PRELIMINARY ASSESSMENT OF PHYSICO - CHEMICAL PARAMETERS OF RIVER KUNKO, DABBAN, NIGER STATE, NIGERIA

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ABSTRACT

Study on the effects of human activities on the physico- chemical parameters of River Kunko, Dabban, Niger State was carried out from April, 2016 to July, 2016 which coincide with the raining season. Turbidity (63.26NTU) and temperature (29.11°C) were greater than permissible limits of FEPA (0 -1NTU) and WHO (25°C) respectively for domestic use. Dissolved oxygen (5.30mg/l), Conductivity (86.86 µS/cm), total hardness (32.05mg/l), nitrate (0.62mg/l), total alkalinity (27.79mg/l) and phosphate (0.49mg/l) fell below WHO (2008) tolerable levels, while chloride ion (48.24mg/l) fall within the range allowable for drinking water. There was significant difference (P<0.05) in depth at the various stations, and also in turbidity, temperature, pH, conductivity, chloride, nitrate and transparency between the months. The water of the river was slightly acidic (6.46±0.22) and showed traces of pollution that could pose health concern in the near future. It is recommended that continuous monitoring of water quality parameters should be done for the river. Water from the river should not be consumed without prior treatment.

Key words:- *Human activities, Drinking water, Physico-chemical Parameter, River Kunko*

INTRODUCTION

Water constitutes one of the most precious natural resource without which no form of livelihood is possible. Therefore, quality and quantity of accessible water must be studied to arrive at possible concept of sustainable development. Bamgbose and Arowolo (2007) reported that since scarcity of water is on the increase, there is need for planning, monitoring and management of the existing water bodies. Rivers have become the focal point of much activities and primary candidates as a sink for wastes from all kinds of human activities (Agbede, 1991).

This has resulted to pollution, which is a major problem facing most developing nations including Nigeria. It is a common practice for people living along the river banks to discharge their domestic wastes as well as human excreta into such river. According to Jain (2009), wild and domestic animals drinking from the water can also contaminate the water through direct defecation and urination. Poor drinking water has led to numerous health problems such as diarrhoea, cholera and guinea worm (Jain, 2009). In order to mitigate the impact of human activities on natural waters, it is becoming increasingly important to implement comprehensive monitoring regimes (Bellingham, 2012). However, information on the quality of River Kunko is relatively scanty, which is of great concern. The river is a major source of water to Dabban community because it is used for drinking and other domestic purposes. However, human activities such as washing, bathing, indiscriminate disposal of wastes in water course, and farming activities around the river could pollute the water. This could pose health concern to the people of the community. This study tends to determine the physico-chemical parameters of the river and compare with allowable limits of Federal Environmental Protection Agency FEPA (1998) and World Health Organization WHO (2008).

MATERIALS AND METHOD

Study Area

Dabban Community is located in Lavun Local Government Area of Niger State, Nigeria which lies between latitude: $9^0 16^{'} 03.79^{''}$N and Longitude: $5^0 44^{'} 20.96^{''}$E. Major farming activities that take place include cultivation of guinea corn, banana, and fish farming and the domestic activities include washing of cloth, plate and bathing.

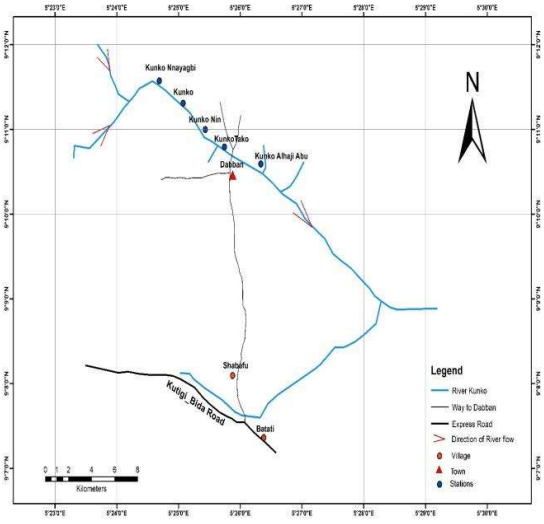

Figure 1: Showing the samplings station on River Kunko, Dabban, Niger State, Nigeria

Sampling stations and Water collection
Water sample were collected from five sampling stations (Kunko Nnayagbin, Kunko Egbako, Kunko Langifu, Kunko Zukomitsun, Kunko Alhaji Abu) on the River Kunko bimonthly from April, 2016 to July, 2016.

DETERMINATION OF PHYSICO – CHEMICAL PARAMETERS

Dissolved oxygen and temperature determination: Dissolve oxygen was determined in mg/l, using dissolved oxygen meter (Jenway 9150). Temperature was determined on site at the time of samples collection using mercury in glass thermometer calibrated in Degree Centigrade. This is in accordance with HACH company laboratory manual (1992).

pH determination: The pH of the samples was determined using Eco Test pH Meter. pH meter was calibrated at 7.0 using buffer solution before measurement. (HACH company laboratory manual, 1992)

Conductivity determination: Electrical conductivity meter (Search Tech, DDS – 307, Manufacture and Model Number) was used to determine the conductivity of water samples. This is done in accordance with HACH company laboratory manual (1992).

Turbidity determination: Turbidity was determined using Turbidimeter (Lovibond turbidirect Model 13/2028) as described by HACH Company Laboratory Manual (1992). A 10 ml of each sample was measured into the curvette of turbidity meter and the respective reading taken. This was done three times and the mean value taken.

Chloride ion determination: The titrant (Silver nitrate[$AgNO_3$]) is titrated against the analyte (water sample) contain potassium dichromate as an indicator, and observed the colour change from yellow to brick red (end point) as described by APHA (2005).

Total hardness and Total alkalinity determination: The titrant EDTA (Ethylene diaminetetraacetic acid) is titrated against the analyte (water sample) contains Net solution (Eriochrome black T) and K10 buffer as an indicator and observed the colour change purple light blue (end point) (APHA (2005). The titrant (Alkalimetric reagent) is titrated against the analyte (water sample) contain Methyl orange as an indicator and observed the colour change from yellow to sunset orange (end point (APHA (2005).

Transparency determination: Transparency was determined using Secchi disc. Transparency was measured by gradually lowering the Secchi disc at respective sampling stations. The depths at which it disappears (A) and reappears (B) in the water were noted. The transparency of the water was computed as follows,

Secchi disc light penetration = A + B / 2

Where, A = depth at which Secchi disc disappears.

B = depth at which Secchi disc reappears.

Trace element determination: Nitrate and Phosphate determination were done using spectrophotometer and the reading was recorded (APHA (1985). Sulphate and Iron were also determined using spectrophotometer and the reading recorded (APHA (1985).

STATISTICAL ANALYSIS
Analysis of variance (ANOVA) was used to test for differences at 5% level of significance. Duncan Multiple Regression was used to separate the means where necessary.

RESULTS AND DISCUSSION
Turbidity (63.26 NTU) recorded (Table 1) was higher than WHO standard of 5 NTU and FEPA (0-1NTU) for domestic use. This did not meet up with the standard guidelines. This could be due to the suspended materials because turbid water has many suspended particles such as silt and clay/mud. According to DWAF (1998) turbid water is usually associated with microbiological contamination. Conductivity (86.86µS/cm) recorded was lower than WHO recommended value of 1250 µS/cm. Andem *et al.* (2012) reported value of 288.76 µS/cm, which was higher than the value of this study. This could be due to the difference in total ions, degree of dissociation and season. The conductivity of River Kunko, Dabban fall within the range 50 - 600µS/cm. This is in line with the findings of Andem *et al.* (2012), who recorded a similar conductivity range value (48 - 600µS/cm) in Ona River, Oyo State. Also total hardness (32.05mg/l) was lower than WHO recommended values of 500mg/l for freshwater. Andem *et al.* (2012) recorded 109.96mg/l total hardness in Ona River, Oyo State. This observation could be due to high concentration of calcium and magnesium ions in the water and utilizing these ions by organisms decrease hardness (Mustapha, 2008). Chlorides concentration of 48.24 mg/l recorded was higher than 0.12mg/l, 1.17mg/l and 0.095mg/l reported by Ugwu and Wakawa (2012) from River Usman, although falls within the range allowable for drinking water (<250mg/l). Phosphate and nitrate are important element that occurs in natural and in

waste water. Phosphate (0.49mg/l) and nitrate (0.62mg/l) were less than the WHO recommended of 6.5mg/l and 50mg/l respectively. The low concentrations could be due to rate of water flow, dilution level and poor algal bloom. Dissolved oxygen (5.30 mg/l) was greater than that of Andem *et al*. (2012) that reported 2.80mg/l. Unpolluted water has dissolved oxygen ranged between 8 and 10mg/l (Rao, 2005). There is trace of pollution, which could be due to high human activities, photosynthesis or diffusion from atmospheric air. Total alkalinity is the buffering capacity of water. 27.79mg/l reported in this study was less than the acceptable range of 30-500mg/l for natural waters. Mean alkalinity (77.5mg/l) was reported by Andem *et al*. (2012), which is higher than the findings of this study. High alkalinity in water is undesirable because it is associated with excessive hardness. The temperature (29.11°C) was greater than 25°C recommended by WHO but fall within the acceptable range (21°C and 32°C) as reported by Olukunle (2000) for aquatic life in tropical waters. Temperature of any water body is dependent upon the sun light, climate and depth according to Atobatele and Ugumba (2008). The pH value obtained (6.46) shows that the water was slightly acidic. This was less than the WHO standard for drinking water (6.5-8.5). pH of water is very important for many biological activities and any variation beyond acceptable range could be fatal to organisms.

Mean water quality parameters varied at the various stations in River Kunko, Dabban (Table 2). Transparency between stations was not significantly different ($P>0.05$), with highest value at Kunko Nnayagbi (7.58 cm) and lowest at Kunko Langifu (6.53cm). Oso and Fagbuaro (2008) reported that decrease sunlight intensity due to heavy cloud in the atmosphere reduce the quantity of light reaching the water. This could also be the reason for such observation in addition to run-off or flood caused by higher amount of rainfall. Mean temperature did not show significant difference ($P>0.05$) between the stations with highest at Kunko Nnayagbi (29.19°C) and lowest at Kunko Zukomitsun (29.06°C). This could be due to the cooling effects of the rains and high relative humidity that reduce evaporation of water. The result agreed with the findings of Ayoade *et al.* (2006) that reported temperatures in tropics to vary between 21°C and 32°C. Conductivity in natural water is influenced by dissolved salts such as potassium and sodium chlorides. The absence or low concentration of these salts could be the reason for the insignificant differences observed between stations. Turbidity values recorded at these stations were not within the recommendation of WHO, though Kunko Nnayagbi had the highest mean (80.67mg/l) and lowest at Kunko Zukomintsun (44.75mg/l). This could be due to run-offs and other human activities such as washing, bathing and source of drinking water for animals. Nitrate levels at the stations did not differ significantly ($P>0.05$) between the stations. Nitrate is among the important parameter of river water showing the pollution status and anthropogenic load in river (Khan and Khan, 1997). Source of nitrates include fertilizers, livestock and waste water discharges. Although these activities were going on around and in the river, the concentration is still within the tolerable level. The values of chloride observed at the stations were not significantly different ($P>0.05$), and less than the recommendation of WHO. Therefore, chloride contents in the river did not pose any health concern at the stations. The highest depth was recorded at Kunko Zukomintsun (50.06cm) and lowest at Kunko Langifu (12.00cm). The significant difference ($P<0.05$) could be due to the gradient of the river, volume of water received from source or siltation.

Monthly variation in physico-chemical parameters is a common observation in aquatic environment. The highest turbidity recorded in July, followed by June and lowest in April, which differ significantly ($P<0.05$) could be due to increase in rainfall that causes high runoffs (Table 3). The lower turbidity experienced in April was probably due to the onset of the rains. Highest temperature (30.12°C) was recorded in April and the lowest was in May (27.90°C), which also show significant differences ($P<0.05$). This could be due to progression in rainfall increase, which also increase water level. Conductivity increases from April (44.51µS/cm) to July (109.32µS/cm). Asuquo (2000) reported conductivity of freshwater to range from 10µS/cm - 1000µs/cm but can exceed 1000µS/cm. This is within the range recorded during the study. The gradual increase of conductivity with time could be due to the uptake of ions by organisms for their metabolism as reported by Mustapha and Omotosho (2005) or increase in suspended solids and ions. The significant difference ($P<0.05$) of pH observed could also be due to dilution as a result of increase in water level. Chloride ions increased in May and decreased in June through July, which also differ significantly ($P<0.05$). Ugwu and Wakawa (2012) reported chloride ions for wet season as 1.17mg/l, which was lower than values for this study. Nitrate also follow the same pattern with chloride and also differ significantly ($P<0.05$). This observation could be due to increase in water volume, which resulted to more dilution. This is a common phenomenon often observed in many freshwater bodies. Also, Ovie and Adeniji (1993) reported high nitrate during low water level, which was attributed to calm water and low water level that favours settlement of suspended materials and dissolved salt concentration in Shiroro Lake. River

Kunko, Dabban is at the stage of turbulence, hence low nitrate concentration. Transparency decreased across the months, which differ significantly ($P<0.05$). This may be due to increased rainfall that resulted in more mixing thereby making the water more turbid.

CONCLUSION AND RECOMMENDATIONS

This study gave an insight of the physico-chemical parameters of River Kunko, Dabban. Turbidity and temperature were not within the suitable range for aquatic organisms and drinking water as recommended by WHO. Conductivity, total hardness, chloride, pH and dissolved oxygen were below the recommended levels. It is therefore recommended that continuous monitoring of water quality parameters of the river should be done; water from the river should not be consumed without prior treatment. Further study is also hereby recommended to cover the dry season, since the present study was conducted in the rainy season.

Table 1: Mean water quality parameters of River Kunko, Dabban, Niger State, Nigeria

Parameter	Minimum – Maximum	Mean ± Standard Deviation
Turbidity (NTU)	6.23-152.00	63.26±48.78
Temperature (°C)	26.9-30.8	29.11±0.98
pH	5.9-6.8	6.46±0.22
Dissolved oxygen (mg/l)	4.10-8.21	5.30±0.69
Conductivity (US/cm)	35.70-114.00	86.86±26.62
Total hardness (mg/l)	14.00-74.00	32.05±15.10
Total alkalinity (mg/l)	22.00-44.00	27.79±5.18
Chloride ion (mg/l)	12.60-113.60	48.24±28.51
Phosphate (mg/l)	0.24-0.57	0.49±0.10
Nitrate (mg/l)	0.20-1.50	0.62±0.47
Transparency (cm)	5.00-9.50	7.37±1.04
Depth (cm)	5.00-62.80	30.97±16.23

Table 2: Mean water quality parameters of sampling stations in River Kunko, Dabban, Niger State, Nigeria

Parameter	Kunko Nnayagbi	Kunko Egbako	Kunko Langifu	Kunko Zukomitsun	Kunko Alhaji Abu
Turbidity (NTU)	80.67±65.80	67.69±51.08	51.21±37.50	44.75±31.24	72.01±54.03
Temperature (°C)	29.19±1.13	29.03±0.90	29.06±0.97	29.19±1.01	29.10±1.15
pH	6.54±0.28	6.38±0.22	6.44±0.18	6.50±0.21	6.45±0.19
Dissolved oxygen (mg/l)	5.44±0.32	5.25±0.22	4.87±0.68	5.38±0.76	5.55±1.09
Conductivity (µs/cm)	88.34±29.40	83.55±26.28	85.78±26.77	88.33±29.24	88.29±28.33
Total hardness (mg/l)	41.25±16.21	27.50±15.25	28.00±14.26	34.75±10.70	28.75±17.26
Total alkalinity (mg/l)	29.25±4.89	26.13±5.99	27.13±6.03	29.63±6.19	30.24±8.55
Chloride ion (mg/l)	45.43±32.47	52.84±35.25	44.90±21.87	44.29±18.65	53.76±36.15
Phosphate (mg/l)	0.51±0.09	0.45±0.12	0.48±0.09	0.51±0.11	0.50±0.10
Nitrate (mg/l)	0.69±0.51	0.58±0.54	0.63±0.39	0.66±0.52	0.54±0.47
Transparency (cm)	7.58±0.89	7.56±1.17	6.53±0.95	7.54±1.03	7.64±0.97
Depth (cm)	17.63±6.21	34.74±7.94	12.00±5.32	50.06±12.05	40.44±6.46

Table 3: Mean monthly water quality parameters of River Kunko, Dabban, Niger State

Month	April	May	June	July
Turbidity (NTU)	7.38±1.37	65.17±41.61	69.11±42.06	111.4±26.83
Temperature (°C)	30.12±0.48	27.90±0.69	29.09±0.74	29.34±0.35
Ph	6.23±0.28	6.44±0.10	6.56±0.12	6.61±0.10
Dissolved oxygen (mg/l)	5.77±1.14	5.19±0.46	5.26±0.19	4.97±0.41
Conductivity (µS/cm)	44.51±8.54	95.41±11.93	98.18±7.95	109.32±3.88
Total hardness (mg/l)	39.80±26.24	29.40±9.29	30.40±7.78	28.60±7.92
Total alkalinity (mg/l)	31.25±8.93	26.20±2.57	26.50±2.32	27.20±2.53
Chloride ion (mg/l)	29.53±19.20	65.46±32.38	63.28±30.40	34.70±2.71
Phosphate (mg/l)	0.42±0.15	0.51±0.09	0.50±0.08	0.54±0.01
Nitrate (mg/l)	0.31±0.12	0.90±0.54	0.89±0.54	0.37±0.07
Transparency (cm)	8.73±1.78	7.10±0.16	7.03±0.13	6.97±0.12
Depth (cm)	20.44±12.22	29.60±15.68	35.39±15.89	38.46±16.85

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