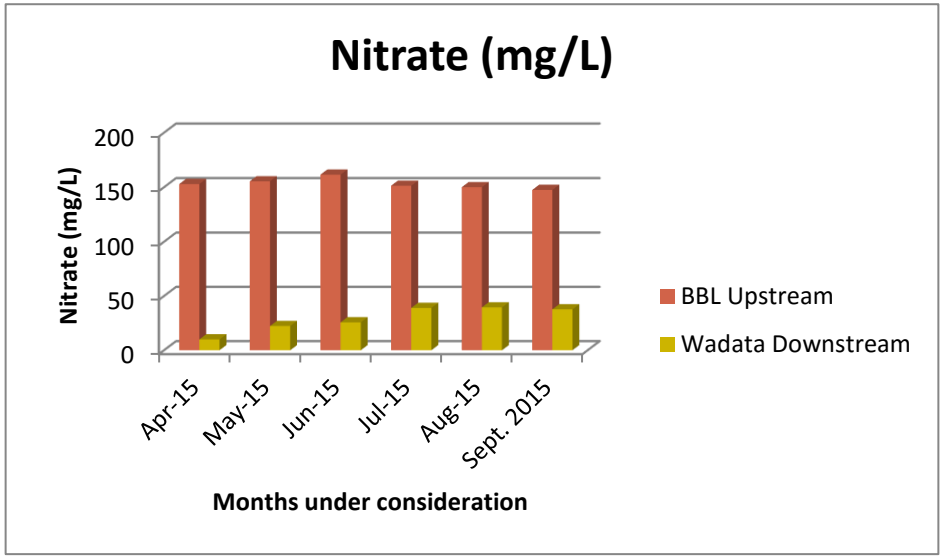


Fig. 7 Plot of the Dissolved Oxygen Test for the water samples







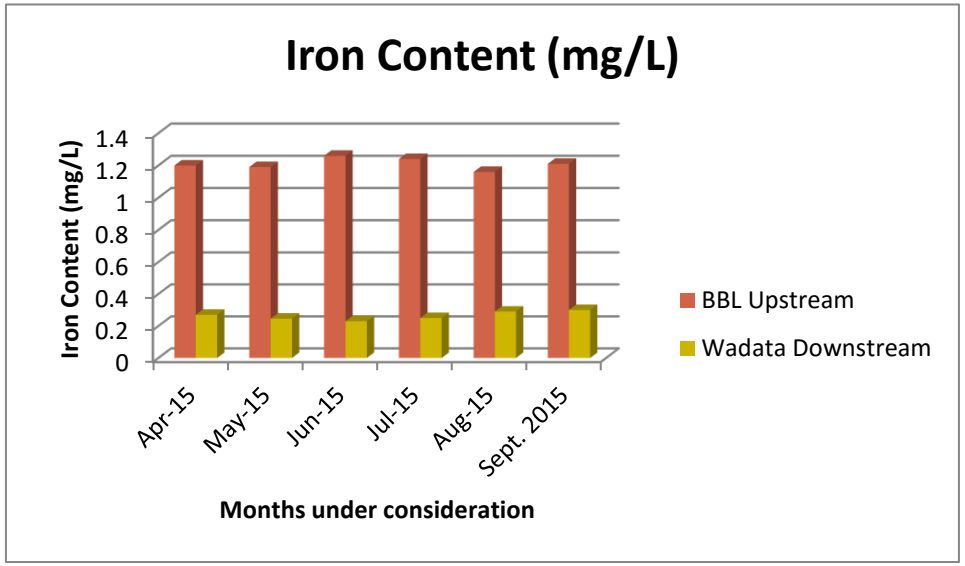


Fig. 8 Plot of the Total Dissolved Solids for the water samples

Fig. 9 Plot of the Total Coliform for the water samples

Fig. 10 Plot of the Nitrate content for the water samples

Fig. 11 Plot of the Iron content for the water sample

4.0 Conclusion

This research has shown that the river under study, River Benue at Makurdi Reach, has the capacity to purify itself over distance. It has also been revealed that wastes/wastewater from the Nigerian Bottling Company and Benue Brewery Limited in Makurdi are heavily discharged into the river without adequate pre-treatment of such waste/wastewater effluent before discharging same into the river.

5.0 Recommendations

The following recommendations have therefore been put forward to help promote the health of River Benue to prevent the outbreak of water borne diseases and water related diseases within the community where the direct use of this river water may be common:

i. Proper disposal of animal and human wastes will help in reducing microbial pollution.
ii. NBC and BBL should implement FEPA (2003) guidelines by treating their wastes to meet the minimum standards before discharging into the river to minimize chemical pollution.
iii. Public enlightenment campaigns should be intensified to educate the people on the dangers inherent in taking water from the river without any form of treatment.
iv. Regular water quality assessment of rivers should be carried out periodically and reports made available. Rapid assessment of water quality can be done by relevant agency like the Department of Water Quality and Sanitation, Federal Ministry of Water Resources.

List of Abbreviations

BBL……Benue Brewery Limited
BOD……Biochemical Oxygen Demand
COD……Chemical Oxygen Demand
DO……Dissolved Oxygen
NBC……Nigeria Bottling Company
TDS……Total Dissolved Solids
WHO……World Health Organization

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