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ASSESSMENT OF SEASONAL VARIATION ON THE PHYSICOCHEMICAL PROPERTIES OF SELECTED FISH PONDS IN EDE METROPOLIS

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ABSTRACT

This research work investigated the impact of seasonal variation on the physiochemical properties of selected ponds in Ede Metropolis for raining and dry season. The pH values for Ede South raining(ESR) and dry season(ESD) and Ede North raining (ENR) and dry season(END) were; 6.87, 7.60, 7.26 and 7.57 respectively. The conductivity values were; 51.80, 52.23, 51.40 and 52.70 µs/cm for the two seasons respectively. Temperature: 27.02, 27.03, 27.05 and 27.07^{0}C respectively. Total hardness values were: 248.3, 125, 275 and 225 mg/L respectively. The values for calcium hardness were: 150, 151.67, 175 and 173.3 mg/L respectively. Magnesium hardness values were: 98.3, 26.67, 100 and 51.7mg/L respectively. The values for dissolved oxygen were: 5.07, 2.18, 6.05 and 2.56 mg/L respectively. The Chemical Oxygen Demand were: 56.67, 43.33,

83.33 and 43.3 mg/L respectively. The values for turbidity were: 41.03, 18.98, 43.07 and 20.1 NTU respectively. The values for total solid were: 0.034, 0.020, 0.042 and 0.019 g respectively. The Total suspended solid were: 0.021, 0.012, 0.032 and 0.014 g respectively. Total dissolved solid values were: 0.01, 0.009, 0.01 and 0.005 g respectively. The values for total acidity were: 60.0, 30.0, 49.2 and 46.4 g/L respectively. Total alkalinity values were: 90, 70.5, 75 and 60.2 mg/L respectively. The Heavy metal analysis on Cr, Pb, Ni, Co and Cd for ESR were; 0.399, 0.041, 0.042, 0 .192 and 0.018 mg/L respectively. The results for ESD were; 0.401, 0.053, 0.047, 0.0 209 and 0.020 mg/L respectively. The results for ENR were: 0.441, 0.054, 0.042, 0.204 and 0.019 mg/L respectively. Also, the results for END were; 0.485, 0.057, 0.050, 0.200 and 0.047mg/L respectively. The present study established that the two seasons fall within the WHO standards for the physicochemical parameters. It also revealed that the amount of heavy metals in dry season was higher than the raining season. However, the concentrations of heavy metals for both seasons were a bit higher than the WHO standard which implies that the fish in ponds may not be suitable for human consumption as it poses health risk.

KEYWORDS; Seasonal variation, Physicochemical, Parameters, Heavy metals, Conductivity.

INTRODUCTION

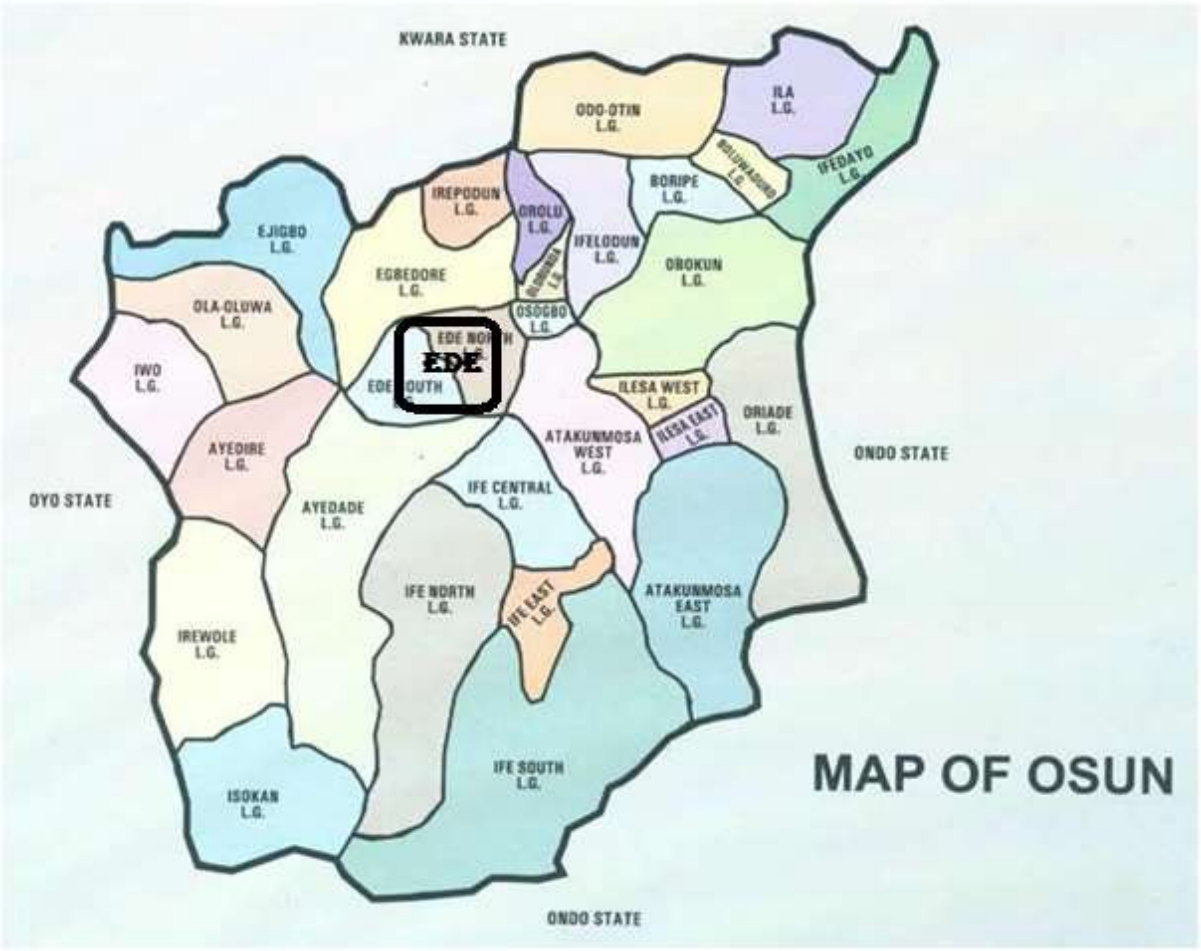
A pond is referred to as a man-made or natural water body which is between 1 m^2 and 2 ha (~5 acres or 20,000m2) in area, which holds water for four months of the year or more (Biggs *et al.*, 2005). Water quality generally means the component of water which must be present for optimum growth of aquatic organisms. The determinant of good growth in water body includes dissolved oxygen, hardness, turbidity, alkalinity, nutrients, temperature, etc.

Conversely, other parameters like biological oxygen demand, and chemical oxygen demand indicate pollution level of a given water body. In most water bodies, various chemical parameters occur in low concentrations. This concentration level increases due to human activities, and lack of environmental regulation (Mehedi *et al*., 1999).

Thus, determination of physico-chemical characteristics of water is essential for assessing the suitability of water for various purposes like drinking, domestic, industrial, irrigation and pisciculture (Bronmark and Hansson, 2005). Fish is an inexpensive source of protein and an important cash crop in many regions of world and water is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (Sikoki and Veen, 2004). Water quality is determined by various physico-chemical and biological factors, as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals (Sikoki and Veen, 2004). A sharp drop or increases within these limits have adverse effects on their body functions (Kiran, 2010). So, good water quality is essential for survival and growth of fish. Water quality is not constant; varies with the time of the day, season, weather conditions, water source, soil type, temperature, stocking density, and feeding rate and culture systems.

Ede metropolis is located in Osun State, South-western Nigeria. It covers an area of approximately 330 km2 (130 sq mi) and borders with Egbedore Local government area of Osun State. It has population of 159,866. The main sources of water supply in the Ede is from construction of dams on the major rivers in the state, with the state water scheme accounting for about 39% of the total design capacity and actual production level of all the water schemes. Thus, Ede communities have resorted to depending on the surrounding rivers for their daily needs.

Thus, this research work is focused on the impact of seasonal variation on the physicochemical properties and heavy metals concentration on the selected ponds in metropolis.



MATERIALS AND METHODOLOGY

SAMPLE COLLECTION

The water samples were obtained for both Ede north and Ede south during the rainy season and dry season using Standard Analytical procedures. About 5 mls of HCl was added to the water samples for heavy metal analysis. Parameters such as pH, Temperature, Conductivity and dissolved oxygen were all determined in-situ. The samples were then kept at 4^0C in an air- tight container for further to analysis.

pH DETERMINATION

The pH meter was standardized using the buffer solutions.The electrode was rinsed with distilled water and wiped off properly. It was then immersed in the beaker containing the water sample and the pH was read (Ehiagbonare and Ogunrinde, 2010).

CONDUCTIVITY DETERMINATION

The conductivity electrode was immersed in the beaker containing the water sample and read directly (Ehiagbonare and Ogunride,2010).

TEMPERATURE DETERMINATION

The temperature of the water sample was determined at site by dipping a thermometer calibrated in degree Celsius into the water body and temperature measurement was taken..

TOTAL SOLID DETERMINATION

The evaporating dish was dried in an oven at 105°C until a constant weight was obtained .It was then cooled in the desiccator and weighed. 50ml of the water sample was thoroughly mixed and measured into the dish. The content was evaporated to dryness on the steam bath. The evaporating dish was then transferred to the oven for total dryness at 105°C for 2 hours. It was put in the desiccator and weighed. The weight of the dish was subtracted from the weight of the dish after drying and recorded (Ehiagbonare and Ogunrinde, 2010).

TOTAL SUSPENDED SOLID DETERMINATION

50ml of the water sample was measured and filtered through the funnel. The residue on the filter paper was dried in the oven at 105°C for 2 hours. After drying, it was then cooled in the desiccator and weighed. This was done until a constant weight was obtained. The weight of the filter paper was subtracted from the weight after drying to get the value of the suspended solid (Ehiagbonare and Ogunride, 2010).

TOTAL DISSOLVED SOLID DETERMINATION

Total dissolved solid was obtained by subtracting Total suspended solids from Total solids (Ehiagbonare and Ogunride, 2010).

TOTA.L HARDNESS DETERMINATION

100ml of water sample was transferred into the Erlenmeyer flask and 2ml of ammonia buffer solution and 2 drops of Eriochrome Black T indicator were added to the solution in the flask. The solution was then titrated against 0.001M EDTA solution until there was a color change from red to blue. The amount of titrant used was then used in calculating the total hardness of water sample.

Calculation:

Total Hardness = (V-B) x M x 50 x 100/V

Where;

V is the volume of the titrant used

B is the volume used for blank

M is the molarity of EDTA

50 is the equivalent weight of $CaCO_3$

V is the volume of the sample.

CALCIUM HARDNESS DETERMINATION

100ml of water sample was measured into the Erlenmeyer flask 1ml of Sodium Hydroxide and 2 drops of Murexic indicator were added.The solution in the flask was titrated against 0.001M EDTA until the colour changed to violet. The amount of titrant used was recorded.

Calculation:

Calcium hardness = V of 0.01 of EDTA x 1000 x 0.400/ vol. of sample

Where V is the volume of EDTA for calcium hardness determined.

MAGNESIUM HARDNESS DETERMINATION

Magnesium Hardness was obtained by subtracting the calcium hardness from Total hardness of water sample.

TOTAL ACIDITY DETERMINATION

50ml of water sample was measured into a conical flask and 2 drops of methyl orange indicator was added and titrated against the 0.1M of NaOH in the burette. There was a color change to faint orange indicating the end point. This was done repeatedly until an average title value was obtained.

Total Acidity=V x 1000/ sample volume

V is the average volume of the titrant used.

TOTAL ALKALINITY DETERMINATION

50ml of water sample was measured into the conical flask and 2 drops of phenolphthalein indicator added. The solution was then titrated against 0.1M of H_2SO_4 in the burette. There was a color change from pink to colorless indicating the end point. The alkalinity was calculated as ;

Total Alkalinity = (A x N x 50,000)/ V

A is the volume of the acid used

N is the normality of the acid

V is the volume of the sample used.

DISSOLVED OXYGEN DETERMINATION

About 2ml of 48% Manganese Sulphate was prepared by dissolving 500g NaOH and NaI in 950ml distilled water in a standard flask, it was allowed to cool and 10g of sodium azide dissolved in 40ml distilled water was added and made up to mark with distilled water. The 2ml of manganese sulphate and 2ml of alkali azide reagent were added to the water sample in a 300ml bottle well mixed and corked. This was done at the site of sample collection.

The solution was then taken to the laboratory, properly mixed and allowed to settle for about 2min. 2ml of H_2SO_4 was added and a 200ml portion of the sample was measured and titrated against 0.0125M of sodium thiosulphate solution and a place straw colour was obtained. 1.5ml starch solution was added and titrated until there was colour change from blue to colourless. The end point was recorded.

D.O. = 16,000 x M x V / A/B (B-2).

M is the molarity of thiosulphate

V is the volume of thiosulphate used for titration

A is the volume of aliquot taken for titration

B is the volume of the bottle with stopper in place

CHEMICAL OXYGEN DEMAND DETERMINATION

The sample was first digested in a COD thermo reactor. To digest the sample, 500ml was homogenized in a blender for 2 min after which 2ml of the sample was introduced to the reaction cell containing the COD reagents. The solution was thoroughly mixed and placed in the COD reactor set at a temperature of 150°C for 2hours. After the digestion, the hot cell was removed from the thermo reactor and made to cool. The content of COD was measured with the spectrophotometer set at a stored programmed number and a correct wavelength of 420mm after it has been standardized with a blank COD reagent as control

BIOCHEMICAL OXYGEN DEMAND DETERMINATION

The BOD was determined by incubating the samples for a standard 5 day period and then determining the change in dissolved oxygen content. The BOD was calculated as follow:

BOD = D_o-D_5 x volume of BOD bottle/ volume of sample

D_o is the dissolved oxygen at initial day

D_5 is the dissolved oxygen after 5 days

TURBIDITY DETERMINATION

The turbidity was determined using the Turbid meter. The instrument measures the intensity of light scattered at 90°C as a beam of light passes the water sample.

HEAVY METAL DETERMINATION

5ml of Hydrochloric acid was added to 250ml of water sample and evaporated. The concentrate was then transferred to a 50ml standard flask and diluted to the mark with deionized water. After the treatment, Atomic Absorption Spectrophotometer (VG Bulk 211) was used to determine the amount of heavy metals in pond water samples (Sangoremi, 2013).

RESULTS AND DISCUSSION

The pH is known to be the negative logarithm of Hydrogen ion concentration. The survival of the fish in the pond is also dependent on the pH of the pond. Fishes are known to have a pH of 7.4 of their average blood (Delince *et al* (2000).From the result above, the pH values of the two ponds for raining and dry season falls within the range. According to the World Health Organization (WHO), the appropriate pH value ranges from 6.0 to 9.0. The pH for Ede south and North raining season were found to be 6.87and 7.26 respectively while that of Ede South and North for dry season were 7.60 and 7.57 respectively. The pH values of the two ponds for raining and dry season was in agreement with the WHO standard.

Conductivity is known to be an indication of freshness of water (Acharya *et al*, 2008). According to (Ganiyu *et al.*,2016), the conductivity ranges from 176 to 598 us/cm during dry season and 191 to 705 us/cm during raining season. The value recorded for Ede South and North raining season were 51.80 and 51.40us/cm respectively while Ede South and North dry season were 52.23 and 52.57us/cm respectively. According to World Health Organization (WHO, 2007), the values fall within the limit of <1000 us/cm. However, the value was higher during the dry season than the raining season.

The temperature of an organism is known to be the degree of hotness or coldness in the body (Shobana *et al*, 2014). The temperature of water can be dependent on season and time of sampling (Ntengwe and Edema, 2008.The temperature range for fish survival is said to be between 20 to 30C (Jonassen *et al*, 1999). The results obtained from this work shows that the temperature for Ede South and North raining season was found to be 27.02 and 27.05^0C while Ede South and North dry season was 27.03 and 27.07^0C respectively. The results were within the range of World Health Organization (WHO, 2009).

Total hardness of water describes the effect of dissolved minerals mainly calcium and magnesium (Solomon *et al*, 2013). In this present study, the total hardness for Ede South and North raining season was 248.3 and 275mg/L while Ede South and North dry season was 125 and 225mg/l respectively. This revealed that the total hardness during the raining season were higher than values obtained for dry season for both locations. This was attributed to high water level during raining season and presence of dissolved minerals. Total hardness value less than 20mg/l could cause stress and >300mg/L could be dangerous to the fishes because it increases pH and leads to non-availability of nutrients (Bhatnagar *et al*, 2004). However, the values reported for both seasons were lower when compared with WHO recommended value.

In this research work, the calcium hardness for Ede South and North raining season were 150mg/L and 175mg/L while 151.67 and 173.3mg/L were reported for Ede South and North for dry season respectively. This results obtained for calcium hardness for both seasons were higher than 104.33mg/L reported by Kumar *et al* (2017) for raining season and fall within the World Health Organization standard 75 - 200mg/l**.**

Magnesium is also essential for bone formation in fishes. The result for Ede South and North raining season were 98.3 and 100mg/L while Ede South and North dry season was 26.67 and 51.7mg/L respectively. This result showed that the values reported during raining season were higher when compared with dry season due to pond water ingression. The World Health Organization standard for magnesium hardness is <150mg/l. This result was in agreement with Kumar *et al* (2017).

Dissolved oxygen is also an important factor in the assessment of water quality and reflects both physical and biological processes of aquatic organisms. Oxygen is needed by fish and other aquatic organisms to survive. The level of dissolved oxygen vary seasonally and is dependent on the penetration of light, temperature, nutrients available, movement of water, salinity of the water and partial pressure of atmospheric oxygen in contact with the water (Dhahran A and Karu S, 2002).It normally affects the growth, survival, behavior of aquatic organism and their physiology (Nduka *et al*, 2008). The results obtained in this study for Ede South and North raining season were 5.07 and 6.05mg/L while Ede South and North dry season were 1.33 and 2.56mg/L respectively. The values obtained during the raining season were higher than the dry season. However, the values for both seasons were within the World Health Organization (WHO, 2009).

Biochemical oxygen Demand is the measure of the Total dissolved oxygen consumed by the organisms in the water for the biodegradation of organic matter (Ademoroti,1996)). BOD depends on the temperature, population of microbes, organic matter concentration, biological activity (Priyanka *et al,* 2013).The BOD for Ede South and North raining season were 1.33 and 1.24mg/L respectively while Ede South and North dry season were 0.84 and 1.77mg/l respectively. The BOD is higher during rainy season because of additional waste accompanied with rain water which could be responsible for increase in BOD. The BOD levels between 1.0 and 2.0mg/L are considered to be clean and not polluted (Ekubo and Abowei (2011).This suggested that the pond waters for both seasons were safe for fishing activities.

The Chemical Oxygen Demand determines the amount of oxygen required for oxidation of organic matter and inorganic matter (Jeyraj *et al*, 2014). Organic matter is one of the important factors responsible for COD. The COD for Ede South and North for raining season were 56.67 and 83.33mg/L while 43.33 and 43.30mg/L were reported for Ede South and North for dry season respectively. According to World Health Organization (WHO,

2002) the COD of pond water should not be greater than 100mg/L. However, these results were below World Health Organization permissible limit.. This suggested that the fish ponds were safe for fish farming activities.

The turbidity of water and the appearance of the pond are important in fish farming. Turbidity measures the ability of water to transmit the light that restricts light penetration (Ademoroti , 1996)). The results for Ede South and North raining season were 41.03 and 43.07NTU, while dry season were 18.98 and 20.10NTU for both locations respectively. The turbidity values were higher during the raining season when compared to the dry season. This was as a result of run-off water which carries dissolved ions and inorganic matter into the ponds when rain falls during raining season. The permissible limit for pond water fishery is 30 to 80 NTU (Bhavnagar and Devi (2013).However, the values obtained for both seasons were within the range. This further suggested that the ponds are fit for fishing activities i.e. high production of fishes.

The Total solids for Ede South and North raining season were 0.03 and 0.042mg/L and that of dry season were 0.02 and 0.019mg/L for South and North respectively. Higher values were recorded during raining season compared to dry season. All the values were below 500mg/L recommended by WHO (2007).The result agrees with similar work by Adeolu *et al* (2011). The Total solids for Ede South and North raining season were 0.021 and 0.032mg/L and 0.012 and 0.01mg/L for both locations respectively. 5mgL. However, the results for both seasons (i.e. Ede South and North) were far below the WHO permissible limit of 5mgL

The Total dissolved solid for Ede South and North raining season were 0.01 and 0.01mg/L and 0.09 and 0.005mg/L for dry season respectively. Higher values were recorded during dry season. All the water samples that were analyzed can be regarded as fresh water because the values were significantly lower than recommended value 10mg/L. (Subramani *et al*, 2005).

The Total acidity values were; 60 and 49.2 mg/L and 30 and 46.4 mg/L for Ede South and North during raining and dry seasons respectively. The values reported for raining season were a bit higher than the dry season .The acceptable range is 50 to 200 mg/L and the desirable range is 50 to 100 mg/L (Bhatnagar and Devi (2 013). These results suggested that the values obtained for both seasons and locations were within the range which showed that the aquatic organisms are safe.

The Total alkalinity of Ede South and North raining season were 90 and 75 mEq/l and 70.5and 60.2 mEq/l for dry season respectively. This result was in agreement with 92.33 mEq/l and 69.66 mEq/l reported by Kumar *et al* (2017) during raining season. The higher values recorded during the raining season was due to the presence of excess CO_2 coupled with mixing of domestic waste from water runoff. According to Bhatnagar and Devi (2013), the permissible limit for fish production was between 25 to 100 mEq/l. The results fall within this range and in agreement with WHO permissible limit.

Table 1: showing result of physiochemical analysis.

PARAMETERS	A1	A2	B1	B2	WHO
PH	6.87	7.60	7.26	7.57	6.0-9.0
CONDUCTIVITY Us/cm	51.80	52.23	51.4	52.57	<1000
TEMPERATURE C	27.02	27.03	27.05	27.07	20-30
TOTAL HARDNESS Mg/l	248.3	125	275	225	20-300
Ca HARDNESS Mg/l	150.0	151.67	175	173.3	75-200
Mg HARDNESS Mg/l	98.3	-26.67	100	51.7	<150
D.O Mg/l	5.07	2.18	6.05	2.56	<6.0
B.O.D Mg/l	0.84	1.33	1.77	1.24	1.0-2.0

C.O.D Mg/l	56.67	43.33	83.33	43.3	<100
TURBIDITY NTU	41.03	18.98	43.07	20.1	30-80
TOTAL SOLID g	0.034	0.020	0.042	0.019	<500
T.S.S g	0.021	0.012	0.032	0.014	<15
T.D.S g	0.01	0.009	0.01	0.005	<10
TOTAL ACIDITY g/l	60	30	49.2	46.4	50-100
TOTAL ALKALINITY mEq/l	90	70.5	75	60.2	25-100

The results for Heavy metals (chromium, lead, nickel, cobalt and cadmium) for Ede South raining season were: 0.401, 0.053, 0.047, 0.209 and 0.020 mg/L respectively while North raining season were: 0.485, 0.057, 0.050, 0.204 and 0.047 mg/L respectively. The result for Ede South dry season were: 0.399, 0.041, 0.042, 0.192 and 0.018 mg/L while North dry season were; 0.441, 0.054, 0.042, 0.200 and 0.019 mg/L respectively. These results were in agreement with Ibrahim *et al*. (2016) on assessment and seasonal variation of heavy metals and mineral element in river Sokoto were; 0.00, 0.00, 0.00, 0.00, 1.41mg/L during raining season and 0.09, 0.01, 0.01, 0.05, 0.00 mg/L for dry season. Heavy metals are toxic even at very low concentration. There

was high concentration in dry season than raining season because the fishes accumulate metals in their body more during the dry season (Sangoremi, 2013). World Health Organization standard for the metals is 0.05, 0.01, 0.02, and 0.1, 0.003 mg/L (WHO, 2003) for Cr, Pb, Ni, Co and Cd respectively. The two seasons were higher than WHO standard.

Table 2: showing results of heavy metal analysis

Heavy metals mg/L	A1	A2	B1	B2	WHO
Cr	0.399	0.401	0.441	0.485	0.05
Pb	0.041	0.053	0.054	0.057	0.01
Ni	0.042	0.047	0.042	0.050	0.02
Co	0.192	0.0209	0.204	0.200	0.1
Cd	0.018	0.020	0.019	0.047	0.003

CONCLUSION

Water quality is an important factor to keep the environment healthy and sustainable. When water quality is poor, it affects not only the life of the aquatic organism but also the surrounding ecosystem. Results from this research work show that there is a difference in the physiochemical parameters for raining and dry season. Most of the water quality parameters fall within the standard of WHO but there was a clear cut difference between the two seasons. Parameters such as dissolved oxygen, biochemical oxygen demand and chemical oxygen demand show that the raining season favors high productivity of fish farming than dry season.

The ponds for both raining and dry season have traces of Cr, Pb, Ni, Co and Cd in them. The concentrations of these metals present in both seasons were higher than acceptable limits. However, the concentration was higher in dry than raining season because of the accumulation of metals in the body of the fishes. The

physiochemical results showed that there will be high productivity in fish farming during the raining season than the dry season.

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