DETERMINING THE PHYSICO-CHEMICAL PARAMETERS OF TWO WATER BODIES (BAYEIKU AND OFFIN RIVERS) IN IKORODU DIVISION OF LAGOS STATE, SOUTHWEST NIGERIA

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ABSTRACT
Contamination of water bodies due to anthropogenic activities of man has been a major concern to mankind particularly in developing nations where regulations by government are either not obeyed or no stringent regulations to monitor and punish the offenders. The biological wealth of a water body is mainly dependent on its physico-chemical parameters' quality. The physico-chemical qualities of two waterbodies (Bayeiku and Offin Rivers) in Ikorodu division of Lagos State, were sampled and analysed with the intention of determining the extent of pollution and the health of the water bodies. Five sampling stations each were established on both rivers and samples collected monthly for six months (March to May 2021). The physico-chemical parameters were analysed using standard methods by APHA. The obtained result revealed that the average value of the parameters analyzed are; turbidity (29.71±23.03 NTU), conductivity (401.94±576.52 µS/cm), DO (33107.92±59091.09 mg/L), hardness (33107.92±59091.09) and that these values are above the WHO allowed limits except for temperature (29.09±1.65°C), pH (7.59±0.34) and salinity (3.05±3.45). One-way analysis of variance (ANOVA) and the 95% confidence level revealed that the value of each parameter was not statistically significantly (p >0.05). The variation of each parameter was as a result of pollution from activities that take place along the river bank.

Keywords: *Physico-chemical, Coastal water, Salinity, Conductivity, Dissolved Oxygen.*

INTRODUCTION
Water is the culture environment for fish and other aquatic organisms, access to adequate, regular and constant supply of good quality water is vital in any aquaculture project. Sikoki and Veen (2004), reported that any water body is a

potential medium for the production of aquatic organisms. Water occupies about 71% of the earth's surface and yet it is one of the scarcest commodities especially in the developing countries of the world (Karikari and Ansa, 2006). Water is also one of the most demanded of all urban and rural amenities and it is indispensable for man's activities. Oketola, *et al.,* (2010) noted that water is abundant on the planet Earth as a whole, but fresh potable water is not always available for human or ecosystem use. Around 780 million people worldwide do not have access to clean and safe water and 2.5 billion people do not have proper sanitation (Singh, *et al.,* 2010). As a result, around 6.8 million people die each year due to water related diseases and disasters (Okoro, *et al.,* 2017). Tajuddin, *et al.,* (2012) conducted an investigation on comparative assessment of water quality in the major rivers of Dhaka and West Java in Bangladesh and concluded that there was a considerable contamination by heavy metals, physico-chemical and biological pollutants. In addition, they opined that biological pollution indicates anthropogenic sources caused by poor sewerage system whereas the heavy metals and physio-chemical pollution indicate industrial sources. Ugwu and Wakawa (2012) studied the seasonal physico-chemical parameters in River Usman and reported that there is adverse effect of the monsoon as well as diverse anthropogenic activities on the bacterial population of water bodies which has led to decrease in bacterial calculations in the heavy rain period owing to flushing effect. Kumar (2007) conducted field research on view of freshwater environment and revealed that high saturation levels of dissolved oxygen and low concentrations of phosphates, nitrate, sodium and potassium in surface waters varies seasonally.

Onyegeme and Ogunka (2015) investigated the seasonal variations in physico-chemical and bacteriological parameters of Ulasi River in Okija, Anambra State Eastern Nigeria and noted that the high value of biological oxygen demand (BOD) and Coliform count in the dry season was an indication of water quality deterioration as a result of effluents released into the water body untreated.

Onyegeme and Ogunka (2015) in a study on physico-chemical properties of water quality of Imeh, Edegelem and Chokocho communities located along Otamiri-Oche River in Etche, Rivers State, concluded that parameters such as the pH, total dissolved solids (TDS), dissolved oxygen (DO), BOD and chemical oxygen demand (COD), alkalinity, hardness, chloride, nitrate-nitrite were found to be abnormal due to large amount of oxygen demanding wastes entering into the river from domestic sources. Iyama. and Edori (2014) in their studies on the water quality of Imonite Creek in Ndoni, Rivers State, concluded that the quality of a given water body is governed by the physical, chemical and biological factors all of which interact with one another and greatly influence its productivity, bio-monitoring in conjunction with physical and chemical observation of water quality is potentially useful in assessing water bodies. Meliga and Salifu (2014) assessed the physico-chemical and biological parameters of Imaboro River in Ibadan, Oyo State, opined that the pH, DO, BOD, chlorides, phosphates and nitrates has changeable levels of pollution from unpolluted to exceptionally-polluted levels depending on the seasons of the year which have a posturing danger to the fish health and biodiversity.

Cosmas A., *et al.,* (2015) conducted an investigation on comparative assessment of the physico-chemical and microbial trends in Njaba River, and reported that industrial activity and its effluent have contaminated the surface water with large amount of heavy metals (Mn, Cr, Cd, Ni, Zn and Fe), Ca, chlorides and total hardness were in high levels. Raja and Venkatesan (2010) also assessed the surface water pollution and its impact in and around Punnam area of Karur district, Tamilnadu, India and reported that there was variation in the parameters like total hardness, total alkalinity, dissolved oxygen, conductivity, and pH of surface water bodies. They found that dissolved oxygen was maximum during winter which was as a result of cool atmospheric temperature. According to the result, during the summer, conductivity, total hardness and total alkalinity were found to be at upper limits.

This study was conducted to assess the physio-chemical parameter of Baiyeku and Offin water bodies; compare these levels with International Standards such as World Health Organization (WHO, 2011) and the implication of these levels of surface water quality on human health in the study area.

STUDY AREAS

Offin and Bayeiku Rivers are major source of water for the communities and its axis. The source of livelihood of the members of the community is also from this river as many are into fishing and fish found from this water are sold to make a living and sometimes for their personal consumption. The Community drink, cook, wash in this rivers and majority of their domestic waste is channeled on this river such as their sewage waste and bath waste. Presently dredging activities is also ongoing in this area.

Bayeiku River

Three station were selected on the river and were tag stations 1, 2, & 3 (represented in red colour) Station one was located at the far-right side of the river, station two was situated near a dredging machine on the river which was about 500m from station one and station 3 was sited at about 500m from station two..

Offin River

Three station were also selected on the Offin river and were tag station 1, 2, & 3 (represented in yellow colour). Station one was located at the far-right side of the river, station two was situated beside mangrove in the river and station three near the shore. All the stations are 500m from each other.

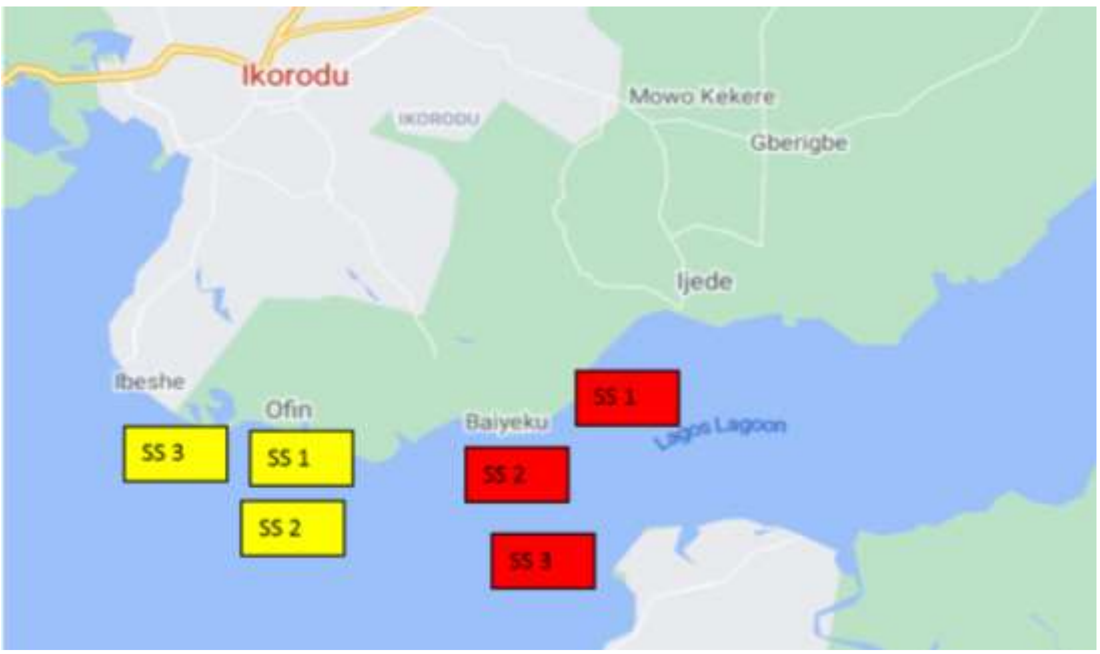

Figure 1: Map of Ikorodu showing Bayeiku and Offin river with the sampling stations, red for Baiyeku and yellow for Offin rivers respectively(Edited Open Source Google Map).

MATERIALS AND METHOD

Experimental Sites and Design

The study areas are Bayeiku and Offin river systems located in Ikorodu division of Lagos State, Southwest Nigeria. Three sampling locations each were set up within the river systems. One of the sampling locations was close to a dredging vessel stationed in Bayeiku river system (Figure 1). Other stations were about 500m apart each. Samples were collected weekly for 12 weeks. Stratified random sampling was carried out in each water body and the physico-chemical parameters measured according to standard method APHA (1981). The stations were marked with the aid of Global positioning system (GPS) and the readings on the GPS were recorded as coordinates of the sampling stations. Samples were collected every Thursday of the week between 8:30am and 11:00am on sample collection days. Sampling operations were carried out using motorized boat.

Collection of Water Sample

Water samples were collected for analysis by dipping 250 cl plastic containers below the water surface at different sampling stations and the containers were closed underneath the water to avoid air being trapped in the containers. The different plastic containers were labeled appropriately with dates of sample and the name of the station where the samples were collected. Samples were taken immediately to the laboratory for analysis and the physico-chemical parameters were obtained. Water and air temperature were measured insitu by using mercury - in - glass thermometer.

Determination of Physico-Chemical Parameters

Turbidity

- Before switching on the turbidity meter, remove the cuvette to avoid damage.
- Rinse the cuvette with deionized water and the sample.
- Pour sample into the cuvette above the mark then apply a drop of silicon oil on the cuvette and clean with a soft cloth (to clean off dirt and finger prints).
- Insert cuvette into the turbidimeter with the arrow mark on the cuvette aligning with the angle in the turbidimeter then close the lid.
- Record readings on the sixth number that comes up on the display
- The standard for turbidity is 5NTU

pH

Switch on the pH meter and after the self-test, insert the probe into the sample (ensure the probe is immersed properly to cover the tip) then press the read button

- Rinse the probe/electrode with deionized water.
- A stabilizing bar is displayed while a lock sign is shown when sample pH is reached.
- Note and record reading when the lock sign appears.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry and electric current. An ion is an atom of an element that has gained or lost an electron.

In water, it breaks apart into an aqueous solution of sodium and chloride ions. This solution will conduct an electrical current the conductivity of water estimates the total amount of solids dissolved in water total dissolved solids).

NB: the higher the conductivity, the lower the salinity

Materials required:

-Well labelled beaker
• Cotton wool
• Delonized water
• Conductivity meter
• Masking tape/labelling palette

Procedure

Using a well labelled beaker, rinse and measure 50mls (after shaking the sample vigorously)

- Switch on the conductivity meter and rinse the probe with de-ionized water then clean with cotton wool to avoid contamination
- Insert the probe into the measured sample and achieve stability
- Once stability is achieved, the readings should be taken

Dissolved Oxygen (DO)

Dissolved oxygen can be defined as one of the most important indicators of water quality. It is essential for the survival of aquatic life. Oxygen dissolves in surface water due to the aerating action of winds; oxygen is also introduced into the water as a by-product of aquatic plant. Dissolved oxygen is the amount of gaseous oxygen dissolved in the water. Temperature and volume of moving water can affect dissolve oxygen levels.

Factors constantly affecting DO include:

- Diffusion and aeration
- Photosynthesis
- Respiration and decomposition

NB:

- Water equilibrates towards 100% air saturation, DO levels will fluctuate with temperature, salinity and pressure changes.
- If DO is too high, it causes gas bubble disease in fish and invertebrates.

Apparatus required:

- Beaker
- Cotton wool
- Conductivity meter
- Masking tape
- De-ionized water

Procedure:

- Water sample should be at room temperature and DO NOT SHAKE to avoid pressure build up (pressure affects DO).
- Switch on the DO meter and ensure the value of calibration ranges between 7.0 – 8.5 (it is air calibrated).
- Rinse the probe with de-ionized water (especially the metal eye) then clean with cotton wool to avoid contamination.
- Insert the probe into the sample and ensure the water covers the metal eye on the probe.
- Take the reading for the DO and temperature immediately the hour glass symbol disappears from the screen.

Note: Each machine has its own calibration method according to manufacturer.

Salinity

Measuring salinity with a conductivity meter (in field or lab)

- Prepare the conductivity meter for use according to the manufacturer's directions.
- Use a conductivity standard solution (usually potassium chloride or sodium chloride) to calibrate the meter for the range that you will be measuring. The manufacturer's directions should describe the preparation procedures for the standard solution.
- Select the appropriate range on the meter, beginning with the highest range and working down. Place the probe into the sample water, and read the conductivity of the water sample on the meter's scale.
- Rinse the probe with distilled or deionized water and repeat the fourth step above with the next water sample until finished.

Hardness

Safety

Avoid skin contact with chemicals.

Materials and Apparatus

- 50% w/v NaOH solution (50 g in 100 cm^3 solution) Eriochrome Black T indicator pH 10 NH_3-NH_4Cl buffer.
- Hydroxynaphthol blue indicator.
- Apparatus required for titration.
- 5 cm^3 measuring cylinder.

Procedures

- Pipette 50 cm3 mineral water into a conical flask.
- Add 2 cm3 buffer solution followed by 3 drops of Eriochrome Black T indicator solution.
- Repeat the titration to obtain two concordant results.

Data Analysis

The following statistical tools were used to analyzed the data obtained: Data were organized using Excel, and residuals of the data were checked for normal distribution using the Kolmogorov–Smirnoff test and homogeneity of variance was checked by use of Levine's test. All statistical analyses were performed by use of SPSS (IBM SPSS Statistics).

RESULTS

Tables 1 and 2 shows the co-ordinates of the sampling stations.

Table 1: Description of co-ordinates of sampling area at Bayeiku stations

	Station description of study area	*Co-ordinate Latitude*	*Co-ordinate Longitude*
1	Far Right of Bayeiku Lagoon	6^0 32' 7.98" N	3^0 33' 26.46" E
2	Near a dredging vessel in the water	6^0 32' 8.91" N	3^0 33' 30.096" E
3	Close to the shoreline	6^0 32' 7.332" N	3^0 33' 25.524" E

Table 2: Description of co-ordinates of sampling area at Offin stations

	Station description of study area	*Co-ordinate Latitude*	*Co-ordinate Longitude*
1	Far Right of Offin Lagoon	6^0 32' 20.904" N	3^0 30' 2.88" E
2	Beside mangrove in the water	6^0 32' 20.76" N	3^0 30' 6.912" E
3	Close to the shore of the water	6^0 32' 22.736" N	3^0 29' 58.128" E

Temperature

Figures 2 and 3 shows the mean temperature at Bayeiku and Offin sampling stations.

The highest water temperature (31.4°C) was recorded in week 4 (station 2) for Bayeiku river and (33.9°C) in week 5 (station 2) for Offin river. The lowest (25.2°C) was recorded in week 6 (station 2), and (26.7°C) in week 10 (station 1) for Bayeiku and Offin rivers respectively. F-value was recorded as (0.867) for Bayeiku and (0.460) for Offin river. Result showed that there were no statistically significant differences in the values of the temperature for both river bodies ($P>0.05$).

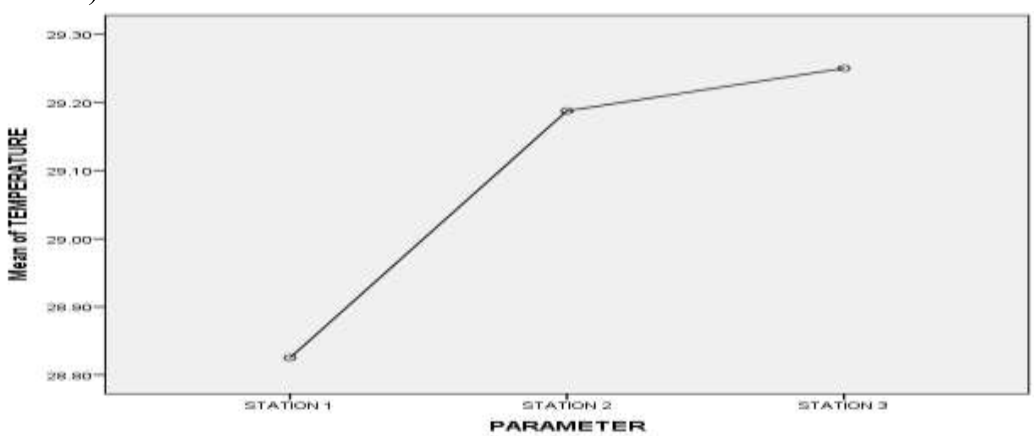

Figure 2: Average mean temperature at Bayeiku sampling station

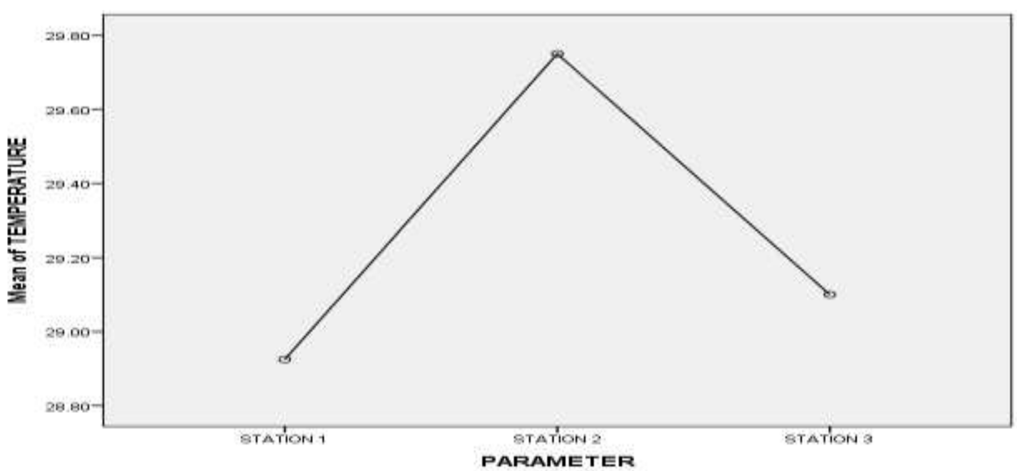

Figure 3: Average mean temperature at Offin sampling station

pH

pH values vary with regular pattern, the highest pH values (8.34) were recorded in week 3 (station 2) for both Bayeiku and Offin rivers. The lowest pH (6.56) was recorded in week 3 (station 3) for Bayeiku and (7.14) recorded in week 9 (station 3) for Bayeiku and Offin rivers respectively. There was no statistically significant difference in the pH (F-value = 0.29, 0.90, P>05) for both rivers respectively.

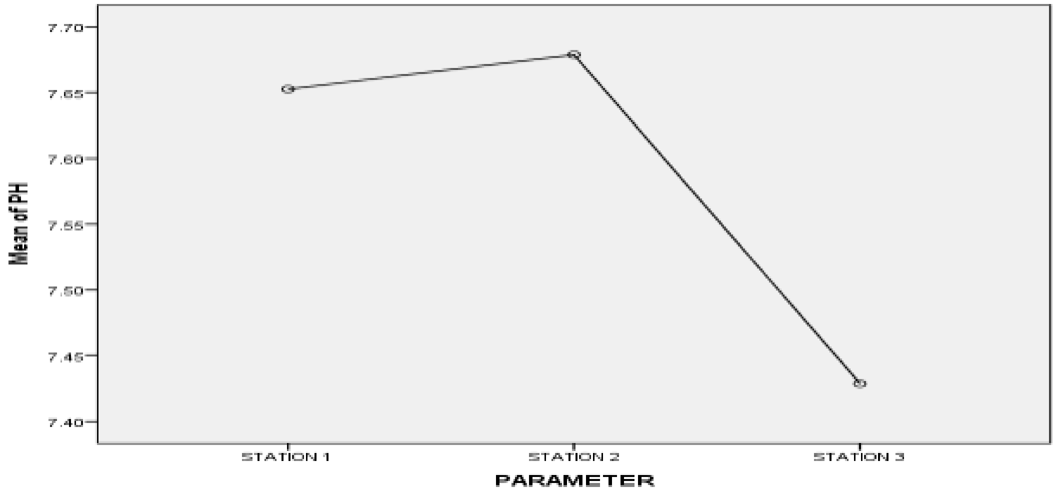

Figure 4: Average mean pH at Bayeiku sampling station

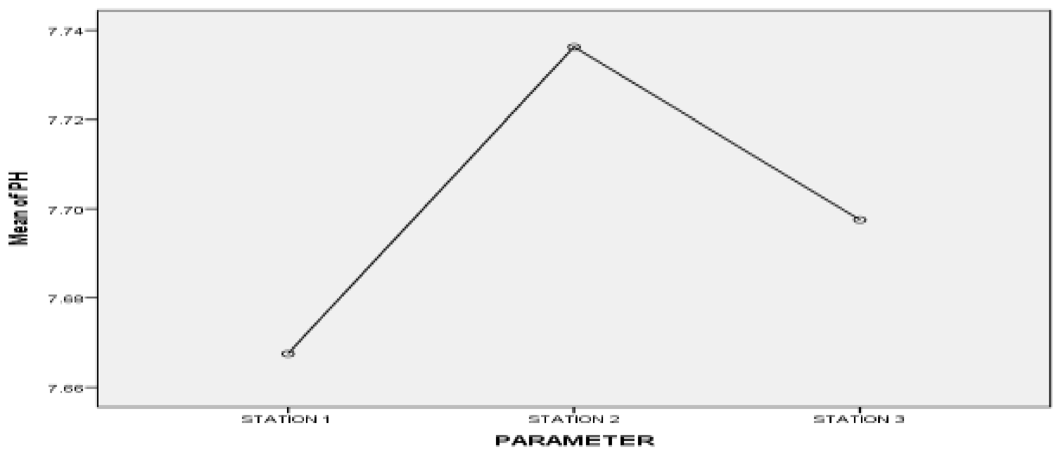

Figure 5: Average mean pH at Offin sampling station

Salinity

Salinity fluctuation almost follows an increasing regular pattern across the weeks. The highest salinity (8.37) was recorded in week 8 (station 2) while the lowest salinity (0.12) was recorded in week 2 (station 2 and 3 respectively) for samples collected from Bayeiku river. Samples from Offin river has the highest salinity (13.2) recorded in week 8 (station 3) and the lowest (0.22) in week 1(stations 1 and 2). F-value= 1.00 and 0.99 for both rivers respectively. There were no statistically significant differences (P>0.05).

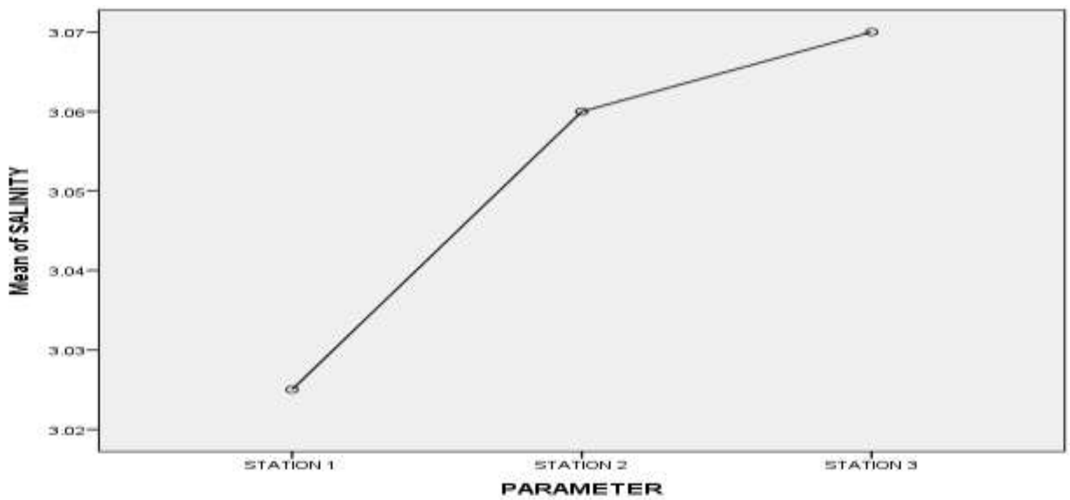

Figure 6: Average mean salinity at Bayeiku sampling station

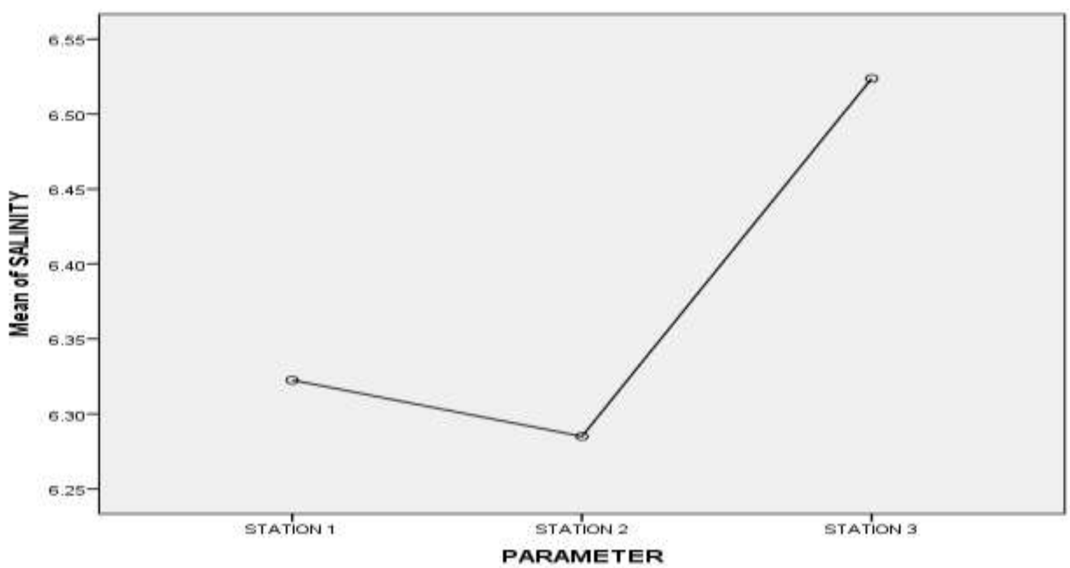

Figure 7: Average mean salinity at Offin sampling station

Dissolved Oxygen (DO)

Fluctuation in DO level varies with no regular pattern. The highest oxygen level (7.46) was recorded in week 3 (station 2) and the lowest oxygen level (3.52) was recorded in week 5 (station 2) for Bayeiku river. The highest oxygen level (7.71) was recorded in week 3 (station 3) and the lowest oxygen level (4.53) was recorded in week 6 (station 3) for Offin river. No statistically significant differences were observed in the samples collected from both rivers (F-value=0.53, 0.63; P>0.05) respectively. Dissolved oxygen (DO) values obtained from both rivers fluctuate between 3.52 to 7.46 mg/l.

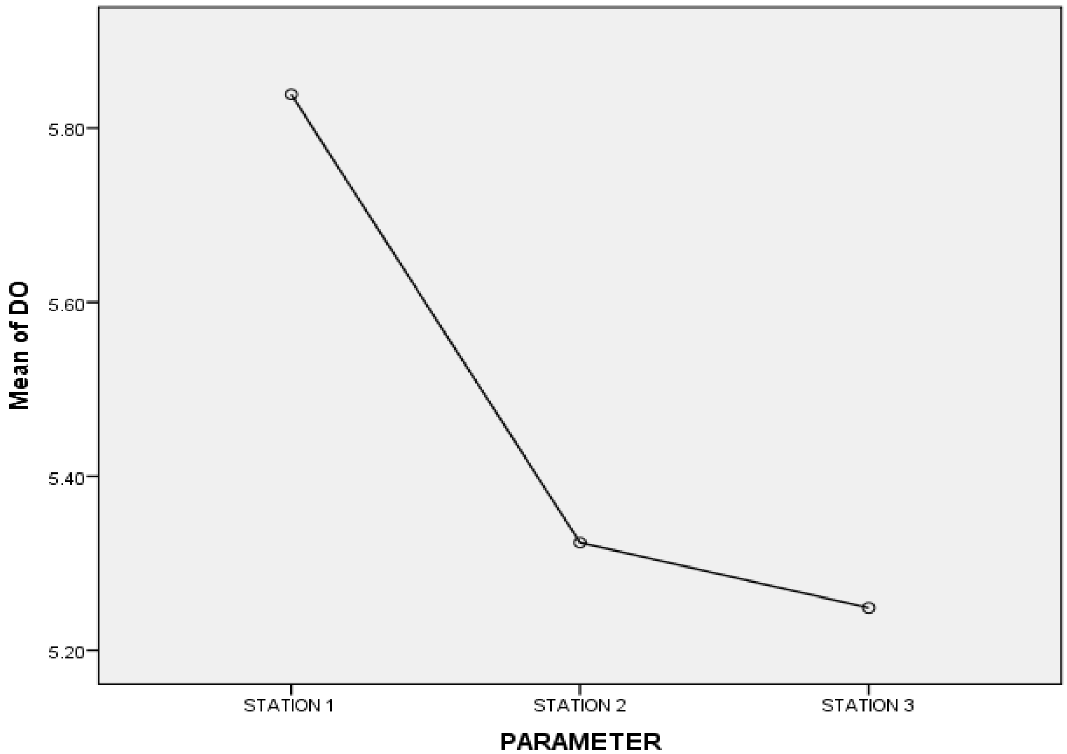

Figure 8: Average mean dissolved oxygen (DO) at Bayeiku sampling station

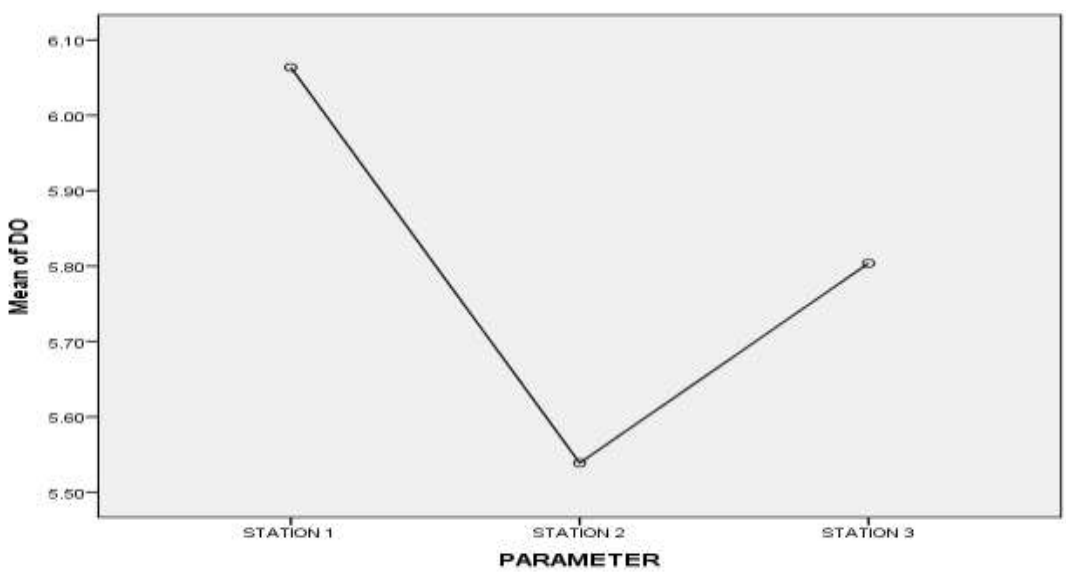

Figure 9: Average mean dissolved oxygen (DO) at Offin sampling station

Turbidity

There was fluctuation in the turbidity value across the stations and weeks. There were no statistically significant differences (F-value =0.99, 0.62; P>0.05) in the turbidity of both water bodies respectively.

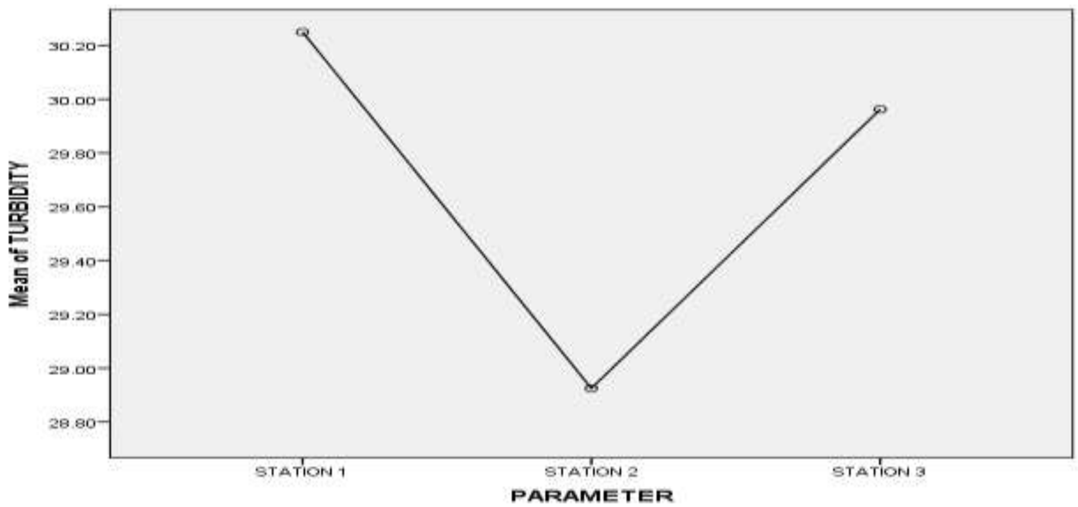

Figure 10: Average mean turbidity at Bayeiku sampling station

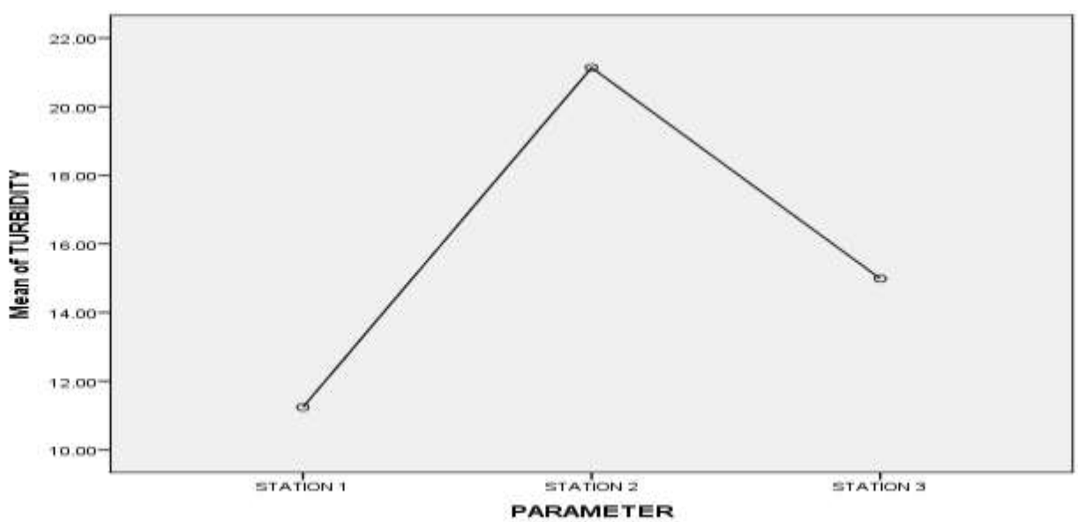

Figure 11: Average mean turbidity at Offin sampling station

Conductivity

Highest conductivity (1834.0µS/cm) was recorded in week 12 (station 1) and the lowest (0.016µS/cm) was recorded in station 1 (week 7 and week 8) for Bayeiku river (F-value=0.99; P>0.05). For samples collected from Offin river, highest conductivity (672µS/cm) was recorded in week 2 (station 3) and the lowest (0.023µS/cm) was recorded in week 7 (station 2) (F-value=0.64; P>0.05).

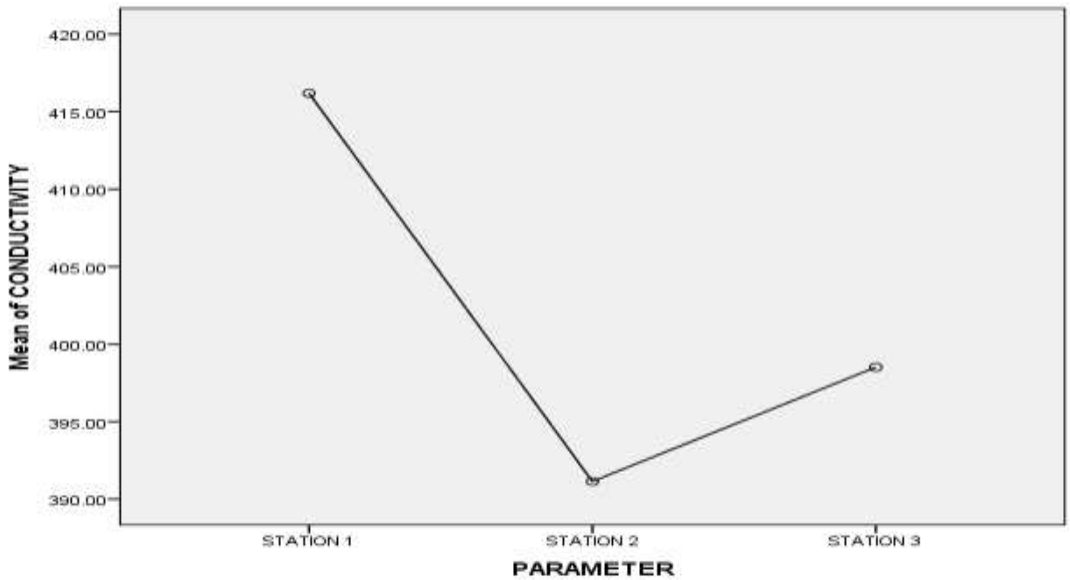

Figure 12: Average mean of conductivity at Bayeiku sampling station

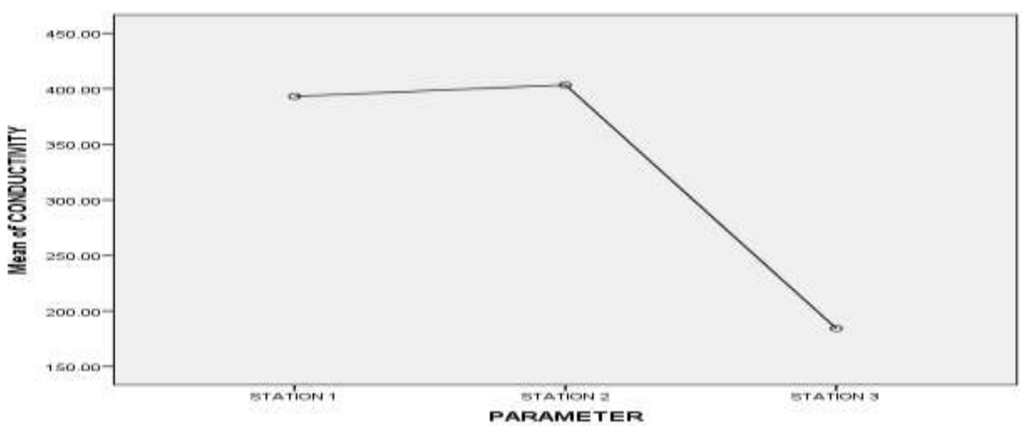

Figure 13: Average mean of conductivity at Offin sampling station

Hardness

Hardness level varies with no regular pattern; the highest hardness level was recorded in week 8 at station 3 (170000mg/l) while the lowest value (36mg/l) was recorded in week 1 (station 3) for both rivers F-value=0.996; P>0.05. There was no statistically significant difference between the samples.

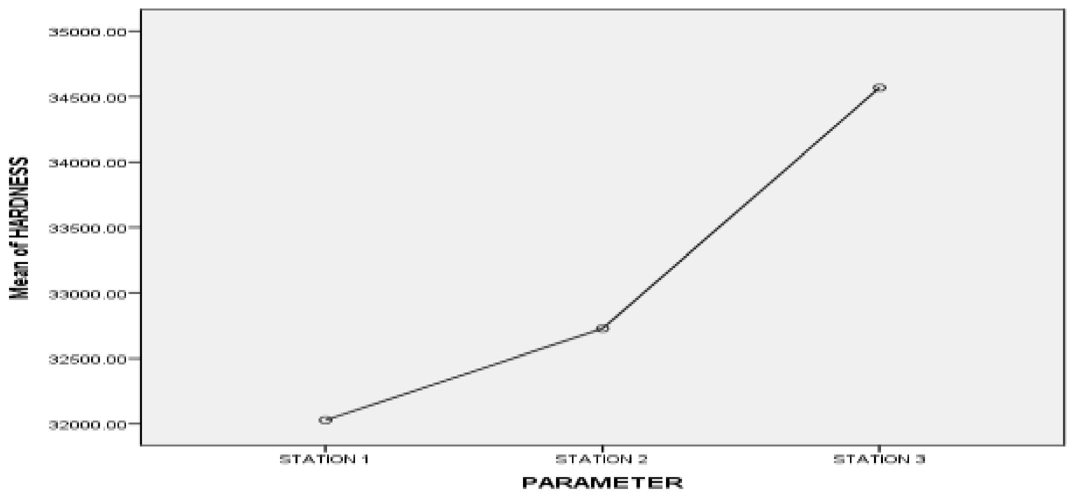

Figure 14: Average mean of hardness at Bayeiku sampling station

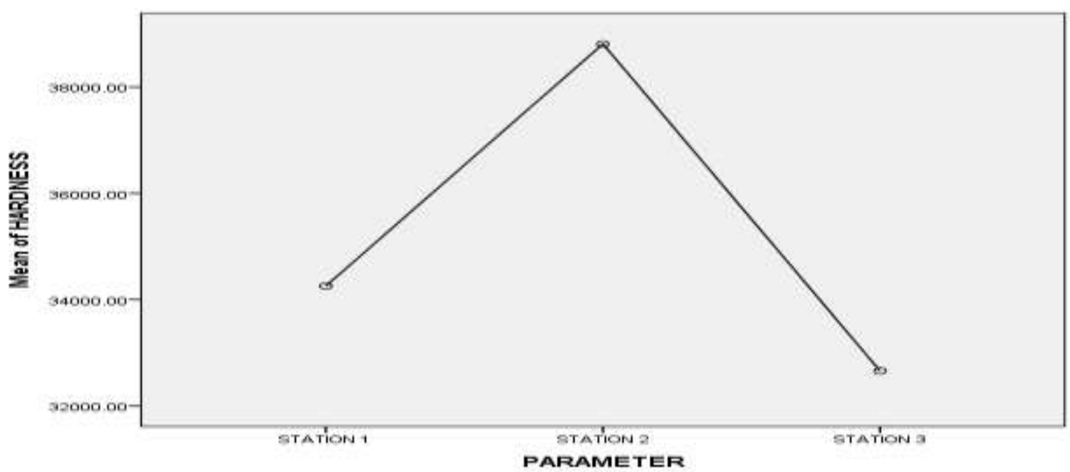

Figure 15: Average mean of hardness at Offin sampling station

DESCUSSION

Offin and Bayeiku Rivers are major source of water for both communities. It also serves as source of livelihood for members of the communities because fish and fishing activities is been carried out in this communities.

The pH levels of the two water bodies are within the normal range.The pH for natural water is usually between 6.5 and 8.5 although variations are known to occur, such water is belief to be good. When pH is greater than 9.2 or below 4.0 such water becomes undesirable for both human and most organisms. pH was within the recommended WHO permissible limits for drinking water (WHO, 2014). According to (Fakayode, S.O., 2005), the pH of a water body is very

important in the determination of water quality since it affects other chemical reactions such as solubility and metal toxicity.
Dissolved oxygen (DO) values obtained varied between 3.52 to 7.46 mg/l as shown in Table 3. The WHO standard (SridhaR, M. K. C 2000) for sustaining aquatic life is stipulated at 5mg/l. A concentration below this value adversely affects aquatic biological life (Todd, D.K., 1959) and (Waziri. M. and Ogugbuaja V.O. 2010). while concentration below 2mg/l may lead to death for most fishes (WHO, 2000 and WHO, 2004) and anaerobic conditions that cause bad odours (Venkatesharaju, K., et al., 2010, WHO, 2004). The DO levels at many points are above this level.
The temperature range of the samples were at ambient temperatures. There were slight increase in the electrical conductivity of water samples from Bayeiku river and these were found to be higher than the acceptable limit.
The results obtained for phosphate and sulphate were within the water quality standards prescribed limits. The study of the levels of phosphate and sulphate concentrations in the samples was important for various reasons. Phosphate enrichment of water bodies contributes to ecological impacts and their presence in water bodies contributes to eutrophication of natural waters.
There was fluctuation in turbidity levels for all sampling stations. It is known that at high levels of turbidity, water loses its ability to support a diversity of aquatic organisms. Water becomes warmer as suspended particles absorb heat from sunlight, causing oxygen levels to fall.Turbidity, as a physical contaminant, has the potential to hinder photosynthesis of organisms with the potential for phytoremediation of polluted water bodies (Elango & Elango, 2017). It can also protect microbes from the effects of disinfectants (WHO, 2017).

CONCLUSION

This research study was a short-term monitoring of the increasing pollution of the Bayeiku and Offin rivers in Ikorodu division of Lagos State, Southwest Nigeria and the impact on aquatic life. It analyzed the general physico-chemical parameters of the two water bodies. The study reveals that the water quality of Bayeiku and Offin rivers was found to be unfit for human use and may impact other aquatic life like fish. Lagos State Environmental Protection Agency and other environmental agencies should regularly conduct short term studies on our water bodies as a means of measuring the qualities and advice the local communities on ways to keep the water safe for human and aquatic life.

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