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Assessment of the Spatio-temporal environmental parameters of surface water in Gurara reservoir, Kaduna state, Nigeria

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Abstract
Water is one of the main concerns in developing countries. In order to deal with this problem, an assessment of the spatio-temporal environmental parameters of surface water of Gurara Reservoir in Kaduna State was studied for twelve months from (March 2017-February, 2018). The physico-chemical parameters were determined monthly using standard methods. They includes water and air temperature, pH, Dissolved oxygen (DO), biological Oxygen demand (BOD), Nitrate (No_3^-N), phosphorus (Po_4^-P), Total Hardness (TH), Potassium (K), Sodium (Na), Total dissolved Solid (TDS) and depth. All results were analyzed using descriptive analysis and analysis of variance (ANOVA). Principal component analysis (PCA) was use to correlate the physico-chemical variables among the stations and months. All the parameters fluctuate between the stations. These was mostly noted within the seasons and most of the values increase as a results of influx of municipal waste, runoff from agricultural fields, herbicides and pesticides, deforestation and other chemicals. Although most of the environmental variable values recorded were within the standard permissible limits set by Nigeria Industrial Standard (NIS, 2007) and (WHO, 2014), few stations within the reservoir are inclined toward eutrophication, therefore, the conservation and management of this water body is very much required.

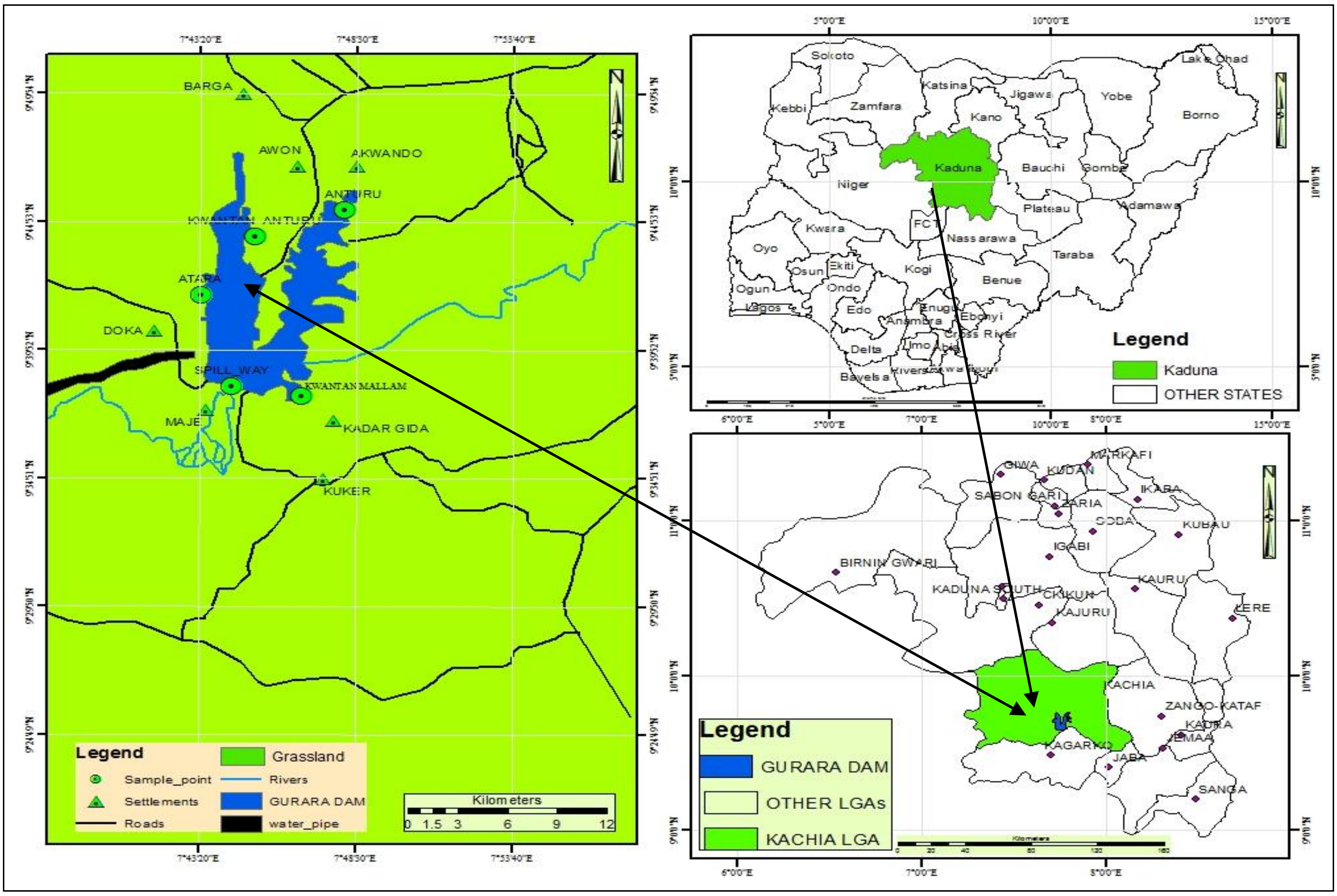
Keywords: Spatio-temporal, environmental parameters, surface water, reservoir

Introduction

Lakes and reservoirs constitute very important nursery and breeding grounds for a large variety of fish species, making it crucial to feeding millions of people around the globe. However, these have being over-exploited, and the environment also ecologically degraded. (Ajani and Omitoyin, 2004) [3]. The major causes of species decline in these ecosystems as reported by Ajani and Omitoyin are anthropogenic activities such as chemical and pesticides released by agricultural activities, effluents discharged from aquaculture, solid wastes dumped from residential areas and harvesting of juvenile fishes by artisanal anglers. According to Kirsten, (2011) [16] environmental conditions influence fish distributions, communities and seasonal movements. In addition, Decline water quality due to environmental upset threatens the stability of the biotic integrity and therefore hampers the ecosystem services and functions of the aquatic ecosystems. (Carini, *et al*, 2014) [7] Water Resources Institute WRI, (2001) [32] reported that there are urgent demands for comprehensive methodological approaches to evaluate the actual state of these ecosystems and to monitor their rate of changes. Physical and chemical measurements commonly form the basis of monitoring, because they provide complete spectrum of information for proper water management (Onah, 2007) [24]. However, in lotic waters, where changes in hydrology are rapid and difficult to estimate, they cannot reflect the integration of numerous environmental factors and long-term sustainability of river ecosystems for their instantaneous nature. As a result, the ability of freshwater ecosystems to provide clean and reliable sources of water, maintain the natural water cycle and the biological food web as well as provision of food and recycling of nutrients has been severely impaired (Hassan *et al.,* 2009) [11]. Monitoring water quality of Gurara reservoir would provide information on management and sustaining the aquatic ecosystem. This serve to monitor change in Physical and chemical conditions of the reservoir, which could help to initiate policy for overall management of the ecosystem health and it productivity.

Methodology

Water sampling the water sample for physicochemical parameters were collected on monthly basis for a period of twelve months (March 2017-February, 2018) from five stations (Kwatan Mallam, Anturu, Kwatan Anturu, Atara and Spill-way) within the reservoir based on accessibility. Sample collection was in 200mls reagent bottles properly cleansed with de-ionized water prior to usage. Sampling was conducted by careful immersion of the sample containers in the lentic water. The containers were seal with tight fitting corks after collection in order to avoid air bubbles. Samples were transfer to a refrigerator (4°C) prior to analysis.



Source: Remote Sensing/ Geographical information system (GIS) Laboratory, Geography Department, FUTMINNA, (2017)

Fig 1: A. Map of Nigeria showing Kaduna state B. Map of Kaduna State showing Kachia local government C. Hydrological map of Gurara Reservoir

Sample preparation and the determination of physicochemical variables

Water samples were process according to the method prescribed by the American Public Health Association (APHA, 2014). The pH, Electrical conductivity (EC) and Total Dissolved Solids(TDS) of the water samples were tested using pre-calibrated pH, TDS and conductivity meter *in-situ* with (Hanna microprocessor pH/EC/TDS meter), while the determination of dissolved oxygen (DO), was determined *in-situ* using a portable dissolved Oxygen analyser, model JPB-607. Similarly, Air/water temperatures of the reservoir were determined with a mercury-in-glass thermometer *in-situ* and the reading expressed in degrees Celsius (°C). Collected and preserved water sample was use to test the nitrate (NO_3), phosphate (PO_4), hardness, alkalinity, Biological Oxygen Demand (BOD), potassium and sodium using Standard methods.

Statistical Analysis

Prior to analysing the data in the different statistics software employed in this study, the raw data were enter into Excel (Microsoft 2007 office) and copied to relevant packages. Descriptive Statistics and Analysis of variance (ANOVA) was use to calculate the mean and Standard deviation of the physicochemical variables. In addition, Principal component Analysis (PCA) using PAST programme was use to correlate the water quality among stations. Ho, R. (2006).

Results

Correlation of water quality parameters among Stations

Principal Component Analysis (PCA) obtained showed five principal components (PCs) Table 1 and 2 explained 100% Total variance and Eigene values. The first principal component explained 99% of total variance as well as Eigene value of 1657.47 and was best represented by Total Alkalinity (28.21); Total hardness (30.043); water temperature (25.199); Air temperature(32.243); Depth (17.28) at Kwatan Mallam. The second principal component explained 0.36% of Total variance and Eigene value of 5.95214 and was loaded primarily by Total Dissolved solids (-5.5998); Air and Water Temperature (1.5918 and 1.8454) respectively; Dissolved Oxygen (0.63187); Total Alkalinity (4.3616); Total Hardness (3.1629); pH (0.13424); Biological Oxygen Demand (0.96689); and Depth (1.8746) at Anturu. The third principal component explained 0.05% variance and Eigene value of 0.849293 and best loaded by pH (0.45602); Biological oxygen demand (0.054027) at Kwatan Anturu. The forth principal component (pc) explained 0.03% variance and 0.429009 Eigene value loaded by Po_4.P (-0.09902); Potassium (-0.07876); pH (0.15828) and Biological oxygen demand (-0.03772) at Atara. Fifth principal component (pc) explained 0.00% variance and 0.009884 Eigene value and slightly loaded in pH (0.035489) and influence positively by Biological oxygen demand (0.14975); Depth (0.065016); Total Alkalinity (0.10429) at Spillway.

Table 1: Correlation of water quality parameters among Stations

Parameters	Station1	Station2	Station 3	Station 4	Station 5
Air- tempt(°C)	32.243	1.5918	0.92599	0.60126	-0.08906
Water tempt(°C)	25.199	1.8454	-0.46145	-0.12153	-0.22821
E.Cond(µs/cm)	35.283	1.2202	0.18477	0.05296	0.07417
TDS(ppm)	103.17	-5.5998	-0.35856	-0.04679	0.035944
PO_4-P(mg/l)	-34.804	-1.2116	-0.15422	-0.09902	0.015423
DO(mg/l)	-26.514	-0.63187	-0.10455	-0.16697	0.090699
No_3^- N(mg/l)	-33.583	-1.1682	-0.19264	-0.03626	-0.01372
T/Alkalinity(mg/l)	28.207	4.3616	-2.2494	0.58403	0.10429
T/Hardness(mg/l)	30.043	3.1629	0.81302	-1.8884	0.05117
Potassium(mg/l)	-32.618	-1.1158	-0.1643	-0.07876	-0.0983
Sodium(mg/l)	-25.606	-0.7877	-0.29952	0.084894	-0.04432
pH	-17.345	-0.13424	0.45602	0.15828	0.035489
BOD(mg/l)	-30.39	-0.96689	0.054027	-0.03772	0.14975
Depth(m)	17.28	1.8746	1.9203	1.0999	0.065016

Key: Air-tempt=Air-Temperature; E.cond=Electrical Conductivity; TDS=Total dissolved solids. $P0_4$-P=Phosphorus; DO=Dissolved Oxygen; No_3-N=Nitrate; BOD=Biological oxygen demand.

Table 2: Percentage Variance (%) and Eigene value of vectors of PCA.

PC	Eigene value	% variance
1	1657.47	99.565
2	5.95214	0.35755
3	0.849293	0.051017
4	0.429009	0.025771
5	0.009884	0.000594

Correlation of water quality parameters among Stations using principal component analysis.

Principal component analysis was use to correlate physico-chemical variables amongst the five stations studied for twelve months (March 2017-February 2018) (Figure 1). It was establish that multivariate analysis such as PCA bi-plot has the potential to explain the interaction of water qualities between the stations, (Marziali, *et al*, 2010) [18]. All stations have a positive relationship amongst the physico-chemical parameters except station 2(Anturu) which is negatively correlated in potassium (k), Nitrate (No_3-N), Electrical Conductivity (EC), Biological Oxygen Demand (BOD), and slightly Phosphorus (Po_4-P). However, all the stations have close relationship with Total dissolved solids (TDS) having a negative relation with other variables at station 2 (Anturu). This is a result of the rate of perturbation associated with anthropogenic activities along the bank of the station (being a landing site for local fishermen) Auta, *et al*, (2016) [5].

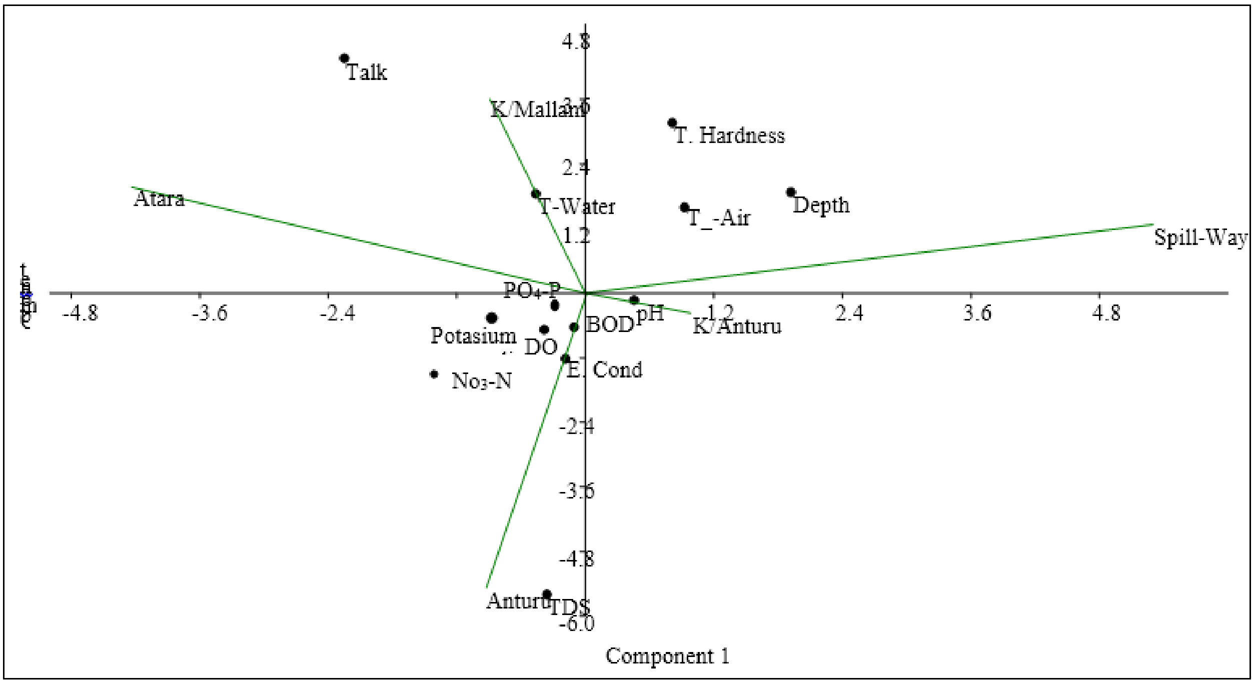


Fig 2: Principal component Analysis (PCA): correlation of physicochemical parameters among stations

All water quality parameters (pH, DO, BOD, Electrical Conductivity, Po_4^-P, No_3-N, Temperature (Water/Air), Total Dissolved Solids(TDS), potassium(k^-), Sodium(Na^-),Total Alkalinity(T.A), Total Hardness(T.H) were examined and there values are seen in Table 3. pH in all the stations are within the maximum permitted limit set by the Nigerian industrial standard (NIS,2007) and World health organization (WHO, 2011) [33] with a ranged value of 6.5-8.5. Electrical conductivity had a ranged value of 33.03-34.04μs/cm in all the stations, which is below the acceptable limit by NIS, (2007) and (WHO, 2011) [33]. TDS range in all the stations was significantly different (p>0.05) between the Stations with a range values of 40-80ppm(station1),48-178ppm, (station2), 50-109ppm (station 3), 49-79ppm (Station 4), and 25-102ppm (Station5).All Station were below the maximum limit set by NIS,(2007). Air Temperature was not significant different amongst the stations with a minimum range of 21.2-38.5(°C) (station3) and a maximum of 25.4-37.1(°C) (station 2). Similarly, water temperature had no significant differences (p<0.05) between the stations with a minimum range of 18.5-31.3(°C) (station3) and a maximum of 22.3-32.5(°C) (station2). DO was 2.5-6.2mg/l (station 1), 2.4-5.8mg/l (station2), 3.1-4.6mg/l, (station 3), 3.0-4.7mg/l(station4), and 2.6-7.0mg/l(station5). BOD range among the stations was generally low with a minimum of 0.7-4.4mg/l (station2) and a maximum of 1.3-4.4mg/l(station 5). Depth was slightly different among the stations with a minimum of 15.29cm (station4) and a maximum of 18-29cm (station1). No_3^-N was generally low within the stations with a minimum value of 0.19-4.3mg/l (station3) and a maximum value of 0.32-4.5mg/l (station1). All values were below acceptable limit set by WHO, (2011) [33] and NIS,(2007). Po_4^- P has no significant different (p<0.05) among the stations with low values record in all the stations. Minimum is 0.06-1.2mg/l (station1) and a maximum of 0.09-1.22mg/l (station5). Total Alkalinity values recorded were within maximum permitted limits of NIS, 2007(30-500mg/l) and (WHO, 2011) [33], the minimum range values was (10-53mg/l) and maximum was (18-49mg/l). Total Hardness was not significantly different (p<0.05) between the stations and months with minimum range value of18-53mg/l (station2) and maximum of 22-66mg/l (station1). Potassium (k) the value were generally low in all the stations with no significant different between the stations minimum range value of 0.6-1.8mg/g (station1) and maximum value of 0.1-2.3mg/g (station5). Sodium (Na^+) had no significant different (p<0.05) between the stations and months and values are low when compared with maximum permitted limits of NIS, (2007) and (WHO, 2011) [33], (200g). The minimum range values was 0.25-6.3mg/g (station4) and maximum value 0.38-67mg/g (station2).

Table 3: Stations

Parameters	K/Mallam	Anturu	K/Anturu	Atara	Spill-way	F-value		P-value	
						Month	Station	Month	Station
pH	8.05±0.82	8.17±0.84	7.85±0.95	7.65±1.11	8.65±0.74	46.87	2.82	1.5	0.06
	(5.1-9.7)	(5.1-9.6)	(3.9-9.6)	(3.1-9.5)	(5.3-10)				
E.Cond(μ/cm)	36.85±0.93	36.75±1.06	37.95±1.15	38.26±1.18	37.16±0.94	2.01	2.58	5.75E-15	0.12
	(33.5-41.4)	(31.5-42.1)	(31.5-42.5)	(32.5-43.5)	(32.3-41.7)				
TDS (ppm)	55.83±2.67	72.75±11.09	62.67±4.69	59.33±2.98	57.83±6.27	2.23	1.22	0.04	0.32
	(40-80)	(48-178)	(50-109)	(49-79)	(25-102)				
Tempt Air (°C)	29.25±1.19	31.4±0.93	30.26±1.28	30.0±1.32	30.3±1.36	8.34	1.05	2.71	0.38
	(23.5-38)	(25.4-37.1)	(21.2-38.5)	(21.4-36.2)	(22.8-38.4)				
Tempt Water (°C)	26.94±0.76	27.84±0.83	27.28±1.03	27.46±1.01	25.98±0.83	7.99	1.71	4.15	0.19
	(22.0-31.0)	(22.3-32.5)	(18.5-31.3)	(19.9-32.0)	(20.7-30.3)				
DO(mg/l)	4.13±0.31	3.99±0.28	3.88±0.14	3.88±0.16	4.08±0.32	2.72	0.42	0.02	0.74
	(2.5-6.2)	(2.4-5.8)	(3.1-4.6)	(3.0-4.7)	(2.6-7.0)				
BOD)(mg/l	2.27±0.35	2.31±0.27	2.07±0.13	2.04±0.18	2.3±0.28	3.62	1.21	0.03	0.32
	(0.8-5.2	(0.7-4.4)	(1.2-2.8)	(1.3-3.2)	(1.3-4.4)				
Depth(cm)	22.83±0.99	23.58±1.12	23.25±1.23	`23.17±1.46	28.17±2.15	8.14	5.34	3.47	0.04
	(18-29)	(16-29)	(17-28)	(15-29)	(15-36)				
No_3-N(mg/l)	0.79±0.34	0.85±0.35	0.73±0.33	0.78±0.30	0.76±0.31	282.31	1.1	5.23E-37	0.37
	(o.32-4.5)	(0.3-4.6)	(0.19-4.3)	(0.2-4)	(0.22-4.1)				
Po_4-P(mg/l)	0.29±0.12	0.28±0.11	0.18±0.06	0.17±0.05	0.24±0.09	6.49	0.79	2.87E-06	0.54
	(0.06-1.2)	(0.06-1.19)	(0.09-0.73)	(0.07-0.66)	(0.09-1.22)				
T. Alkalinity(mg/l)	29.5±3.64	27.67±3.41	27.75±4.7	30.92±4.54	26.67±4.36	93.78	3.42	8.53E-37	0.37
	(16-50)	(18-49)	(12-52)	(14-54)	(10-53)				
T. Hardness(mg/l)	30.53±3.89	29.67±3.28	30.08±3.51	28.08±2.83	28.42±4.33	40.53	0.78	2.24E-19	0.55
	(22-66)	(18-53)	(22-60)	(20-50)	(18-64)				
Potassium(mg/l)	1.18±0.11	1.26±0.15	1.25±0.11	1.18±0.15	1.16±0.17	19.78	0.44	1.50E-13	0.78
	(0.6-1.8)	(0.6-2.2)	(0.6-2)	(0.6-2.2)	(0.11-2.3)				
Sodium(mg/l)	4.25±0.45	4.54±0.47	4.27±0.41	4.41±0.44	4.18±0.43	49.44	1.14	4.34E-21	0.35
	(0.36-6.3)	(0.38-6.7)	(0.3-5.6)	(0.25-6.3)	(0.28-6.4)				

Mean deviation, minimum and maximum range of physico-chemical parameters of Gurara Reservoir, Kaduna State, Nigeria

Discussion

The summary of standard deviation, Minimum and maximum range of physico-chemical parameters of Gurara reservoir (Table 1) showed slight to wide variation among stations and months of the research period. During the period, Temperature varied from 25.78±0.83°C-27.84±0.83°C. Water temperature is generally high ranging from 18.5-32.5°C that is good for fisheries (Boyd and Tucker, 1998) [6]. The range of water temperature of Gurara reservoir was found within the standard range and higher in dry season at the surface due to higher air temperature. The present observation is similar to the seasonal fluctuation in temperature studied by Sharma,

(2007) [26]. Water temperature has a significant correlation with most water parameters as it influences the quality and diversity of aquatic life (Huq, 2002) [13]. The rise in water temperature at the arrival of dry season is follow by rapid growth of plants and microscopic aquatic animals. Many fish and other aquatic animals breed at this time of the year because they have warmer waters and abundant foods. Togue, *et al*, (2017) [30]. Aquatic organisms are affected by pH because most of their metabolic activities are dependent on it. The mean pH was found to be 7.65±1.11-8.65±0.74 at most of the stations, an indication that the reservoir is alkaline in nature. The alkaline nature of the reservoir water values may be due to sewage discharged by the surrounding villages and agricultural fields. In the rainy season, the highest average pH was observe because in this period sewage and agricultural discharges increase, Kumar *et al*. (2010) [15]. Sewage and agricultural discharges are generally a combination of natural and organic materials and man-made compounds. It contains many fertilizers, metals, sediments, pesticides, herbicides, nutrients, salts, phosphorus, bicarbonates. (Ongley, 2004) [25]. Lowest values of pH (3.1) are associated with depth. The above values usually indicate the presence of carbonates of calcium and magnesium in water, however, this results show that values were within the permissible limit, (WHO, 2011) [33]. Conductivity is a measure of the ability of water to conduct electricity. It dependent on the ion concentration and water temperature (Shinde and Destimush, 2008) [27]. The total load of salts in a water body is related to its conductivity (Mane *et al*, 2013) [17]. The Electrical Conductivity value of the study area varied from 33.03-34.04µs/cm in range. According to the Federal Environmental Protection Agency (FEPA), the sustainable Electrical Conductivity value for aquatic organism is 10.77-12.30µs/cm, Aina *et al*, (1996) [2], WHO, (2011) [33] standard is 1000µs/cm and (NSWQ, 2007) 1000µs/cm. Total Dissolved Solids (TDS) is a measurement of organic salts, organic matter and other dissolved materials in water (Phyllis *et al*, 2007). The value of Total Dissolved Solid in the study area ranged from 25-178 part per million (ppm) and mean value was between 55.83±2.67-72.75±11.09ppm. Water with TDS concentration within 0.1-20ppm is considered as suitable for aquatic life. (ENVIRO SCI INQUIRY, 2000-2011) [33]. The TDS levels recorded in the entire sample stations were within the standard guidelines for the protection of fisheries and aquatic life (Mosummath *et al*, 2017). The palatability of water which has a TDS level of less than 500mg/L is normally considered to be healthy for drinking (WHO, 2011) [33] as the water becomes considerably and gradually more unpalatable at greater levels. The values recorded during this research are less than the maximum permissible limits of 500mg/L. Higher levels of this element in surface water can lead to eutrophication in the long term, (Togue, *et al*, 2017) [30]. Total Alkalinity is a measure of its capacity to neutralize acids water with high alkalinity is undesirable. The values recorded in this research ranged from (10-54) mg/L with a mean value of 26.67+-4.36-30.93+-4.54mg/L. The standard value of alkalinity for river water is 100-200mg/L for fisheries activities (WHO, 2011) [33]. The maximum Total Alkalinity values obtained during the dry season. During these period, the water temperature was high at the surface and the alkalinity show positive correlation with water temperature (Tripathi *et al*, 2014) However, the values obtained were within the standard range and these make the reservoir suitable for aquatic life. Total Hardness is the concentration of ca2+, $mg2^{+}$, Na^{+} and K^{+} and all other minerals typical of freshwater, Chapman and Kimstach, (1996) [8]. Although, relatively high concentrations of this parameters were recorded, the reservoir can be categorized as soft water, since its total hardness was less than 120mg $CACO_3$/L. The mean total hardness 30.53±3.89mg/l $caco_3$, however fell short of the optimal range 75-250mg $caco_3$ for aquatic life. Akindele *et al*, (2013) [4]. The high value recorded during dry season can be link to inflowing sewage and high anthropogenic activities in and around the reservoir. All the values obtained in the research are less than the limits 150mg/L set by NSDWQ (2007) [21] and WHO, (2011) [33]. Dissolved oxygen (DO) content of the Reservoir is influence by the source of raw water temperature, treatment and chemical or biological process taking place in the distribution system. Depletion of DO in water supplies can encourage the microbial reduction of nitrate to nitrite and sulfate to sulfide. It can also course an increase in the concentration of ferrous iron in solution, with subsequent discoloration at the top when the water is aerated. No health base guideline value recommended. The observed range of DO 2.4-7.0 mg/L indicated low oxygen level that agrees with findings of low oxygen level in New Calabar River (Ekeh and Sikoki, 2003). The range is similar to values obtained from other studies such as 6.0mg/L in some months on river chanchaga, Niger state Ojutiku and Kolo, (2011) [22]. The low DO observed is probably due to organic detritus and human interferences particularly at the lowest reaches. The low level could also be due to influx of allochthonous materials during the period of high water. The DO recommended for the survival of aquatic life in tropical water is between 3 and 5mg/L Olukunle, (2000). Nitrate is an integral part of the nitrogen cycle in the environment and can be form when microorganism breaks down fertilizers, decaying plant manures or other organic residues. Although nitrate occur s naturally in most cases higher levels are thought to result from human activities such as fertilizer and manures, animal feed lots and waste, municipal waste water, sludge, septic systems and Nitrogen fixation from atmosphere by legumes, bacteria and lightening. The level of No_3-N in Gurara reservoir ranged from 0.3-4.6 mg/L with no mean significant difference ($p< 0.5$) between the stations and within the months. These values are low when compared with maximum permissible limit set by NIS, (2007) and WHO, (2011) [33] at 50m/L. Adeyemo, *et al*. (2008) also stated that initial rains flush out deposited nitrate from near surface soil and nitrates level reduce drastically as rainy season progresses. Phosphate is one of the principal nutrients that limit productivity of tropical waters. Ekeh and Sikoki, (2003) [9]. The occurrence of phosphate-phosphorus in low concentration in Gurara reservoir is in line with concentration in other unpolluted tropical waters. Sikoki and Veen (2004) [28] recorded low values in shiroro Lake, similar to what is recorded in these research within the research period (March, 2017- Feb, 2018). The observed range of BOD (1.3-4.4mg/L) in the study is higher than some tropical rivers studied Ekeh and Sikoki (2003) [9] recorded 0.2-6.8mg/L values in the Calabar River. The highest range (1.3-5.2)mg/L observed could be attributed to increase decay of organic matter from anthropogenic sources particularly at station 2 (Anturu). The lower value in most of the station depicts the reservoir as clean but slightly polluted in station 2. High values in few stations may also be due to organic load from human perturbations and influx of allochthonous materials from surrounding environment through erosion, Ojutiku and Kolo (2011) [22]. Although the WHO, recommended a BOD limit of 6mg/L the above values are below the permissible limits (WHO, 2011) [33]. However, these values are threatening the health of the Reservoir if not control, as they tend to magnify. Potassium (k) occurs in various minerals from which it may be dissolved through weathering process. It is also source from fertilizer and plants. Being an essential element, it is present in the tissues of all plants and animals. Potassium is applied in many industrial processes such as in alloy and organic syntheses, fertilizer production, glass making, soap making. Waste generated from these production processes is hazardous when discharged on surface water and it is difficult to purify, Shuaibu and Shuaibu, (2016) [29]. Concentration of potassium in the water samples in the result on table 3 below ranges from 0.6-2.3mg/L with a mean of 1.16 ± 0.17 – 1.26 ±0.15 mg/L for dry /rainy seasons. This indicates that the concentration of all the seasons sample fall below the WHO, (2011) [33] permissible unit of 12mg/L. this could be attributed to run off with high-suspended particles and from heavy rainfall. Currently there is no evidence that potassium levels in municipal treated drinking water, even water treated with potassium permanganate are likely to pose any risk for the health of consumers WHO, (2007) [33]. Sodium (Na) is sourced from rocks and soils washed by moving water ending up in ocean, rivers and lakes. Sodium can also be source from deposited wastes. Sodium is a dietary mineral for animals. In humans, it is partially responsible for nerve functions. In these research, sodium concentration range from 0.28-6.4(mg/l) (station 5) which is the lowest mean value recorded and 0.38-6.7(mg/l) (station-2) which is the highest value recorded with a mean lowest value of 4.18± 0.43(mg/l) (station-5) and 4.54 ± 0.45(mg/l) (station-2) highest value recorded. The maximum permissible unit for sodium occurring to both NSDWQ, (2007) [21] and WHO, (2011) [33] standard is 200mg/L and the result above shows that all the water sample have low concentration of sodium compared the maximum unit set by these national and international standard organizations.

Conclusion and Recommendation

In the present Research, It revel that due to presence of impurities in the Reservoir, there were many different parameters found to increased during dry season and have been diluted during rainy season. Therefore, this kind of changes would affect the aquatic environment as increase in nitrogen content would result in eutrophication naturally which leads to decrease in the oxygen content level. Lack of oxygen can cause fish kills and lack of fish enables malaria-hosting mosquitoes, as mosquitoes are natural food for fish. Without oxygen at the bottom at all times, beneficial bacteria and insects cannot biodegrade the organic sediment at bed level of the Research Stations. Purification methods should exist from filtration processes that should be carried out before introducing any foreign material into the water body. Some pollutants are released into the Reservoir, Proper bioremediation techniques should be use to improve the water quality. The present research reveals that nutrient loading is low, when compared with the WHO Standard, but is gradually increasing the rate of eutrophication and may lead to a hyperactive entropic status if not control. The differences observed between stations and Months and other variations in the physico-chemical parameters of the reservoir could be attributed to the site/location of the Reservoir, the amount of precipitation obtained annually as well as the anthropogenic activities taking place around the Reservoir. The physico-chemical parameters analyzed indicated that most of them fall within standard limit set by the Nigeria Industrial Standard (NIS, 2007) for Nigeria and World Health Organization, (2014).

References

1. Adeyemo OK, Adedukun OA, Yusuf RK, Adeleye EA., Seasonal changes in physico-chemical parameters and nutrient load of River sediment in Ibadan city Nigeria. Global NEST Journal. 2008; 10(3):326-336.
2. Aina EOA, Adeleye NO. Water quality monitoring and Environmental status in Nigeria, FEMA, Monograph 6, FEPA, Abuja, Nigeria, 1996, 239.
3. Ajani EK, Omitoyin BO. Effects of Some Anthropogenic Activities on Fish Species diversity In Eleyele Lake, Ibadan. Nigeria African Journal of Livestock Extension. 2004; 3:13-18.
4. Akindele FO, Adeniyi IF, Ndabawa IT. Spatial-Temporal Assessment and Water Quality Characteristics of Lake Tiga, Kano, Nigeria Research Journal of Environmental and Earth Sciences. 2013; 5(2):67-77.
5. Auta YI, Arimoro FO, Mohammed AZ, Ayanwale VA. Monitoring seasonal changes in environmental variables and Chironomid diversity at Shiroro Lake, Niger state, Nigeria. International journal of Applied Biological research. 2016; 7:36-47.
6. Boyd CE, Tucker CS. Pond Aquaculture and Water Quality Management, Klumer Academic Publisher, London, 1998, 87-148.
7. Carini R, De Cesaris MG, Splandore R, Abano E. Stimulation of Map Kinase Reduces acidosis' And sodium Overload In Preconditioned Nepatocytes. Experimental Cell Research. 2014; 419:180-183.
8. Chapman D, Kimstach V. Selection of Water Quality Variables I: Chapman, D. (Ed) Water Quality Assessment, Chapman and Kimstach, London, 1996, 65-122.
9. Ekeh IB, Sikoki FD. The State and Seasonal variability of some physico-chemical parameters in the New Calabar, River, Nigeria Supplementa Ad Acta hydrobiol. 2003; 5:45-60.
10. Environmental Science Inquiry, Lehigh Environmental Initiative at Lehigh University, 2000-2011.
11. Hassan FM, Saleh MM, Salman JM. A Study of Physicochemical Parameters and Nine Heavy Metal in the Euphrates River, Iraq. E-J. Chem. 2009; 7:685-692.
12. Ho R. Handbook of univariate and multivariate data analysis and interpretation with SPSS. London: Chapman & Hall, 2006.
13. Huq ME. A Completion of Environmental Causes of Bangladesh Administered by the Department of Environment ABAE, 2002, 60-63.
14. Jimoh OD, Adodeji OS. Impact of the Gurara River interbasin water transfer scheme on the Kaduna River at the Shiroro Dam, Nigeria. Proc of symposium IAGG2003-Hydrological Risk management and Development, IAHS Publication, Sapolo, 2013, 277-286.
15. Kumar GN, Srinivas P, Changdra JK, Sujathra P. Pollution of Ground Water Potential Zones using Remote Sensing And G.I.S Techniques; A Case Study of Kurma Palli Yagu Basin in Andhva Pradesh, India. International Journal of Water Resources and Environment Engineering. 2010; 2(3):70-78.
16. Kristens CI. Correlations between Fish Abundance and

Physic-Chemical Parameters in Humboldt Bay, California. An unpublished M.Sc dissertation submitted to the department of natural resources and fisheries biology, Humboldt State University, California, 2011, 129.
17. Mane AV, Pardeshi RG, Gore VR, Waleye RE, Manjrekar SS, Sutar GN. Water quality and sediment analysis at selected locations of pavana River of pane district, Maharashtra. Journal of chemical and pharmaceutical Research. 2013; 5(3):91-102.
18. Marziali L, Armanini DG, Cazzola M, Erba S, Toppi E, Buffagni A, *et al*. Responses of chironomid larvae (insect, Diptera) to ecological quality in mediteranean River mesohabitats (south Italy).River Research and application. 2010; 26:1036-1056.
19. Mosummath HA, Nazim MDU. Subhas CS, Utton K. Seasonal variation of temperature dependent Physico-parameters of A Coastal River Bhada, Bangladesh. Journal of tropical Biological Conservation. 2017; 14:69-81.
20. Nigerian Industrial Standard (NIS,). Standard Organization of Nigeria (SON) Quality Standard, 2007.
21. Nigeria Standard for Drinking Water Quality NSDWQ, Nigeria Industrial Standard, Approve by Standard Organization of Nigeria Governing Council. 2007; 20:15-19.
22. Ojutiku RO, Kolo RJ. Temporal and Spatial Variants in Some Physico-Chemical Parameters of River Chanchaga, Niger State, Nigeria. Journal of Applied Biological Science. 2011; 47:3242-32455.
23. Olukunle O. Homestead Pond Management. Published By John Archers (Publishers) Ltd. Ibadan, 2000, 34.
24. Onah FO. Environmental Impact Assessment (EIA) of Gurara Water Transfer Project, Report, 2007, 95.
25. Ongley ED. Control of Water Pollution from Agriculture, Food and Agricultural Organization (FAO) Irrigation and Drainage Paper. 2004; 55:6-13.
26. Sharma KK. Some Limnological investigation in Ganga Stream, Katra, 2007.
27. Shinde AH, Deshinukh BD. Seasonal Changes in Physico-Chemical Characteristics of Zirpunmadi Lake, The 12thWorld Lake Conference, 2008, 1794-1795.
28. Sikoki FD, VEEN JV. Aspects of water quality and potentials for fish production of Shiroro Reservoir, Nigeria. Livestock system, Sustainable Dev. 2004; 2:1-7.
29. Shuabu AM, Shuaibu I. Water quality assessment of Gurara Water Transfer Project and Lower Usman Dam, Abuja Nigeria. International Journal of Centric and Research, Publication, 2016, 6(1).
30. Togue FK, Kuate GLO, Oben LM. Physico-Chemical characterization of the Surface Water of Nkam River Using the Principal Component Analysis. Journal of Material and Environmental Success. 2017; 8(6):1910-1920.
31. Tripathi B, Pandey R, Rathavanshi D, Pandey Y, Shukia DN. Study on the physico-chemical parameters and correlation coefficient of the River Ganga at Holy place shringverpurg, Al Ashland. Journal of environmental science, Toxicology and Food Technology. 2014; 8(10):29-36.
32. World Resources Institute, (WRI, 2001). Part 2: Taking Stock of Ecosystem. In: World Resources Institute (Ed) World Resources Elsevier, Washington, DC, 2000-2001, 43-145.
33. World Health Organization Standard for Drinking Water Quality (fourth Edition) World Health Organization (WHO) Geneva, 2011.
34. World Health Organization (WHO). Potassium in Drinking Water, Background Document Of WHO Guideline For Drinking Water Quality, 2009. WHO/HSE/WSH/09.01/7.