

# Evaluation of Suitability of Omambala River in Anaku Community for Aquaculture Production

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Received:- 05 February 2022/ Revised:- 20 February 2022/ Accepted:- 11 March 2022/ Published: 31-03-2022

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## Abstract—

**Background and Objectives:** Water quality is the most important factor affecting fish health and performance in aquaculture production. This research was therefore carried out to evaluate the suitability of Omambala river in Anaku community for aquaculture purposes.

**Materials and Methods:** Physicochemical properties, heavy metals and biological parameters were assessed to determine the suitability of the river water for aquaculture production using three different sampling stations. Data obtained were compared with the permissible limit of World Health Organization. Analytical tools used were T-test and ANOVA with SPSS Version 20.

**Results:** The study revealed that the physicochemical parameters and heavy metal concentration were in the range of temperature,  $27.33 \pm 0.57^\circ\text{C}$ , turbidity,  $49.80 \pm 5.70\text{cm}$ , nitrate,  $1.06.00 \pm 0.52\text{mg/l}$ , Ammonia,  $0.53 \pm 0.03\text{mg/l}$ , pH,  $6.77 \pm 0.06$ , Dissolved oxygen,  $9.33 \pm 0.57\text{mg/l}$ , lead,  $0.123 \pm 0.015\text{ppm}$ , cadmium,  $0.133 \pm 0.003\text{ppm}$ , mercury,  $0.861 \pm 0.101\text{ppm}$ , zinc,  $0.518 \pm 0.03\text{ppm}$  and iron,  $7.436 \pm 0.58\text{ppm}$ . This study revealed that the physicochemical parameters were within tolerable limit except nitrate while the heavy metals were above the tolerable limits except zinc. There were abundance of phytoplankton and zooplankton in Omambala river.

**Conclusion:** Omambala river in Anaku fishing community is suitable for aquaculture purposes when properly treated to reduce high concentrations of heavy metals and it is recommended that proper environmental impact assessment of industrial, domestic and anthropogenic effluents into Omambala river be carried out to establish adequate detoxification measures.

**Keywords:** Physicochemical parameters, heavy metals, Aquaculture suitability, plankton productivity and tolerable limits.

## I. INTRODUCTION

The importance of water as a resource that supports growth, survival and production of fish cannot be over emphasized. Nigeria is blessed with numerous water bodies ranging from the marine (Atlantic Ocean), through the brackish waters (deltaic rivers and estuaries) to inland freshwaters (rivers, streams, springs and lakes). Despite these available resources, recent trends have shown decline in the Nigerian capture fisheries and this calls for development of aquaculture especially in fishing communities as they possess the potentials<sup>1</sup>.

Aquaculture is said to be the rational rearing of aquatic organisms (fish, shrimp, prawns, water snails) in an enclosed and fairly shallow body of water where all its life processes can be controlled<sup>2</sup>. It is an important sector for the nation's economic development, at a time when government is seeking ways to diversify the economy, from being purely oil based. This can contribute to alleviation of food insecurity, malnutrition and poverty through the provision of food of high nutritional value, income, and employment generation, decreased risk of monoculture production failure, improved access to water, enhanced aquatic resource management and increased farm sustainability<sup>3</sup>. Aquaculture is the fastest growing food producing industry in the world and global aquaculture production is likely to double in the next fifteen years, as a result of wild fisheries approaching their biological limits and the world demand for cultured fish continuing to increase<sup>4</sup>.

Water pollution is the introduction of substances by man directly or indirectly which can cause harm to living resources, hazard to human health, hindrance to aquatic activities and impairment of water quality with respect to its use in agriculture, industrial and other economic activities<sup>5</sup>. Natural (erosion) and anthropogenic (agricultural discharge) activities affect the quality of regional surface water<sup>6</sup>. These activities have undesirable, effects on the natural environment. Also, uncontrolled land use, urbanization, deforestation, accidental (or unauthorized) release of chemical substances and discharge of untreated wastes or leaching of noxious liquids from solid waste deposits have impacted negatively on the quality of water resources<sup>7</sup>.

Water quality evaluation is considered as a critical issue in recent years, especially when freshwater is becoming a scarce resource in the future<sup>5</sup>. Water quality evaluation aims to identify the sources of water pollution and develop a strategy for sustainable water source management, maintaining and promoting human health and other social and economic growth<sup>8</sup>.

The fishing activities in the Anaku community is of great importance since fishing is an important income source, contributing to the economy of fisher folks living around Omambala river. There has been a recent report on the number of fisher folks in Anaku fishing community who intend to increase fish production by engaging in fish culture but there is inadequate information on the quality of Omambala River for aquaculture production. Thus, this work was conducted to evaluate the suitability of Omambala river for aquaculture purposes in Anaku fishing community.

## II. MATERIALS AND METHODS

### 2.1 Study Area

This research work was conducted in Omambala river which is located in Anaku fishing community in Anambra State, Nigeria in October, 2019. Omambala is the native name of the Anambra River, which is a tributary of the famous River Niger (North), Ezu River (South), Omor and Umuerum communities (East). Anaku is a fishing community and the administrative head quarters of Ayamelum Local Government Area of Anambra State, South-East Nigeria.

The study area lies 6°15' North of the Equator and 6°44' East of the Greenwich Meridian. The area falls within the tropical climate which accounts for the prevailing moist rainforest vegetation. Climate of the area is characterized by dry season during November to March and rainy season from April to October with mean annual rainfall of about 1805 mm. The river is the most important feeder of the River Niger which flows 210 kilometres (130 miles) into the Niger River before finally being released into the Atlantic ocean through various outlets. The crop farming and fishing activities in the community are of great economic importance as most of the dwellers are crop farmers and fisherfolks who cultivate mainly rice, as well as other crops (yam, cassava, vegetables, and cocoyam) and also engage actively in daily fishing activities.

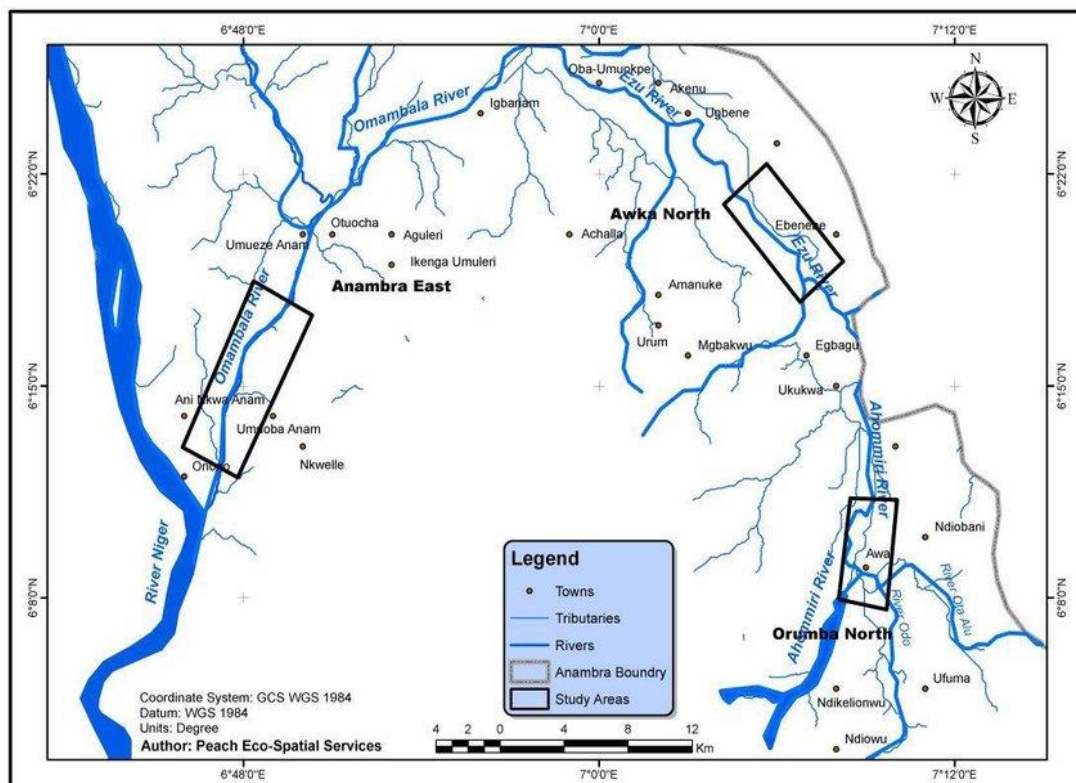


FIGURE 1: Map showing Omambala river

## 2.2 Water sampling and Method of Water Sample Collection

Three sampling stations were selected along the length of the river and labelled Station 1, Station 2 and Station 3 respectively. These sampling stations were chosen based on the hydrodynamics and characteristic features of the area. Sterilized and sealed bottles were used for sample collection. The marked sterilized bottles were dipped into the river, sealed and covered with black sack with water to avoid solar radiation effect. Then, the water samples from the three different stations in Omambala River was analysed for physico-chemical (temperature, turbidity, pH, ammonia, dissolved oxygen and nitrate), biological parameters (planktons) and heavy metals such as Iron(Fe), lead(Pb), Mercury(Hg), Cadmium(Cd) and Zinc(Zn) in order to determine the suitability of Omambala River for Aquaculture purposes.

## 2.3 Analysis of Physico-chemical parameters in the Water Samples

### 2.3.1 Temperature

The temperature was determined *in situ* using Mercury-in-glass thermometer. It was lowered into the water and allowed for three to five minutes for the thermometer to assume the temperature of the water and the reading was taken while the thermometer was still in the water to avoid interference with ambient temperature.

### 2.3.2 pH

The portable Combo HANNA instrument water check (model HI 98129) was used to determine the water pH. The instrument was dipped in a water sample until a stable pH value was displayed.

### 2.3.3 Transparency

The Sec chi disk attached to a graduated rope was lowered at the sampling station and the point of disappearance and appearance were noted and recorded as the value of transparency.

### 2.3.4 Odour and Colour

The odour and colour of the river was determined by perception and sight.

### 2.3.5 Ammonia

1ml of the water sample was introduced into a 30ml of Kjehdal flask and 1ml of the kjehdal catalyst mixture was added. The mixture was heated cautiously in a digestion rack under fire until a clear solution appeared. The clear solution was then allowed to stand for 30minutes and allowed to cool. After cooling, about 100ml of distilled water was added to avoid caking and then transferred to the kjedahl distillation apparatus. A 500ml receiver flask containing 5ml of boric acid was placed under a condenser of the distillation apparatus so that the tap was about 20cm inside the solution. The 10ml of 40% sodium hydroxide was added to the digested sample in the apparatus and distillation commenced immediately until distillation reached the 35ml mark of the receiver flask, after which it was titrated to pink colour using using 0.01N hydrochloric acid adding necessary indicators.

## 2.4 Dissolved Oxygen in Water determination

Dissolved oxygen (DO) was measured using Winkler's method. This was carried out by adding 1cm<sup>3</sup> of Manganese sulphate solution followed by 1cm<sup>3</sup> of alkaline iodide solution to the water samples. The contents were thoroughly mixed by inversion and rotation until a clear supernatant water was obtained. Then, 1cm<sup>3</sup> of concentrated sulphuric acid was added with the tip of the pipette below the level of solution and the stopper was replaced. The mixture was shaken until the precipitation was completely dissolved. Then, it was titrated against standard sodium thiosulphate (0.025 moldm<sup>-3</sup>) using freshly prepared starch solution as the indicator (added when solution became yellow). The titration was carried out in duplicate.

## 2.5 Nitrate Determination Method

Nitrate was determined using PD303 UV spectrophometer<sup>9</sup>. 50ml of the water samples was measured into a porcelain dish and evaporated to dryness on a hot water bath. Then, 2ml of phenol disulphonic acid was added to dissolve the residue followed by the addition of concentrated solution of sodium hydroxide and distilled water in order to make it alkaline. This was filtered into a Nessler's tube and made up of 50ml with distilled water, the absorbance was read at 410mm using a

spectrophotometer after the development of colour. The value of nitrate was found by comparing absorbance of sample with the standard curve and expressed in mg/l.

$$\text{Cone of sample} = \frac{\text{Abs of sample} \times \text{conc. of std}}{\text{Abs of std}}$$

## 2.6 Methods for the Heavy Metal Analysis

Heavy metal analysis was conducted using Varian AA240 Atomic Absorption Spectrophotometer (AAS) according to the method of APHA9 (American Public Health Association). For the heavy metal analysis of iron, cadmium, mercury, zinc and lead, the water sample was aspirated into the flame and atomized when the AAS's light beam was directed through the flame into the monochromator and onto the detector that measures the amount of light absorbed by the atomized element in the flame. Since metals have their own characteristic absorption wavelengths, a source lamp composed of that element was used, making the method relatively free from spectral or radiational interferences. The amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample. The standard solution for each tested element was prepared according to its concentration and the calibration curve for each metal was prepared by plotting the absorbance of standards versus their concentrations.

## 2.7 Plankton sampling and analysis

The biological properties were determined by collecting water samples from the three stations. The water samples were sieved with 1mm mesh plankton net. The sieved materials were collected in three plastic containers containing 500ml of the river water each. They were left to stand for an hour after which 480ml of the water was decanted. Then, 20ml of the filtrate was centrifuged at 3000rpm for 5minutes after which the deposit was viewed under a light microscope at X100 oil immersion and the planktons were identified using the guide to fresh water algae.

## 2.8 Statistical Analysis

Data from physicochemical and heavy metal analyses were subjected to T-test while data from biological parameters was analysed using analysis of variance (ANOVA) with Statistical Package for Social Science (SPSS) version 20 to obtain their mean differences.

## III. RESULTS

**TABLE 1**  
**FISH SPECIES AVAILABLE IN OMAMBALA RIVER**

| Common name         | Native name          | Species                        |
|---------------------|----------------------|--------------------------------|
| Electric catfish    | <i>Elulu</i>         | <i>Malapterus electricus</i>   |
| Trunk fish          | <i>Asa mkipete</i>   | <i>Gymnarchus niloticus</i>    |
| Nile tilapia        | <i>Ikpokpo</i>       | <i>Oreochromis niloticus</i>   |
| African Bony Tongue | <i>Okpo</i>          | <i>Heterotis niloticus</i>     |
| Mud catfish         | <i>Asu isi/ikere</i> | <i>Clarias gariepinus</i>      |
| Moonfish            | <i>Orowo</i>         | <i>Citharinus citharus</i>     |
| Snakehead           | <i>Efi</i>           | <i>Parachanna obscura</i>      |
| African Lungfish    | <i>Ekwumu</i>        | <i>Propterus annectens</i>     |
| Elephant snout      | <i>Uzeh</i>          | <i>Mormyrus rume</i>           |
| Upside down catfish | <i>okpor</i>         | <i>Synodontis membranaceus</i> |
| Squanga whitefish   | <i>Azu ocha</i>      | <i>Coregonus sp.</i>           |

Table 1 showed the various fish species available in Omambala river which includes; Electric catfish, Trunk fish, Nile tilapia, African Bony Tongue, Mud catfish, Moonfish, Snakehead, African Lungfish, Elephant snout, Upside down catfish, Squanga whitefish. However, fish species that are mostly demanded by consumers in the study area are Mud catfish, Trunkfish and Nile tilapia.

**TABLE 2**  
**PHYSICOCHEMICAL PROPERTIES OF THE WATER SAMPLES COLLECTED FROM THREE DIFFERENT STATIONS IN OMAMBALA RIVER.**

| Physicochemical Properties | Water Bodies Sampled |             |             | Mean $\pm$ SD     | WHO limits |
|----------------------------|----------------------|-------------|-------------|-------------------|------------|
|                            | Station 1            | Station 2   | Station 3   |                   |            |
| Turbidity                  | 44                   | 50          | 55.4        | 49.80 $\pm$ 5.702 | 5-50       |
| Temperature                | 27                   | 28          | 27          | 27.33 $\pm$ 0.577 | 15-32      |
| pH                         | 6.7                  | 6.8         | 6.8         | 6.77 $\pm$ 0.057  | 6.5-8.5    |
| Nitrate                    | 1.45                 | 0.459       | 1.28        | 1.06 $\pm$ 0.529  | 0.5        |
| Ammonia                    | 0.50                 | 0.56        | 0.53        | 0.53 $\pm$ 0.033  | 0.50       |
| Dissolved oxygen           | 9                    | 10          | 9           | 9.33 $\pm$ 0.57   | >5.0       |
| Odour                      | Odourless            | Odourless   | Odourless   |                   | Odourless  |
| Colour                     | Light brown          | Light brown | Light brown |                   | -          |

Table 2 showed that the mean value of the physiochemical parameters were in the range of temperature, 27.33 $\pm$ 0.577<sup>0</sup>C, turbidity, 49.80 $\pm$ 5.702cm, nitrate, 1.06.00 $\pm$ 0.529mg/l, Ammonia, 0.53 $\pm$ 0.033mg/l, pH, 6.77 $\pm$ 0.057 and Dissolved oxygen, 9.33 $\pm$ 0.57mg/l. This study revealed that the physicochemical parameters were within tolerable limit except nitrate.

**TABLE 3**  
**HEAVY METAL CONCENTRATIONS OF THE WATER SAMPLES COLLECTED FROM THREE DIFFERENT STATIONS IN OMAMBALA RIVER**

| Heavy metals | Water Samples |           |           | Mean $\pm$ SD     | WHO limits | USEPA limits |
|--------------|---------------|-----------|-----------|-------------------|------------|--------------|
|              | Station 1     | Station 2 | Station 3 |                   |            |              |
| Lead         | 0.120         | 0.140     | 0.110     | 0.123 $\pm$ 0.015 | -          | 0.015        |
| Cadmium      | 0.130         | 0.136     | 0.132     | 0.133 $\pm$ 0.003 | 0.005      | 0.01         |
| Mercury      | 0.76          | 0.861     | 0.961     | 0.861 $\pm$ 0.101 | 0.01       | -            |
| Zinc         | 0.491         | 0.519     | 0.543     | 0.518 $\pm$ 0.026 | 5.0        | 5.0          |
| Iron         | 6.989         | 7.216     | 8.102     | 7.436 $\pm$ 0.588 | 0.30       | -            |

Table 3 showed that the heavy metal concentrations were in the range of cadmium, 0.133 $\pm$ 0.003ppm, mercury, 0.861 $\pm$ 0.101ppm, zinc, 0.518 $\pm$ 0.026ppm and iron, 7.436 $\pm$ 0.588ppm. This study revealed that the heavy metals were above the tolerable limit except zinc. The Fe>Hg>Zn>Cd>Pb order of occurrence of the heavy metal investigated in this study means that Fe had the highest concentration while lead had the least.

**TABLE 4**  
**PHYTOPLANKTONS ABUNDANCE AT THE THREE SAMPLING STATIONS IN OMAMBALA RIVER**

|               | Phyoplanktons    |                   |                   |                  |
|---------------|------------------|-------------------|-------------------|------------------|
|               | Chlorophyta      | Cyanophyta        | Rhodophyta        | Phaeophyta       |
| Station 1     | 23               | 33                | 41                | 29               |
| Station 2     | 34               | 62                | 18                | 17               |
| Station 3     | 27               | 31                | 31                | 18               |
| Mean $\pm$ SD | 28.00 $\pm$ 5.57 | 42.00 $\pm$ 17.35 | 30.00 $\pm$ 11.53 | 21.33 $\pm$ 6.66 |

From the result above, the taxon Cyanophyta had the greatest population mean of 42.00 $\pm$ 17.35. The second most abundant taxon was rhodophyta with a mean of 30.00 $\pm$ 11.53 followed by chlorophyta with a mean of 28.00 $\pm$ 5.57 while the lowest being phaeophyta with a mean of 21.33 $\pm$ 6.66.

**TABLE 5**  
**ZOOPLANKTONS AT THE THREE SAMPLING STATIONS IN OMAMBALA RIVER**

| Zooplanktons                                | Station 1 | Station 2 | Station 3 | Mean abundance± SD       |
|---|-----------|-----------|-----------|--------------------------|
| Nematode (Adenophorea)                      | 6         | 7         | 9         | 7.33±1.53 <sup>ab</sup>  |
| Rotifier- <i>Branchionus quadridentatus</i> | 2         | 9         | 3         | 8.00±5.57 <sup>ab</sup>  |
| Protozoa- <i>Vorticella convallaria</i>     | 4         | 13        | 7         | 8.00±4.58 <sup>ab</sup>  |
| Rotifier- <i>Keratella cochlearis</i>       | 7         | 12        | 15        | 11.33±4.04 <sup>ab</sup> |
| Copepods- <i>Valdiviella insignis</i>       | 18        | 27        | 3         | 16.00±12.12 <sup>b</sup> |
| Tadpole                                     | 1         | 3         | 1         | 1.67±1.16 <sup>a</sup>   |
| Cladocerans- <i>Bosmina</i> spp             | 2         | 4         | 3         | 3.00±1.00 <sup>a</sup>   |
| Cladocerans- <i>Viaplinia</i> spp           | 2         | 4         | 3         | 3.00±1.00                |

*Columns sharing similar superscripts are not significantly different (P>0.05)*

The zooplankton community of Omambala River is dominated by Copepods with a mean of 16.12±12.12 of the total population. Rotifera was next to Copepods (mean of 11.33±4.04), followed by Protozoa (8.00±4.58) and then Cladocerans with a mean of 3.00±1.00 and the least was tadpole with a mean of (1.67±1.16).

#### IV. DISCUSSIONS

The physicochemical parameters, heavy metals, phytoplankton, and zooplankton in Omambala river were evaluated to determine its suitability for Aquaculture production. The results obtained from the physicochemical parameters of Omambala river in Anaku community showed that there was a significant difference in all the physicochemical parameters of the three stations in the Anaku water bodies ( $P<0.05$ ) except nitrate ( $P>0.05$ ). The analyses showed that the physicochemical parameters of the river water were within the standard requirement for fish culture which is an encouragement for aquaculture production in the community. The turbidity values as observed from this result are within the WHO permissible limit showing that the water contained adequate nutrients since fairly turbid water allows light penetration which support photosynthesis and oxygen production in the river<sup>10</sup>. The surface water temperature of the Omambala River recorded during this study (27.33±0.577) was optimum for normal growth and survival of aquatic organisms. The results from these findings are in agreement with the findings of Abowei<sup>11</sup> who reported that surface water temperature varied from 27°C – 31 °C in Nkoro River, Niger Delta, Nigeria. Temperature controls the rate of nutrient cycling therefore affects the availability of food and thus rate of productivity. Temperature influences water chemistry, e.g. Dissolved Oxygen, solubility, density, pH, and conductivity. Water holds less oxygen at higher temperatures<sup>12</sup>. At elevated temperatures, metabolic activity of organism increases, requiring more oxygen but at the same time the solubility of oxygen decreases, thus aggravating the stress<sup>13</sup>.

The mean pH value of water samples analysed from the three stations in Omambala River in Anaku community river was 6.77± 0.057 which was significantly ( $P< 0.05$ ) close to neutrality of the river. The pH values obtained from this result supports the work of Bellingham<sup>14</sup> who reported that the pH of natural water usually lies in the range of 4.4 to 8.5. Based on the WHO guidelines, the pH of Omambala River in Anaku community was within permissible limit. The pH of water determines the solubility and biological availability of certain chemical nutrients such as phosphorus, nitrogen, carbon and heavy metals like lead, copper, cadmium, etc<sup>14</sup>.

The ammonia value was within the permissible limits of 0.5 while the nitrate value was found to be higher than the permissible tolerance value of 0.50mg/l as suggested by WHO<sup>15</sup>. This may be due to inflow of sewage and runoff in the rainy season and leaching of fertilizers from farmlands into the river.

The concentration of dissolved oxygen (9.33±0.57) recorded in this study is apparently within the maximum allowable limit of >5 recommended by WHO<sup>15</sup>. The high level of dissolved oxygen recorded across the stations can be linked to the agitation of the water body which is caused by the activities of canoes that constantly convey passengers across the river to their various farms, school and other locations. DO concentrations of below 5 mg/L may adversely affect the functioning and survival of biological communities while below 2 mg/L may lead to fish mortality<sup>16</sup>.

The Fe>Hg>Zn>Cd>Pb order of occurrence in the heavy metals investigated in this study means that Fe had the highest concentration in Omambala River of Anaku community during the period of study. This agrees with the report of Asonye *et al*<sup>17</sup> who also reported iron as the most dominant metals in different rivers. The Iron level in the river at the time of this study exceeded the recommended standard of WHO<sup>15</sup> for surface water. This supports the work of Ikeogu *et al.*,<sup>18</sup> who reported that

iron is a major element in various minerals and rocks types and reaches natural water from sources including leaching and flaking rust from Ferro metals pipes. Mercury as seen from the result is above the standard set by WHO<sup>15</sup> (0.01ppm) for water. Anthropogenic sources have been known as one of the causes of accumulation of mercury in the form of methyl mercury in water and fish as reported by Alfred *et al*<sup>19</sup>. The heavy human activities in the stream might have contributed to this high level of mercury in the three sampling stations. From the results of heavy metal analyses, zinc was the only heavy metal below the recommended limit of WHO<sup>15</sup> while cadmium and lead concentrations were above the recommended limit of 0.01 mg/l and 0.015 mg/l respectively adopted by WHO<sup>15</sup>. According to Oguzie and Ogubere<sup>20</sup>, the presence of heavy metals in the environment is of major concern because of their toxicity, bioaccumulation tendencies and threat to the environment and human life.

Phytoplankton productivity of Omambala River in Anaku community was composed of four taxa which included chlorophyta, cyanophyta, rhodophyta and phaeophyta. There was no significant ( $P>0.05$ ) difference between the abundance of phytoplanktons sampled in the three stations in the Anaku water bodies. The presence of phytoplanktons is an indication of high nutrient content available for aquatic life. The taxon Cyanophyta had the greatest number of total mean population of  $42.00\pm 17.35$  followed by Rhodophytes with total mean population of  $30.00\pm 11.53$ . This indicates that the water has high nutrient because Rhodophytes are rarely found in rivers. The high percentage composition of Cyanophyceae indicates higher productivity of Omambala River water due to nutrient enrichment. The same observation was made by Pramila *et al.*<sup>21</sup> on Nagpur city Lakes. There was no significant difference ( $P>0.05$ ) between the abundance of zooplanktons sampled in the three stations in the Anaku water bodies. This rich zooplankton community is an indicative of good water quality with the presence of some organic pollution as suggested by Pramila *et al.*<sup>21</sup> who reported that the presence of pollution indicator species such as *Branchionus* along with clean water indicates a good water quality of the water body with presence of some organic pollution.

## V. CONCLUSION

Water quality analysis for physicochemical parameters, heavy metals concentrations and plankton productivity are very important in order to determine the suitability of Omambala River for Aquaculture purposes. The results of water quality parameter analysis from this study was found suitable for aquaculture purposes in Anaku community. This study revealed that the physicochemical parameters were within the permissible limit of World Health Organization standard except nitrate while the heavy metals were above the tolerable limit except zinc. However, this result showed that heavy metal concentrations could be a limitation to aquaculture production in Anaku fishing community. There were also abundance of fish, phytoplankton and zooplankton in Omambala River. This study revealed that the concentration of heavy metals in Omambala River present extremely serious risk for Aquaculture production. This study, therefore recommends the implementation of proper and relevant treatment techniques for treating the water before use for aquaculture production. The villagers should also be sensitized on the danger of dumping refuse inside the river. Further research on Omambala river should include the determination of source and possible solutions of heavy metal contents of the river as well as fish species harvested from this river in order to ascertain their safety for human consumption.

## REFERENCES

- [1] Asonye, C.C., Okolie, N.P., Okenwa, E.E and Iwuanyanwu, U.G (2007). Some physico-chemical characteristics and Heavy metal profiles of Nigeria Rivers, streams and waterways. *African Journal of Biotechnology* 6(5), 617-624.
- [2] FAO, (2007) Food and Agriculture Organization of the United Nations. *The state of World Fisheries and Aquaculture*. FAO Fisheries Department, Rome Italy; Pp30.
- [3] Prein, M. and Ahmed, M. (2000). *Integration of aquaculture into smallholder farming systems for improved food security and household nutrition*. Food Nutr. Bull. 21: 466-471.
- [4] Ayinla, O.A. (2012). Aquaculture Development and Appropriate Enterprise Combination in the Braced States. *In the High level meeting of experts and the meeting of Braced States Commissioners for Agriculture*. Songhai Farms, Port -Harcourt. Oct 31 –Nov.2, 2012. Pp 1-41.
- [5] Varol, M. and Sen, B. (2012). Assessment of nutrient and heavy metal contamination in surface water and sediment of the upper Trgris River, Turkey. *Cat.*92:1-10
- [6] Li Y, Khan MY, Jiang Y, et al. CART and PSO+ KNN algorithms to estimate the impact of water level change on water quality in Poyang Lake, China. *Arab J Geosci*. 2019;12(9)287.
- [7] UNESCO. (2003). Water for people, water for life: UN world water development report, executive summary. Paris: United Nations Educational, Scientific and Cultural Organization.

- [8] Carroll, S. P., Dawes, L., Hargreaves, M., Goonetilleke, A. (2006) Water Quality Profile of an Urbanising Catchment – Ningi Creek Catchment. Technical Report. School of Urban Development, Queensland University of Technology, Caboolture Shire Council, QLD, Australia, pp. 1–93.
- [9] APHA, (1995). Standard methods for the examination of water and waste water. American Public Health Association 18<sup>th</sup> Ed. New York, Washington D.C. pg 1268.
- [10] Allison, M.E., Sikoki, F.D., Hart, A.I., and Ansa, E.J. (2007). Some aspects of physico-chemical characteristics of the freshwater reaches of the lower Nun River, Niger Delta, Nigeria. *African Journal of Applied Zoology and Environmental Biology*, 9:51-58.
- [11] Abowei, J.F. (2010). Salinity, dissolved oxygen, pH and surface water temperature conditions in Nkoro River, Niger Delta, Nigeria. *Advanced Journal Food Science Technology*, 2(1): 16-21.
- [12] Akin-Oriola, G.A. (2003). On the phytoplankton of Awba reservoir, Ibadan, Nigeria. *Revista de Biologia Tropical*, 51:1
- [13] Boulton, A. J. (2012). Temperature impacts on stream ecology, *Water Encyclopedia* <http://www.waterencyclopedia.com/Re-St/Stream-Ecology-TemperatureImpacts-on.html>
- [14] Bellingham, K. (2012). Physicochemical Parameters of Natural Waters: Stevens water monitoring systems. <http://www.stevenswater.com/index.aspx>
- [15] World Health Organization (2008). Guideline for Drinking Water quality (electronic Resource). Incorporating first Addendum 1, Recommendations 3rd retrieved August 4, 2017 from <http://www.who.int/publications/2006/9241546-964.eng.pdf>.
- [16] Ramachandra, T. V. and Malvikaa, S. (2007). Ecological Assessment of Lentic Water Bodies of Bangalore. *ENVIS Technical Report: 25*. <http://ces.iisc.ernet.in/biodiversity>.
- [17] Asonye, C.C., Okolie, N.P., Okenwa, E.E and Iwuanyanwu, U.G (2007). Some physico-chemical characteristics and Heavy metal profiles of Nigeria Rivers, streams and waterways. *African Journal of Biotechnology* 6(5), 617-624.
- [18] Ikeogu, C.F., Charity, I.N., Uche, C.N., and Josiah, C.O. (2014). Histopathological Alterations in the Liver and Kidney of the Fish *Chrysichthys nigrodigitatus* due to Heavy Metals in Niger River. *Journal of Natural Sciences Research*. Volume 4, No.12. pp.14.
- [19] Alfred, B.K., Horvat, M., Prezelj, M., Briski, A.S., Krsnik, M., Dizdarevic, T., Mazej, D., Falnoga, I., Stibilj, V., Arneric, N., Kobal, D. and Osredkar, J. (2004). The Impact of Long-Term Past Exposure to Elemental Mercury on Anti-oxidative Capacity and toxicity. *Asian journal of toxicology* 65: 112-130
- [20] Oguzie, F.A. and Ogubere, C.A. (2007). Bio accumulation of heavy metals in the African catfish, (*Clarias gariepinus*) from Aze river and Idonior Fish Isoko, Delta State, Nigeria *Big Journal Applied Science*. 25: 185-196 pp.
- [21] Pramila, K., Sharda, D., Chaudhani, P.R., and Wate, S.R. (2008). A bio-monitoring of plankton to assess quality of water in the lakes of Nagpur city. In Sengupta, M and Dalwani, R (Eds). *Proceedings of Taal 2007: The 12th world lake conference*: 160 – 164