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ASSESSMENT OF POLLUTION STATUS OF KAFIN CHIRI DAMS USING SELECTED PHYSICOCHEMICAL PARAMETERS IN KANO STATE, NIGERIA

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ABSTRACT

Physicochemical parameters of kafin-chiri were investigated for three season to determine the quality of water. Water samples were collected and analyzed using standard methods. Four sampling sites (KFA, KFB, KFC and KFD) were chosen on the Dam based on the

INTRODUCTION

Water is the most essential resource that supports all forms of life that exists on earth. Unfortunately, this resource is not distributed evenly all over the world (Eran 2012). Large quantities of appropriate quality water are required both for domestic and industrial purposes. Urban areas depend greatly on water stored in dams and reservoirs for various purpose. Water stored during high rainfall is used at the time of low rainfall. This is especially important during season and where there is shortage of rainfall. Seasonal variations and climatic irregularities in flow impede the efficient use of river runoff, with flooding and drought causing problems of catastrophic proportions.

geographical positioning. pH, Temperature, Conductivity, Turbidity, Total Dissolved Solid (TDS), Total Hardness (TH), Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Suspended Solid (SS), Chloride Cl^-, Nitrate (NO_2^-), Nitrite (NO_3^-), Phosphate (PO_4^{2-}) were analysed using standard procedure. The mean values of these parameters indicate the effectiveness of the treatment process on suspended solids mturbidity, NO_3^- and color. From the result obtained it shows a high value of nitrates and this might be as a result of the use of nitrous based fertilizer in the sampling location. There is significant variation ($P <0.05$) between the values of color, nitrate, phosphates temperature, suspended solids and conductivity, observed for the three seasons. The overall quality of Kafin-Chiri reservoir was found to be within the WHO recommended value for drinking water. It is therefore recommended that proper attention need to be given to the water body by appropriate authorities due to its possible health implication on the consumers through continuous monitoring so as to track any adverse environmental changes in the dam.

Key words: Assessment, Pollution, Physico - chemical, Reservoir, Water Qualitv. Seasonal Variation.

Dams and reservoirs are effective and can be used to maintain water levels in a river. The water downstream can be temporarily stored in a dam and released later when it is required (Anonymous, 2014).

According to Ibrahim (2009) Water resources are of critical importance to both natural ecosystem and human development. It is essential for agriculture, industry and human existence. The healthy aquatic ecosystem is depended on the physicochemical and biological characteristics (Verma *et al.*, 2012). The quality of water in any ecosystem provides significant information about the available resources for supporting life in that ecosystem (Ibrahim, 2008). Good quality of water resources depends on a large number of physic-chemical parameters and biological characteristics to assess the monitoring of these parameters is essential to identify magnitude and source of any pollution load (Adesalu *et al.,* 2010). Due to increased population and use of fertilizers in agriculture and man-made activities, the natural aquatic environment is increasingly polluted leading to depletion of aquatic biota and water quality (Adakole *et al.,* 2008 and Kawo *et al.,* 2008).

Dams are structural barriers built to obstruct or control the flow of water into rivers and streams (ICOLD, 2005). They can be used to generate electricity, to direct water from rivers into water supply systems, to direct water into canals and irrigation systems to increase depths for navigational purpose to control flow during times of flood and drought to create artificial lakes for fisheries and recreational purposes (EPA, 2002). In ancient times, dams were built for the single purpose of water supply or irrigation. As civilization developed, there was a greater need for water supply, irrigation, flood control, navigation, water quality, sediment control and energy (Ita *et al., 2011*). This study was conducted for the purpose of monitoring the quality of Kafin-chiri reservoir, Kano state Nigeria for drinking water purpose, using selected physico - chemical parameters. The result will help in predicting the pollution status of the reservoir and form a baseline data in identifying emerging water quality problems. Reservoirs in Kano state have subjected to contaminating materials capable of initiating the impairment of the aquatic environment. Untreated industrial effluents are discharged into water bodies (Bichi, 2013) because most industries in Kano do not have waste water treatment facilities. This poses a great threat to the aquatic environment (El-Buraire, 2010).

Study Area

Kano state is located in the North-Western Nigeria. It shares borders with Katsina to the North-West, Jigawa to the North-East and Bauchi and Kaduna to the South. It has a total area of 20,131 Square km. Kano is located at 481 meters (or about 1580 feet) above sea level.

Kafin-Chiri is a city, town, village or other agglomeration of buildings where people live and work. Its center lies at latitude of 11.6°N and longitude of 8.8°E and it has an elevation of 478 meters above sea level (Ahmed, 2008). It receives water from rivers Dudduru (at Garin Ali town), Zabaro (at Mai manda town) and Marmara (at Dakatsalle town).

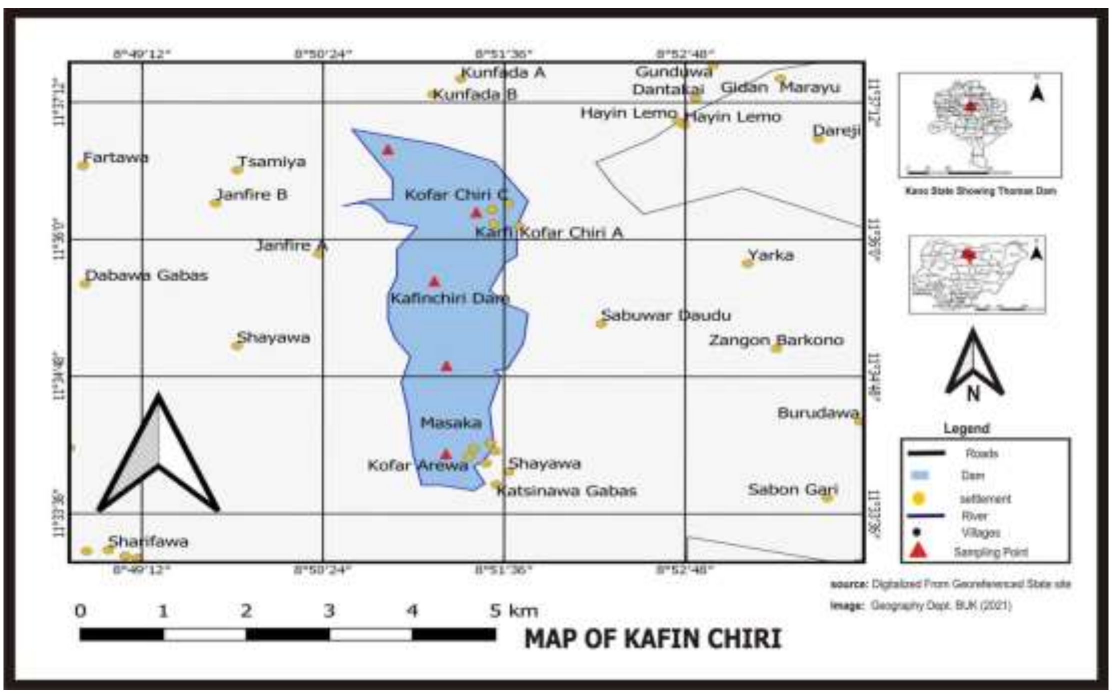

Figure 1: Map of Kafin-chiri Dam

Materials and Method

Sampling: water samples were collected using clean plastic containers (Maitera *et al.,* 2010), and preserved following (Manjare *et al.,* 2010) procedure. Approximately 1000 cm^3 of water were collected into each container. The pH of the first container was adjusted to less than 2 by the addition of 2 cm^3 Conc. HNO_3 to prevent adsorption of metals into the walls of the plastic container (APHA, 1995). The samples were transported to the laboratory for analysis for three seasons between the months of March - June (dry season), July - September (rainy season) and November - February (cold season).

Methodology

Physical parameters temperature, total dissolved solids, conductivity, turbidity and suspended solids; chemical parameters. pH, total hardness, DO, BOD, Cl^-, No_2^-, No_3^-, COD, and Po_4^{3-} were analyzed using standard methods and procedures (Mustapha *et al.*, 2008), (NIS 2007). Some of the parameters were determined in the field using pre-calibrated hand held equipment. pH was measured using Jenway pH meter model 3505. DO was determined using water proof Jenway Do_2 meter model: 9200; conductivity, TDS and temperature were measured using HI ECi model No. 961. Turbidity was determined using Wagtech turbidity meter Wag WT 3020 model. The other parameters were brought to the laboratory for immediate analysis (Mustapha *et al.,* 2008). Chloride was measured in the laboratory by silver nitrate titration method. Suspended solid was measured gravimetrically after filtration. BOD was measured using HACH BOD Track meter model No. 205 by measuring initial and final BOD after incubation in the dark for five days. Nitrite was determined using sulphanilamide spectrophotometric method and Nitrate was determined by cadmium reduction method using HACH colorimeter model no. 890. COD was determined by dichromate oxidation method. Phosphate was

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measured using ascorbic acid molybdate spectrophotometric method (Mustapha *et al.*, 2008).

Result and discussion

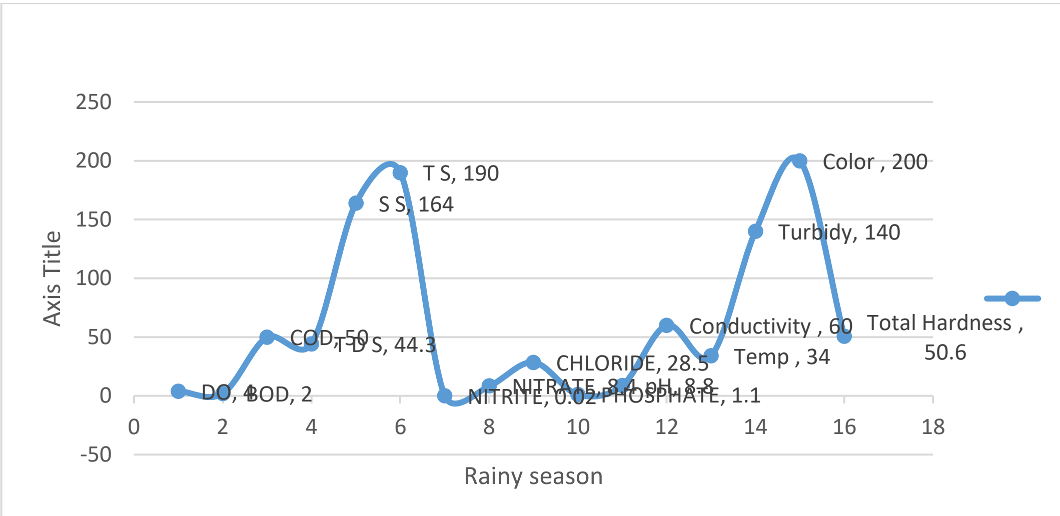

Fig II: Mean values of Physical and Chemical Parameters for Rainy Season (Std. Units)

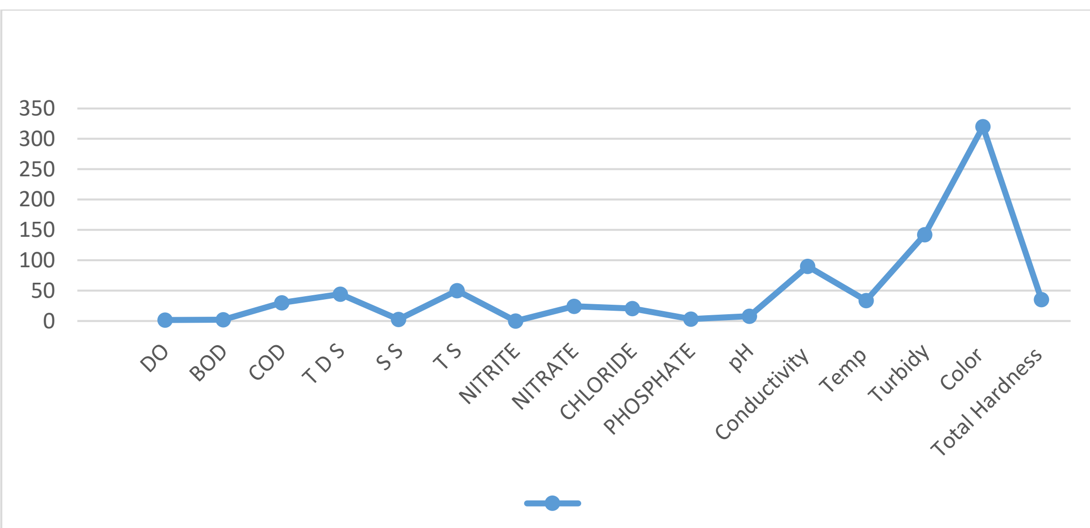

Fig III: Mean values of Physical and Chemical Parameters for Dry Season (Std. Units)

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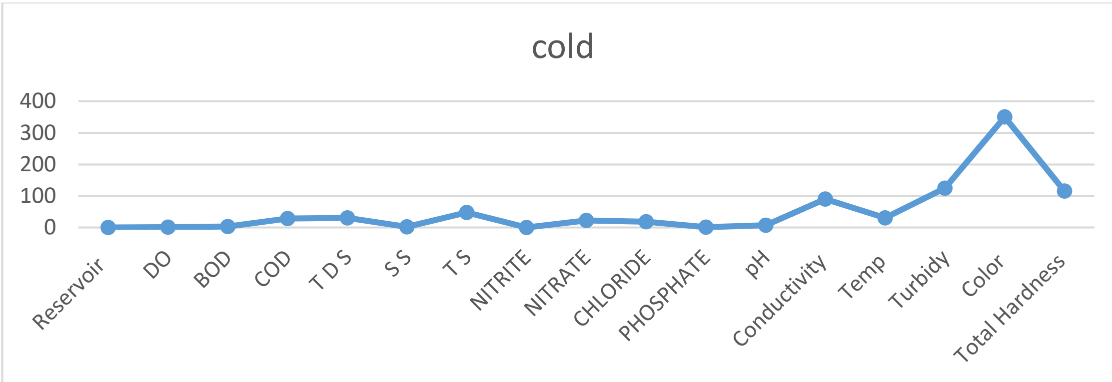

Fig IV: Mean values of Physical and Chemical Parameters for cold Season (Std. Units)

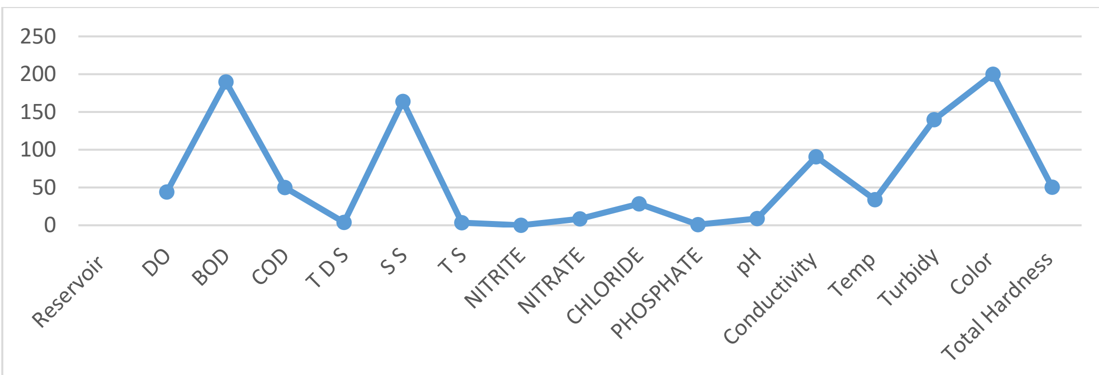

Fig. V Mean Values Seasonal variations of Physical and Chemical Parameters for kafin-chiri during rainy season (Std. Units)

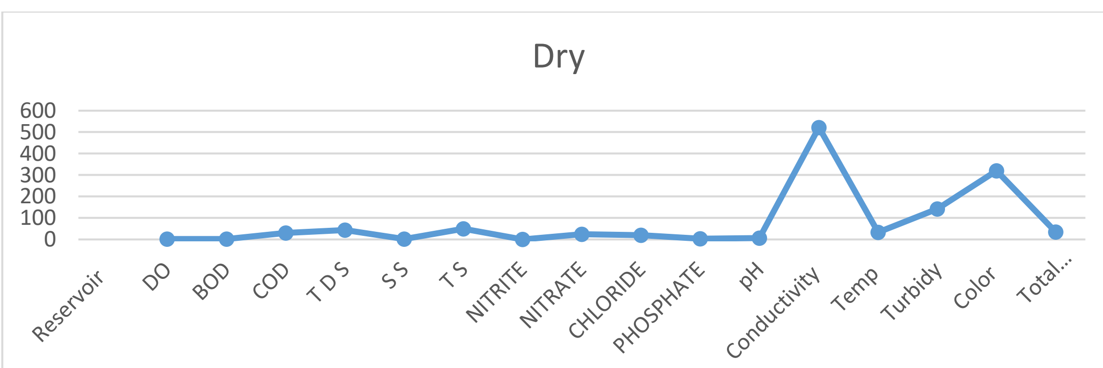

Fig. VI Mean Values Seasonal variations of Physical and Chemical Parameters for kafin-chiri during Dry season (Std. Units)

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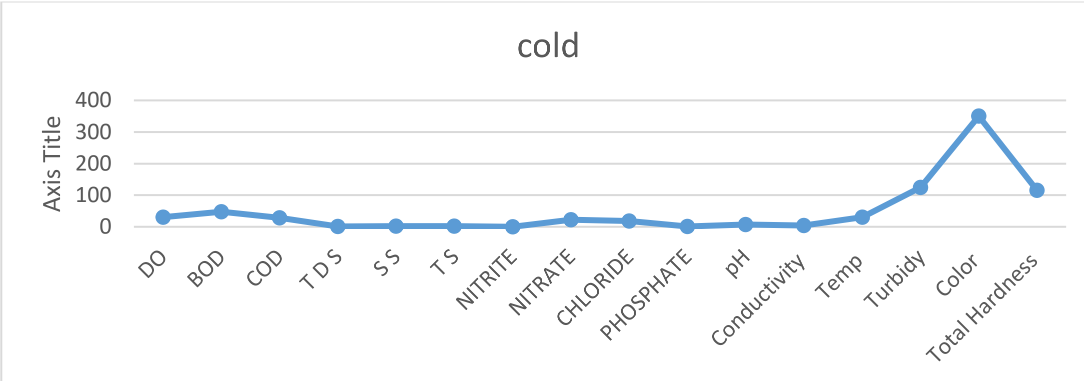

Fig. VII Mean Values Seasonal variations of Physical and Chemical Parameters for kafin-chiri during cold season (Std. Units)

Discussion

Physical and chemical parameters of Kafin-Chiri reservoir were studied for three seasons of the year; rainy season, dry season and cold season (Hamattan period. The mean values of the results obtained for the three sampling sites indicate that there is significant variation ($P<0.05$) for most of the parameters. (Figures II to VII).

The mean pH values for rainy season (Figure Il) ranges from slightly acidic to slightly alkaline at the reservoir. For dry season (Figure Il), the pH values fall within the WHO ranges for drinking water quality (6.5 — 8.5). The pH values for rainy season have a mean value of 8.8. This may be due to high water volume and leaching of soil by water run-off along the adjourning rivers. High pH values affect aquatic organisms by increasing solubility of toxic substances. Temperature have a mean range value between 32.0-38.9^{o}C which is lowest during the hamattan period and highest during dry season. There is however no significant variation at $P<0.05$ between the three seasons. Similar values were also reported by (Nollet *et al.,* 2007) on assessing pollutant levels in Mario Jose tannery effluents from Kano metropolis, Nigeria.

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Total dissolved solids and conductivity have mean range values of 44.3-60 (30-44.5) (mg/L) and (60-90.6) (IIScm^{-l}) respectively for the three seasons Fig II. The values obtained for both TDS and conductivity were found to be higher in dry and cold seasons due to low volume of the reservoir water (Figure IV). The values recorded are much lower than WHO and EPA values for surface water 500mg/L and 100011Scm-l respectively. Conductivity indicates presence of dissolved ions in water. Water treatment process involves the use of flocculants to remove suspended and dissolved solids. Higher value for TDS is unpalatable and potentially unhealthy. The lower values for TDS and conductivity may be responsible for the soft nature of the water and excellent quality for drinking purpose. Similar values were reported by reference Ill when assessing water quality of Oyun reservoir Offa, Nigeria. TDS concentration at the range of 25-80mg/L represent moderate quality above which serve as potential impairment of water bodies (Stankovic 2008)

The main physical problem that may be caused by suspended solids and turbidity in natural water bodies is that they cut down light transmission through the water and so lower the rate of photosynthesis in plants (NIS 2007). The WHO recommended values for turbidity in drinking water is 5 NTU. Turbidity is the measure for cloudiness of water. It provides a medium for bacterial growth, hence a good treatment process must effectively reduce turbidity to the minimum (NIS, 2007). ANOVA at $P<0.05$ shows the values of turbidity and SS to be significantly higher at the reservoir water.

Water containing hardness concentrations of up to 60mg/L (ppm) are referred to as "soft", those containing 120180 mg/L (ppm) as "hard". Mean values obtained for total hardness ranges from 7.78 - 62.44mg/L. All the values are within the standard level. The dry season have higher values which may be as a result of high concentration of ions during

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the period (Fig. II). There is significant variation between the sampling sites at $P<0.05$ (Figures V to VII). The values obtained are similar to reports by (Ahmed 2008): when analyzing water quality of Tolmande tank of Kolhapur district, Maharashtra.

Chloride does not cause health problems but high chloride levels in drinking water may be a sign of other problems. For example, road salt can contaminate water supplies causing chloride levels to be high. High levels of chlorides in drinking water may also give water an unpleasant taste. The maximum level for chlorides in water is 250 mg/L (NIS 2007). The values obtained for chloride are within the range set by WHO (Stankovic, 2008) and NIS (Taiwo *et al.,* 2012).

DO is vital to aquatic life, oxygen enters the water by diffusion from the atmosphere or through plant photosynthesis (NIS 2007). The dissolved oxygen level in water is constantly changing and represents a balance between respiration and decomposition that deplete oxygen and photosynthetic activity that increases it. The amount of DO ranges from 1.4-4.0 mg/L with the dry season having the lowest value and the higher value found in the rainy season (Fig. II) due to increased water volume and relatively lower temperature. DO level >2 supports aquatic life. The results obtained correspond to reports by other researchers (Adefemi, *et al.,* 2007). There is no significant variation between dry and cold season at confidence level.

Biochemical Oxygen Demand (BOD) refers 10 the amount of oxygen that would be consumed if all the organics in one liter of water were oxidized by bacteria and protozoa. The range of possible readings can vary considerably: water from an exceptionally clear reservoir might show a BOD of less than 2 mg/L of water. Raw sewage may give readings in the hundreds and food processing wastes may be in the thousands. The mean values of BOD obtained ranges between 2.0-3.3 mg/L (fig. II). The result is in agreement with other report by (Akan *et* *al.,* 2009) when investigating some physical and chemical parameters in Lake Isykli, in Denizli Turkey. Variation of Nitrate, Nitrite and phosphate in the reservoir reflect the effect of watershed ando anthropogenic contamination around the reservoir. Mean values in the range of 0.02, 8.4, 28.5 and 1.1 Mg/L were obtained (Fig. II). ANOVA ($P<0.05$) shows the values for Nitrate to be significantly higher in rainy season for all the three sampling sites. (Figure V-VII). Significant reduction in nitrate concentration is noticed at treated and potable water when compared with reservoir water (Figure Il-IV). Nitrate in elevated levels is linked with two known health problems: Methemoglobinemia or "blue baby syndrome" is caused by an oxygen deficiency in the blood. This causes bluish skin tone in infants (Vermont-Gov 2011). In adults, nitrates can form chemicals called nitrosamines that have been linked to cancer. These may pose long-term health risks. Agricultural run-off of pesticides, plant and animal 's wastes, phosphate fertilizers from nearby farms in addition to cow dungs washing from the watershed into the Reservoir is also a major contributing source of organic pollution to water bodies in Nigeria 181. The maximum level for nitrate in water is 10.0 mg/L. However, when levels exceed 5 mg/L, the source of nitrate should be investigated WHO, (2008), The values obtained (Fig. II) is in agreement with the work by (Dan azumi *et al.,* 2010)

Color has a mean value that ranges from of 0.02 to 540.80 HAZEN. The large difference is as a result of values obtained at the treated and potable water which is very low compared to that obtained at the reservoir (Fig.II). The value at the reservoir exceeds the NIS maximum permissible limit of 15 HAZEN for drinking water (Taiwo *et al.,* 2012) Color in water is associated with absorption of certain wavelengths of normal white light by dissolved or colloidally dispersed substances.

Similar results were obtained by (Xiao *et al.,* 2006). There is significant variation at $P<0.05$ between the three seasons (Figure V-VII).

Conclusion

The overall quality assessment of Kafin-chiri reservoir shows that most of the parameters are within the WHO and NIS recommended values for drinking water quality with few exceptions. The results obtained correspond to that recorded for tropical reservoirs by other researchers.

Reference

Adefemi, O.S. Salu, S.S and Olaofe O. (2007) Assessment of the Physico Chemical Status of Water Samples from Major Dams in Ekiti State, Nigeria. Pakistan Journal of Nutrition 6(6) 657-659

Adakole JA, Abuulode DS, Balarabe ML. Assessment of water quality of man-made lake in Zaria, Nigeria. Proceedings of tail 2007: The 12th word lake conference. 2008; 1373-1382

Ahmed, K. (2013) The Kano Physical Environment http://www.kanostate.net/physical.html*Applied Sci. 7: 527-530.*

Akan J. C. Abdurrahaman, F.I., Ogugbuaja, V.O, And Reuben, K. 1).(2009): Study of the Physico-Chemical Pollutants in Kano Industrial Areas , Kano state, Nigeria. J. Applied Sci. VOL. 4 NO.2, 89-102,

Anonymous, (2014): Gazetteerr.com Bagwai Dam Map. Retrieved from gazetteering.com on 22nd July, 2014.

Bichi M.H. & Anyata BU (2010) Industrial Waste Pollution in the Kano River Basin. Environmental Management and Health, 10(2): p. 112-116. http://www.kanostate.net/physical.htm

Dan azumi S and Bichi M. Il. (2010) Industrial Pollution and Implication on Source of Water Supply in Kano. nigerian international journal of engineering & Technology IJlìT-1JlìNS Vol: 10 No: 01

EPA (2002): Environmental Proton Agency office of water (4606M) The clean water Drinking Water Infrastructure Gap Analysis. Retrieved from htpp://www.epa-gov/safewwater/on on 15/03/2012

El Buraie, M.M; El Barbary, A.A; Yehia, M.M and Motawea, E.A (2010): I-Teavy Metals Concentration in Surface River Water and Bed Sediment at Nile Delta in Egypt. *Society SUO 61(1):1-12*

Eran Feitelson (2012) what is water? A normative perspective, Water Policy 14 (2012) 52–64, Department of Geography, The Hebrew University of Jerusalem, Mount Scopus, Jerusalem 91905, Israel E-mail: msfeitel@mscc.huji.ac.il

Ibrahim B.U; Auta, J and Balogun, J.K (2009): Assessment of the physic-chemical parameters of kontagora Researvior, Niger state Nigeria. Bayero *Journal of Pure and Applied science,* 3 (1): 64-69.

Ita, E.K. Balogun, pandagori, A. and Ibitoye,B.(2011); A preliminary checklist of Inland Water Bodies in Nigeria with special Reference to lake and Reservoirs. Kainji Lake Research Institute retrieved 2010 -05-22

Kawo, A.H; Abdullahi, B.A; Saminu, M.Y; AbdulHadi, S.K and Sha'aya'u, A.G. (2008). Seasonal and Spatial Variations in Water Quality and Its Ecological Implications on Challawa River, Nigeria. Nigerian Journal of Basic and Applied Sciences, 16(2): 129 – 135.

Maitera, O. N. Ogugbuaja, V .o and Barminas J. T (2010). An Assessment of the Organic Pollution Indicator Levels of River Benue in Adamawa State, Nigeria Journal of Environmental Chemisfry and Ecotoxicology Vol. 2(7), Pp. 110-116, online http://www.academicjournals.org/jece

Manjare, S. A. Vhanalakar S. A. and Muley, D. V. (2010) Analysis of Water Quality Using Physico-Chemical Parameters Tamdalge Tank in Kolhapur District, Maharashtra. Intemational Joumal of Advanced Biotechnology and Research ISSN 0976-2612, Vol l, Issue 2, Pp 115-119 http://www.bipublication.com

Mustapha, M. K. (2008): Assessment of the Water Quality of Oyun Reservoir, Offa, Nigeria, Using Selected Physico-Chemical Parameters. Turkish Journal of Fisheries and Aquatic Sciences 8: 309-319

Nigerian Industrial Standard (2007): Nigerian Standard For Drinking Water Quality NIS 554: ICS 13.06020

Nollet, L.M.L (2007): Handbook of Water Analysis, Second Edition. CRC Press Tailor and Francis group London.

Taiwo, A.M. o.o. Olujimi, O. Bamgbose and T.A. Arowolo (2012). Surface Water Quality Monitoring in Nigeria: Situational Analysis and Future Management Strategy, Water Quality Monitoring and Assessment, Dr. Voudouris ISBN: 978-953-51-0486-5, In Tech, Available from: http://www.intechopen.com/books/waterquality-monitoring-and-assessment/surface-water-quality-monitoring-innigeria-situational-analysis-and-futuremanagement-strategy

Verma, P.U; Purohit, A and Patel, N.J. (2012). Pollution Status of Chandlodia Lake Located in Ahmedbad Gujarat. IJERA. 2(1): 1600- 1606

Vermont-Gov (2011): Department Of Health, Agency Of Human Health, Testing Your Water Supply Vermont Department Of Health | 108 Cheny Street I Burlington, Vt 05402

Stankovic, S (2008): The physical and chemical characteristics of Danube water quality near Kovin (Vojvodina) in Serbia.

Subramanian, M.S Environmental chemistry and analysis: Analysis of mtljor constituents in water. Module 2.1. Indian Institute of Technology. MadrasAhmed, K. (2008): The Kano Physical Environment. http://www.kanostate.net/physical.html

WHO, (2008): Guidelines for Drinking-water Quality Third Edition Incorporating the first and Second Addenda Volume I Recommendations Geneva

Xiao-Li,S., Yu, P., Hose, G.c, Jim, C, And Feng-Xiang, L., (2006): spider Web as Indicators of Heavy Metal Pollution in Air. Bull Environ Contam. Texicol 76-271 - 277

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