Assessment of Plankton Diversity in Relation to Water Quality Variables of Musgola Fish Farm at Lapai - Gwari, Minna, Niger State, Nigeria

Link Between Fish Farm Water Quality and Plankton Diversity at Lapai-Gwari

*Auta, Y. Iliya[1],
Shehu,Abubakar[1].,
Mohammed, A.Z.[1],
Hamzat , Aliyu[2].,
Mohammed,C.Dangana[3].,
Gilbert, Ndatimana[1].

[1]Animal Biology Department, Federal University of Technology, Minna. Nigeria.
[2]Ibrahim Babangida Badamasi University, Lapai, Niger State. Nigeria.
[3]Plant Biology Department, Federal University of Technology, Minna. Nigeria.

*Corresponding Author

Abstract:- This study was carried out to determine the plankton interaction with the physico-chemical parameters of four earthen fish ponds in Musgola Fish Farm Minna, Niger state. The study was conducted from March to June; 2021. Samples of Water were analyzed using standard methods. One-way analysis of variance with Duncan multiple tests was used to analyze the water quality parameters. PAST (Multivariate: Canonical correspondence analysis) was used to evaluate relationship between plankton communities and environmental variables. Physico-chemical Parameters determined include: Biochemical Oxygen Demand, Alkalinity, Dissolve Oxygen, Nitrate (NO_3), Phosphate (PO_4), Sodium(Na),potassium(k), Electricalconductivity, Air temperature and potential hydrogen. There was no significant temporal variation in physico-chemical variables. However, there were slightly change in parameters throughout the study period. The study revealed thatzooplanktons were dominated by Cladocera species (*MoinaMicrura*) with (43.02%), followed by Copepod (*Cydopoid copepods*) with (26.99%) and Rotifers (*Brachionuscalyciflorus)*representing7.45%.The abundance of zooplankton observed in this study can be attributed to the anthropogenic perturbations on-going in and around the Fish farm as well as the farmed fish. Moreover, the presence of suitable zooplankton species is essential for successful farming. Similarly, seventeen species of phytoplankton were identified,including *Bacillariophytes*, *Chlorophytes* and *cyanophytes*. *Chlorella* species of the class Chlorophyceae was the most prevalent group in the four ponds over *Bacillariophyceae* and *Cyanophyceae.*Canonical correspondence Analysis revealed that physico-chemical variables have positive influence on the composition and diversityof plankton in earthen fish ponds at Mosgola Fish Farm. The plankton community, on which the whole aquatic population depends, is largely affected by an interaction of a number of limiting factors such as, moderate sulphate, nitrate, phosphate and other factors. Variations of the physical and chemical parameters in a fish pond showed that the limnological conditions in the fish pond are not spatially homogenous.Thus, water quality management in the fish pond expressed direct influence on planktonic population, since fish ponds are shallow and constantly receive large nutrient loads (feed, fertilizing, and fish waste).

Keywords: *Planktons Diversity, Water Quality, Physico-Chemical Parameters, Musgola Fish Farm.*

I. INTRODUCTION

The plankton encompasses the phytoplankton and zooplankton inhabitants. Phytoplankton are important organisms which act as primary producers in any aquatic ecosystem (Bwala et al., 2009). They are the early biological constituent by which energy is conveyed to complex organisms along the food chain (Babatunde and Saifullah, 2014). Phytoplankton are the biological resources of the water body and form the bases of food chain in ponds (Otene and Nnadi, (2019). On the other hand, zooplanktons are the animal portion of the planktons (Nasir *et al*, 2017). They are defined as pelagic animals which are unable to maintain their position by swimming against the physical movement of water.Zooplanktons are a principal component of food for omnivorous fish that are usually farmed in extensive aquaculture (Otene*et al.,* 2019).Further, Brummett and Noble, (2013) emphasized on the fact that zooplanktons are very important in the food web of open water ecosystem. Zooplanktons are heterotrophic animals that are incapable of synthesizing organic matter by themselves They play key role in the pelagic food web by controlling phytoplankton's production and shaping pelagic ecosystem(Nasir, *et al,* 2017). Furthermore, Otene and Nnadi, (2019) observed that lack of zooplanktons causes poor survival of spawn in nursery ponds.

They are commonly divided into *Rotifers* (Rotifera), *Cladocerans (Cladocera)* and *Copepods (Copepoda*). The composition of zooplanktons has vital role for successful fish farming (Otene*et al.,* 2019), since they play important role in the food chain, ad being in the second trophic level as primary consumer and also as contributors to the next trophic level (Arazu and Ogbeibu, 2017).Zooplankton population get improved with the application of manure to maintain the water quality favourable for fish production. As such, poultry manures are found to release soluble salts continuously, resulting in high production of zooplankton (Arazu and Ogbeibu, 2017). Moreover, Manoharan,*et al,* (2015) suggested that duck excreta were good source of nutrients, easily soluble in water and available for plankton production. In his study, Roy(2014) revealed that poultry droppings produce more zooplanktons compared to cow dung and pig dung.Zooplanktonoccupyboth freshwater and saline water; and found in almost all water bodies, including river, stream, lakes, reservoir, ponds, irrigation canals, rice-field and temporary water bodies(Nasir, *et al,* 2017). The zooplankton community is a dynamic system that responds quickly to environmental changes (Roy, 2014). The relationship between the physico-chemical parameters of water quality and plankton production in fish ponds is of great importance and essential for fish culture (Otene*et al.,* 2019).

Phytoplankton sorts are bio-indicators of water quality due to their reaction which bring active response to alterations in the surrounding environment (Siddika, 2012). Qualitative and abundance of phytoplankton signify the prolific condition of a water body (Chowdhury,*et al.*, 2008), thus a thorough awareness of abundance of phytoplankton and its quality in time and space in relative to environmental conditions is essential for fish production. The awareness on how water quality through physico-chemical variables affect plankton would bring new discernment on future management of ponds for ecological monitoring. However, there is no well-known information on the work of plankton in earthen ponds in Minna. Therefore, this evaluation focused on measurement of some physico-chemical parameters and to assess the richness and variety of planktons in relation to these factors in fish earthen ponds in Musgola fish farm, Minna, Niger state.

II. MATERIALS AND METHODS

➢ *Study Area:*

Musgola farms, is located at Lapai-Gwari, Bosso local Government Area Northern region of Minna, Niger State, the area falls between latitude 9^0 31′ N and longitude 6^0 31′ E (**Fig.1**).These farmsarebanded by a stream which flows through Minna, the Niger state capital and carry domestic waste-water from this town and its surrounding. Musgola farms has economic value due to the fishing activities carried out by individuals and some irrigation farming by some of the community in vicinity. Other anthropogenic activities that affect directly the stream are bathing, swimming, washing and sand mining.

➢ *Water Sample Collection:*

Water Samples were collected from the fish ponds located in Musgola fish farm for 4 months from March to June, 2021. Sampling was done once in a month (i.e; mid-week) for all of the fish ponds.

➢ *Physico-Chemical Parameters Analysis:*

Water analysis was conducted within a day to five days of collection of the water samples. Air and water temperatures were measured in situ using Mercury-in-glass thermometer, (APHA, 2014). pH was determined using dip-in mobile battery-operated pH meter, Electrical conductivity was determinedusing EC/TDS meter in whichthe meter was calibrated in µS/cm. Turbidity was determined using HANNA LP 2000 model turbidity meter this was done after the meter was calibrated at HI 93703-0 and HI 93703-10 NTU standards. Alkalinity and total hardness were determined titrimetrically. Dissolved oxygen was determined using 200 model DO meter. The biological oxygen demand (BOD) was carried out after 5 days incubation in the dark at 28^0C. Alkalinity, phosphate-phosphorous, Nitrate-nitrogen and calcium were determined titrimetically following the methods in APHA (2014).

➢ *Planktons Sampling And Analysis:*

Zooplankton's sample were collected horizontally and vertically with 30µm mesh size plankton net. The samples were preserved in 100ml 10% Formalin. The samples were also recounted after 24 hours. Identification, estimation and counting using Goswami, (2012) as a guide. Both vertical and horizontally, the volume filtered was calculated using:

$V = \pi r^2 h$
r = radius of diameter of sampling net.
h = distance travel horizontally or vertically

Samples for phytoplankton study were collected using a cone curved, silk securing cloth net of 20 µm mesh size, a mouth radius of 20 cm and a 50 mL use bottle. The 50 mL concentrates were transferred to distinctly labeled 100 mL glass jars and fixed instantly with Lugol solution to preserve green algal cells (APHA 2014). Handling and examination of algal samples were study according to the procedures of APHA (2014). Microscopic cell counts using the drop count method (Bartram & Rees 2000) was used to regulate the green algal cell mass (no of cells per mL). A drop of the distillate was placed on a glass slide and the total number of characters in that drop counted. Prior to these counts, the glass dispenser used was adjusted to limit the number of drops that provided one milliliter.

➢ *Data Analysis:*

Water quality and plankton's analysis were done using Microsoft Excel. One-way Analysis of Variance (ANOVA) was used to test for statistical variances between the means of the physical and chemical constraints of the fish ponds. The weakness and pattern of association between the water quality variables and plankton abundance in each pond within the sampling period was correlated using Canonical Correlation Analysis in PAST software.

III. RESULTS

- *Physico-Chemical Variables of Lapai Gwari Fish Earthen Pond:*

Air temperature and pH shows no substantial difference (P>0.05). The highest pH value was recorded in June (7.79±0.58) and the lowest in the month of March (6.65±0.22). Electrical conductivity (EC) revealed that in the month of June there was low mean value (180.50±10.92µs/cm) and the highest mean value was in the month of April (425.50±25.49µs/cm), Biochemical Oxygen Demand (BOD) was low in the month of June (3.83±0.28 mg/l) while, the month of April have the highest mean value (4.90±0.20mg/l), NO_3, PO_4, Na and K showed no significant difference (P>0.05), while alkalinity (96.50±9.07mg/l), Dissolve Oxygen (DO) (7.98±0.46 mg/l) were the highest (Table 1).

- *Composition of Zooplankton in the Sampled Ponds:*

Composition of zooplankton showed 12 species which include *rotifers* (5), *Cladocera* (5), and *copepod* (2) all from the four sample sites. The results illustrated that *Moina Micrura* belonging to the class of Cladocerawas more abundant, representing 43.02%, followed by *Cyclopoid copepods* with 26.99% belonging to the class of Copepoda. *Brachionus calyciflorus(*7.45%) was the most abundant in the class of Rotifera and ranked the third in whole samples, whereas the rest of zooplankton species were foundwithin the range of 0.70% to 4.22% (Fig. 2)

- *Composition of Phytoplankton in the Sampled Ponds:*

The researched confirmed seventeen phytoplankton sorts, appropriate to the classes *Chlorophyceae* (7), *Bacillariophyceae* (2), and *Cyanophyceae.* from the four sampling sites. Chlorella species had the highest proportion with 51.82% belonging to the class *Chlorophyceae*.*Anacystis* species was the second most abundant species with 7.30% belonging to the class *Cyanophyceae*. Other species of the phytoplankton ranged between 6.50% and 0.80%for *Zygnema* species *and Scenedis musquadricauda* species respectively (Fig. 3).

- *Correlation of Physico-Chemical Variables and Plankton Interaction in Mosgola Fish Pond:*

Canonical Correspondence Analysis (CCA) showed that Temperature(WT), Total alkalinity (TA), pH and Nitrate (NO_3) had positive correlation with the most of phytoplankton of *cyanophyceae group* such as *antrospira species*, *Analytis species*, *Oscillatoria species* and *Microspora species.* These physico-chemical variables expressed positive correlation to the zooplankton species, mostly of the genus Branchianus including *Branchianus angularis, Branchiarus falcatus* and *Branchianus Calyciflorus.* Moreover, Sodium (Na) and Potassium (K) ions expressed the same correlation to these plankton species. However, Total hardness (TH), Total Dissolved Solids (TDS), Phosphate (PO_4), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Electrical Conductivity (EC) had negative correlation with the planktons (Fig.4)

IV. DISCUSSION

The variations in physico-chemical properties of the four selected ponds investigated in Musgola fish farm Minna, Niger State may be due to the influence of climatic, topographic, and edaphic condition of water quality of fish ponds in the area. It is similar to the reported study by Ayanwale et al., (2012), which argued the contribution of edaphic factors to variation in physico-chemical properties of the ponds. The water temperature in the four ponds was not significantly different which may be as a result of dominant influence of atmospheric temperature on water temperature. The average temperature observed from the four fish ponds ranged from (21.77±0.31). This is within the recommended temperature range for fish activities (Kurniawan et al., 2022).Roy, (2014) recommended temperature between 25°C to 32°C for good performance of fishes. The highest temperature (31.34°C) recorded in Musgola fish ponds was expected since the stations had the highest exposure to sunlight with the least shading effects.Generally, the dissolved oxygen requirement for fish ponds varies with species.However, a minimum constant value of 2.0mg/L of DO is satisfactory for the most species and stages of aquatic life(Rajagopal, *et al*., (2010).The average dissolved oxygen variation in Musgola fish pond may also be connected to atmospheric impurities by wind, wave and human disturbance and a continual discharge of water from the inlet pipes. This reflects the conducted study about the factors affecting the variation of DO in stagnant water especially ponds (Long et al., 2018). pH was significantly different in the selected ponds, thus the average pH recorded were 6.65±0.22; 7.03±0.18); 6.99±0.05 and 7.79±0.58 for first to fourth pond respectively. According to Sterling and Philips (2007), the pHof these ponds falling in the range of recommended for good fish production (6.5-8.5). The highest BOD value was recorded in the month of April (7.98±0.46), these could be attributed to the presence of decomposition of organic matter in the fish ponds. This is not far from the study revealed that BOD reach maximum due to the activities taking place in water (Susilowati et al., 2018; Prambudy et al., 2019); basically due to the organic matter degradation from increased weeds decomposition. Nitrate level range from 9.8-49mg/L and phosphate 3.2-6.30mg/L.(Adeniji, 2005) observed the same results in more productive inland lakes and ponds of Africa; this might indicate that it supports aquatic productivity. Total dissolved solid (TDS) showed significant difference (P<0.05) between the months of April and May. This observation may be found in the management practice, being that artificial fish habitual organic particles were not allowed to accumulate. This may be due to the tendency of the fish reared in the pond to feed on such particles. Electrical Conductivity and alkalinity varied significantly among the ponds, these may be due to the influence of edaphic factor especially the substratum, even though the four ponds were located closed to each other. Bird *et al*., (2009) argued that the ideal range of alkalinity to be between 20-30 mg/L. Thus, the average alkalinity for the four ponds did not fall within the recommended range. This may be as a result of the topography and climate change. Conductivity varied significantly between the months, (393.25±22.42), (425.50±25.49), (323.00±25.05) and (180.50±10.92) for March, April, May and June respectively. Sodium (Na) showed no significant difference ($p<0.05$) in all the months.

Most of the plankton encountered in the study area appears to be normal inhabitants of natural lakes, ponds, streams and artificial impoundment in the tropics and subtropics regions (Usman, 2015).*Cladocera* were the most abundant collection of zooplankton documented in all the stations. The capacity of *Cladocera* to experience vertical immigration, which minimizes opposition through niche operation and food utilization, could probably be the purpose for their control. The dominant status of Cladocera species in the pond comparative to the Rotifers and copepods is characteristic of tropical lakes and rivers (Thirupathaiah, *et al*., 2012). The number of Rotifers in Musgola fish farm was relatively low; this may be attributed to the absence of aquatic macrophytes, which may have accelerated the rate of predation by fish (Usman, 2015). This is in agreement with the findings of Arimoro and Oganah, (2010) in a perturbed tropical stream in the Niger Delta.

Seven species of class Chlorophyceae were recorded throughout the period such as *Spirogyra species, Ulothrix species, Scenedesmus quadricauda, Scenedis musincrasa tulus, Pediastrum species, Chlorella species and Zygnema species.* The minimum units of algae of class Chlorophyceae were recorded during dry season and maximum units were recorded during rainy season between April and May. *Chlorophyceae* was widespread and most dominant group among other phytoplankton. It is not doubtful, since the Chlorella species has been used as a source of dietary protein for freshwater fish as it causes an improvement in weight and meat quality. Therefore, considering these fish ponds, there would be the reason for high abundance. This reflected the study by Nirmal and Cini, (2011) where they opined that high temperature favors the growth of blue-greens. This is clear from the result that Cyanophyceae were lowest during dry months, then when the water column was remarkably stratified to a large extent because of heavy rainfall, reduced salinity, decreased temperature and pH, overcast sky and cool conditions. Contrary, Roy, (2014) reported minimum density of phytoplankton during dry season and maximum during rainy season in Chatla Lake, Assam; as the same as the result reported by Rajagopal, *et al*., (2010). Generally, the plankton community, on which the whole aquatic population depends, is largely affected by an interaction of a number of limiting factors such as, moderate sulphate, nitrate, phosphate and other factors, the physico-chemical variables affect the partial spreading and richness of plankton (Baird and Telfer, 2009).

As many studies illustrated the effects of physicochemical parameters to the composition of planktons (Chandran et al., 2021, Heneash et al., 2022); the specific variables correlate positively with some plankton species whereas other were inversely associated (Liu et al., 2010). Given the fact that CCA of the present study is reporting positive association with physical chemical variables; it is in confluence with the reported study by Coelho et al., (2007) for temperature and PH; and Kalin et al., (2001) for Sodium and Potassium. Moreover, the same results have been obtained on positive correlation between plankton and total alkalinity (Ferdoushi et al., 2021; Malik and Rathi, (2022) for Total alkalinity. Our findings revealed inversely association between plankton and DO, BOD, TH and EC. Although, this result fall to agreement with the report study by Simantiris et al., 2021 about inversely correlation of plankton with DO as well as BOD and Tufail et al., (2022) for Electric conductivity; It is in contrast with the study by Malik and Rathi, (2022), where they found that positive correlation of DO and BOD with phytoplankton. Therefore, there are evidence that the physico-chemical variables have slight influence on composition and abundance of plankton species in water body such as pond.

V. CONCLUSION

There are evidence to conclude that the dominant zooplanktons compositions of Mosgola Fish Farm, Bosso Local Government in Niger State were rotifers, copepods, cladocerans and microscopic protozoans, while the Phytoplankton’s are dominated by Chlorella species Signifying seasonal and monthly variations in the physico-chemical variation in the distribution ofplanktons. Conclusively, it was observed that there was a good interaction between the phytoplankton species and physico-chemical parameters and a moderate water quality with the dominance of Chlorella species. This indicate that the physicochemical variables restricted the spreading and abundance of the phytoplankton. The results of the physio-chemical parameters showed that all the values recorded were within the guideline limit and the recommended safety limit for survival of aquatic organisms except for Dissolved Oxygen which exceeded the WHO standards in the month of April. Variations of the physical and chemical parameters in a fish pond reveal that the limnological conditions in the fish pond are not spatially homogenous, since differences have been observed not only between the different sampling months, but also between the different sites analyzed. Based on the results of the current analysis, water quality management in the fish pond showed a direct influence on planktonic population, since fish ponds are shallow and constantly receive large nutrient loads (feed, fertilizing, and fish waste).

RECOMMENDATION

The present study recommends research on how the plankton species together with the physico-chemical properties of the water quality should be carried out in an algal cultured environment to see the effectiveness on how this interaction can benefit the ecosystem, since the phytoplankton species are essential natural feed for higher organisms which includes fishes. The regular analysis, either monthly or bi-monthly should be carried out to either supplement the fish feeds with the plankton community or to replace entirety the synthetic foods as well, to prevent the ponds from algal bloom (eutrophication).In addition, this study recommends the application of the water quality index as a very helpful tool that will enable the public and decision makers to estimate water quality of fish ponds. Finally, the qualitative study and the plankton abundance and delivery in the ponds; there is a need to work methods to improve the value of the ponds water for sustainability of the cultured fishes.

REFERENCES

[1]. Adeniji, (2005). A simple guide to water quality management to fish pounds NIFFR Technical Report Series. No 23-29pp.

[2]. Ahmed M. Heneash · Ahmed E. Alprol · Hussein A. El-Naggar · Samiha M. Gharib · ShimaaHosnyMuhammad A. El-Alfy·

[3]. Hazem T. Abd El-Hamid (2022). Multivariate analysis of plankton variability and water pollution in two highly dynamic sites,southeastern Mediterranean (Egyptian coast). *Arabian Journal of Geosciences* 15:330https://doi.org/10.1007/s12517-022-09595-1

[4]. APHA (2014) *Standard Methods for the Examination of Water and Waste Waters.* 22th edition, American public health association (APHA), Washinton DC, USA. 279-292

[5]. Arazu, V.D.N. &Ogbeibu, A.E. (2017). The composition, abundance and distribution of zooplankton Of River Niger at Onitsha stretch, Nigeria. *Animal Research International*, 14(1): 2629 –2643.28.

[6]. Arimoro, F. O &Oganah, A. (2010). Zooplankton community responses in a perturbed tropical stream in the Niger delta, Nigeria,*The Open Environmental and Biological Monitoring Journal* 3: 11pp.

[7]. Ariyadej, C., Tansakul, R., Tansakul, P.,&Angsupanich, S., (2004) Phytoplankton Diversity and its Relationship to the Physicochemical Environment in the Banglang Reservoir,Yala Province. Songklahnakarin,*Journal of Science and Technology* 26 (5), 595—607.

[8]. Ayanwale AV, Minnin MA, Olayemi KI. (2012). Physico-chemical Properties of Selected Fish Ponds In Nigeria: Implications for Artificial Fish Culture. *Webmed Central Biology*. 3(10): WMC003751

[9]. Babatunde, M.M. (2014) Variations of phytoplankton abundance and species composition in KudiddiffiKubanni stream, Hanwa-Makera,Zaria, Nigeria. Implication for water quality. *International Journal of Advance Scientific Technical Research.*6 (4): 415-424.

[10]. Baird, D. Beveriddge M. & Telfer, Y. (2009). *Water Quality Notes for Aquaculture Institute of Aquaculture University of Stirling, U.K. pp 1-5.*

[11]. Bartram, J. & Rees, G. (2000). *Monitoring bathing waters* –A practical guide to the design and implementation of assessments and monitoring programmes. World Health Organization, Boundary Row, London.

[12]. Brummett R E & Noble R (2013). Aquaculture for African Small Holders. *ICLARM – The World Fish Cente*r, Penang, Malaysia pp. 1–69.

[13]. Bwala, R.L. &Omoregie, E. (2009). Organic enrichment of fish ponds: application of pig dung vs tilapia yield. *Pakistan Journal of Nutrition* 8:1373-1379.

[14]. Chowdhury, M.M.R, Shahjahan M., Rahman, M.S., &Sadiqul Islam M. (2008). Duckweed (Lemna minor) as supplementary feed in monoculture of Nile tilapia, Oreochromis niloticus.Green algal interactions with physicochemical parameters of some manmade ponds in Zaria, northern Nigeria *Revista Brasil. Bot*., V.34, n.3, p.285-295.

[15]. Cunqi Liu, Lusan Liu, Huitao ShenC. (2010). Seasonal variations of phytoplankton community structure in relation to physico-chemical factors in Lake Baiyangdian, China. *International Society for Environmental Information Sciences 2010 Annual Conference* (ISEIS) 2 :1622–1631

[16]. D. S. Malik and Prachi Rathi (2022). The Influence of Physico-Chemical Parameters on Habitat Ecology and Assemblage Structure of Freshwater Phytoplankton in Tehri Reservoir Garhwal (Uttarakhand) India. *The Proceedings of the National Academy of Sciences, India, Section B: Biological Sciences*. https://doi.org/10.1007/s40011-021-01313-3

[17]. Goswami, A. P. and Mankodi, P. C. (2012). Study on Zooplankton of Fresh Water Reservoir Nyari – II Rajkot district, Gujarat, India. *ISCA Journal of Biological Sciences* 1(1):30 - 34.

[18]. Kalin, M., C. Cao, M.P. Smith and M.M. (2001) Olaveson, Development of the Phytoplankton Community in a Pit-Lake in relation to Water Quality Changes",*Water Research* (35:13) pp. 3215-3225.

[19]. Kolo, R.J (2014). The Limonological Studies of Shiroro lake and its major tributaries Ph.D thesis Federal University of Technology Minna, Nigeria.

[20]. Kurniawan Kurniawan, JojoSubagja, Vitas AtmadiPrakoso, RudhyGustiano, Tri HeruPrihadi, IrinIrianaKusmini,OtongZenal Arifin, Deni Radona, Anang Hari Kristanto (2022). Tolerance Level of Domesticated Asian Red-Tail Catfish *Hemibagrus Nemurus*to Salinity, Acidity, and Temperature Variability. Journal of Hunan University (Natural Sciences)(3):49

[21]. Long HoD, Duy Tan Pham, Wout Van Echelpoel I.D, LeackyMuchene, Ziv Shkedy , Andres Alvarado, Juan Espinoza-Palacios, Maria Arevalo-Durazno, Olivier Thas and Peter Goethals (2018). A Closer Look on Spatiotemporal Variations of Dissolved Oxygen in Waste Stabilization Ponds Using Mixed Models. *Water* (10):201. doi:10.3390/w10020201

[22]. Manohar S, Kitur EL,& Kibet F.C (2016) Water Quality and Plant Species Composition of Chemususu Dam, Baringo County, Kenya. *Journal of Environmental & Analytical Toxicology* 6: 390.

[23]. Manohar S, Mang'oka, J.M, Ndunda, E., &Gathuru, G., (2017) Assessment of Yatta Canal Water Quality for Irrigation, Machokos County, Kenya. *Journal of Environmental & Analytical Toxicology* 7: 423.

[24]. Manoharan, J., D. Varadharajan, B. Thilagavathi & Priyadharsini,S. (2015). Biodiversity and abundance of benthos along the South East Coast of India. *Advance Applied Science. Research.*, 2: 554-562.

[25]. Mathias Ahii Chia1., Sunday Paul Bako1, Samson O. Alonge & Abu Kasim Adamu1,(2011) *Innovation and Technology* 2 (1): 56-61Institute of Aquaculture University of Stirling, U.K. pp 1-5.

[26]. Nasir Abdus-Salam, Olamide S.A & Mojeed O. B. (2017). Assessment of the Impact of Petroleum Depot Effluents on a Nearby River Quality. *European Scientific Journal*, 13(36)

[27]. Nigeria Industrial Standard (NIS, 2015). *Nigerian Standard for Drinking Water Quality*. NIS 554:ICS 13.060.20, Approved by the Standard Organization of Nigeria (SON), Governing Council,14-18.

[28]. Nikolaos Simantiris, Alexander Theocharis, Markos Avlonitis (2021). Environmental effects on zooplankton dynamics of a shallow Mediterranean coastal lagoon (October 2020–March 2021). *Regional Studies in Marine Science* 48 (2021) 102001.

[29]. Nirmal Kumar &CiniOommen, (2011) *Applied ecology and environmental research*. 9(3) 279-292.

[30]. Otene, B.B, Alfred-Ockiya, J.F & Amadi, F (2019) Physicochemical Properties and Zooplankton Community Structure of Okamini Stream, Port Harcourt, Nigeria. Department of Fisheries and Aquatic Environment, Rivers State University, Port Harcourt, *Nigeria International Journal of Research and Innovation in Applied Science (IJRIAS)* | Volume IV, Issue X, October 2019|ISSN 2454-6194.

[31]. Otene, B.B. &Nnadi, P.C. (2019). Water Quality Index and Status of Minichinda Stream, Port Harcourt, Nigeria. IIARD *International Journal of Geography and Environmental Management* ISSN 2505-882, 5(1).www.iiardpub.org.

[32]. H Prambudy, T Supriyatin and F Setiawan (2010). The testing of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) of river water in Cipager Cirebon. *International Symposium on Sciences, Engineering, and Technology*. doi:10.1088/1742-6596/1360/1/012010

[33]. Rajagopal, T., Thangamani, A., Sevarkodiyone, S. P., Sekar, M. & Archunan, G. (2010). *Journal of Environmental Biology*. 31 (2010) 265-272.

[34]. Rejani Chandran, A. K. Jaiswar, Sudhir Raizada, Sangeeta Mandal, Trivesh S. Mayekar, Amit Singh Bisht, Sanjay Kumar Singh, Vindhya Mohindra, Kuldeep K. Lal and L. K. Tyagi (2021).Plankton dynamics and their relationship with environmental factors shape fish community structure in fluvial ecosystem: A case study. *Indian Journal of Fisheries 68(4): 1-13, 2021* DOI: 10.2 1077 /ijf. 2021 .68. 4. 111193-01

[35]. Roy, K. (2014). Ecological Dynamics and Hydrobiological Correlations in Freshwater Ponds Textural Types in Aquaculture Ponds. *International Journal of Agricultural Resources*, 4 (2):112-118

[36]. Shahzad Tufaila, Iram Liaqata, Sadiah Saleemb, Asia Bibic , Muhammad Mubind , Bushra Nisare (2021). Population dynamics of pelagic rotifers in Marala Headworks (Pakistan). *Brazilian Journal of Biology*, 2021, vol. 84, e250134 | https ://do i.org /10. 1590 /1 519-6984.250134

[37]. Siddika, F. (2012). Abundance of Plankton Population Densities in Relation to Bottom Soil Textural Types in Aquaculture Ponds. *International Journal of Agricultural Resources, Innovation and Technology* 2 (1): 56-61.

[38]. Sterling H.P & Philips, M.J. (2007). Lecture notes on the water quality management for aquaculture and fisheries materials edited by Bafru Bangledesh *Aquaculture publications,* university of sterling.Institution of Aquaculture. UK.

[39]. Susilowati Susilowati, Joko Sutrisno, Muhammad Masykuri & Maridi Maridi (2018). Dynamics and Factors that Affects DO-BOD Concentrations of Madiun River. *American Institute of Physics Conference Proceedings* 2049, 020052; https://doi.org/10.1063/1.5082457

[40]. Susana Coelho, Sofia Gamito, Angel Pe´rez-Ruzafa (2007). Trophic state of Foz de Almargem coastal lagoon(Algarve, South Portugal) based on the water quality and the phytoplankton community. *Estuarine, Coastal and Shelf Science* 71 (2007) 218e231.

[41]. Thirupathaih, M., Sravanthy, C. H. & Sammaiah. C. H (2012). Diversity of Zooplankton in Lower manoir reservoir, Karimnagar, A.P, *India International Research Journal of Biological Sciences* 1(7), 27-32.

[42]. Ude, E. F., Ugwu, L. L. C. & Mgbenka, B. O.(2011). Evaluation of Zooplankton Diversity in Echara River, Nigeria. *Continental Journal of Biological Sciences* 4 (1), 1-5.

[43]. Usman, A (2015). Determination of Physico-chemical Parameters and Plankton Composition of Wawan-Rafi Lake in Kazaure Nigeria, Department of Biological Sciences, Faculty of Science, Ahmadu Bello University, Zaria, Nigeria

[44]. WHO. 2014. *Guidelines for Drinking water quality. Addendum: Microbiological Agents in Drinking Waters.* World Health Organization: Geneva.

[45]. Zannatul Ferdoushi, M.d Abul Kalam Azad, M.d. Shamim Rahman & Mst Nahid Akter (2021). Water quality assessments of the river Gorveshwari in Dinajpur, Bangladesh. *Bangladesh Journal of Fish eries*(2021)33(1):119-128

➢ *Figures:*

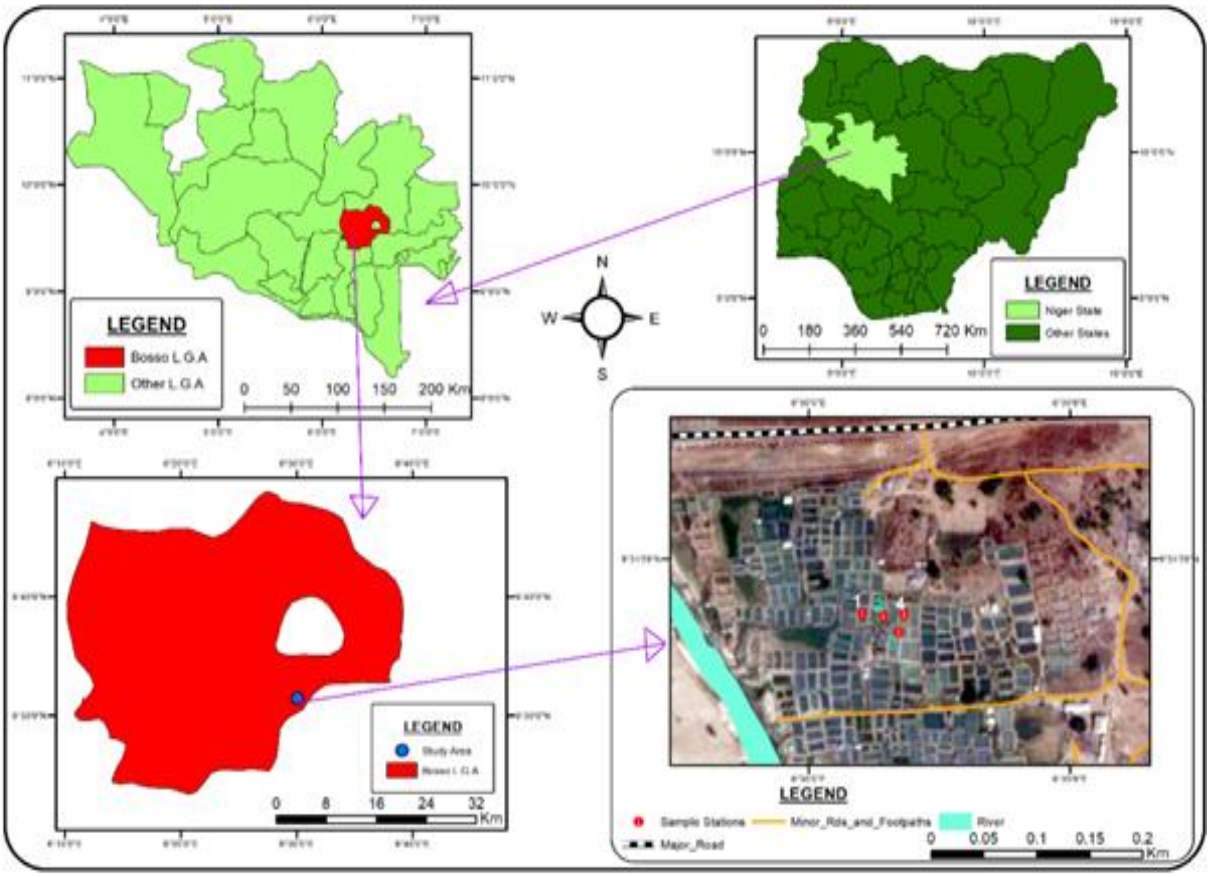

Fig 1 Vector Map of Musgola Farm, Lapai-Gwari with the Sample Sites

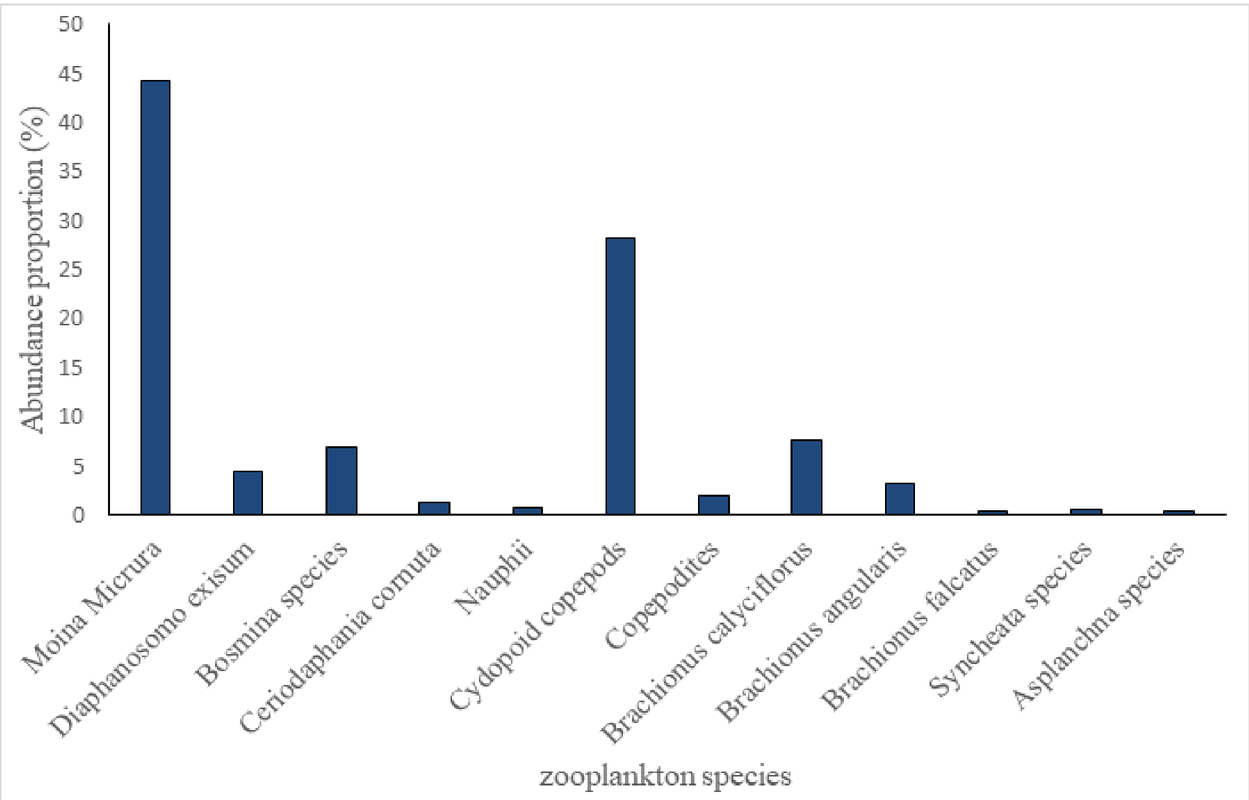

Fig 2 Abundance of Zooplankton of Mosgola Fish Farm in Lapaigwairi, Minna

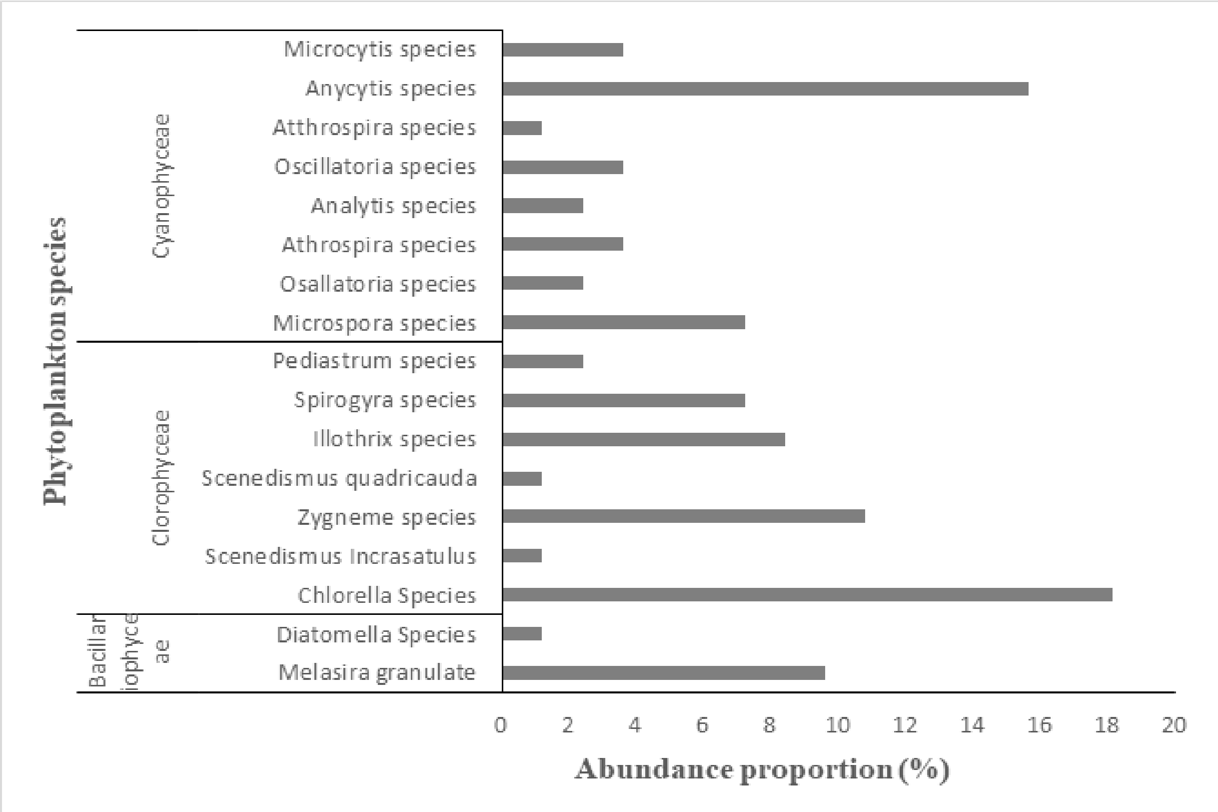

Fig 3 Abundance of Phytoplankton in Mosgola Fish Farm

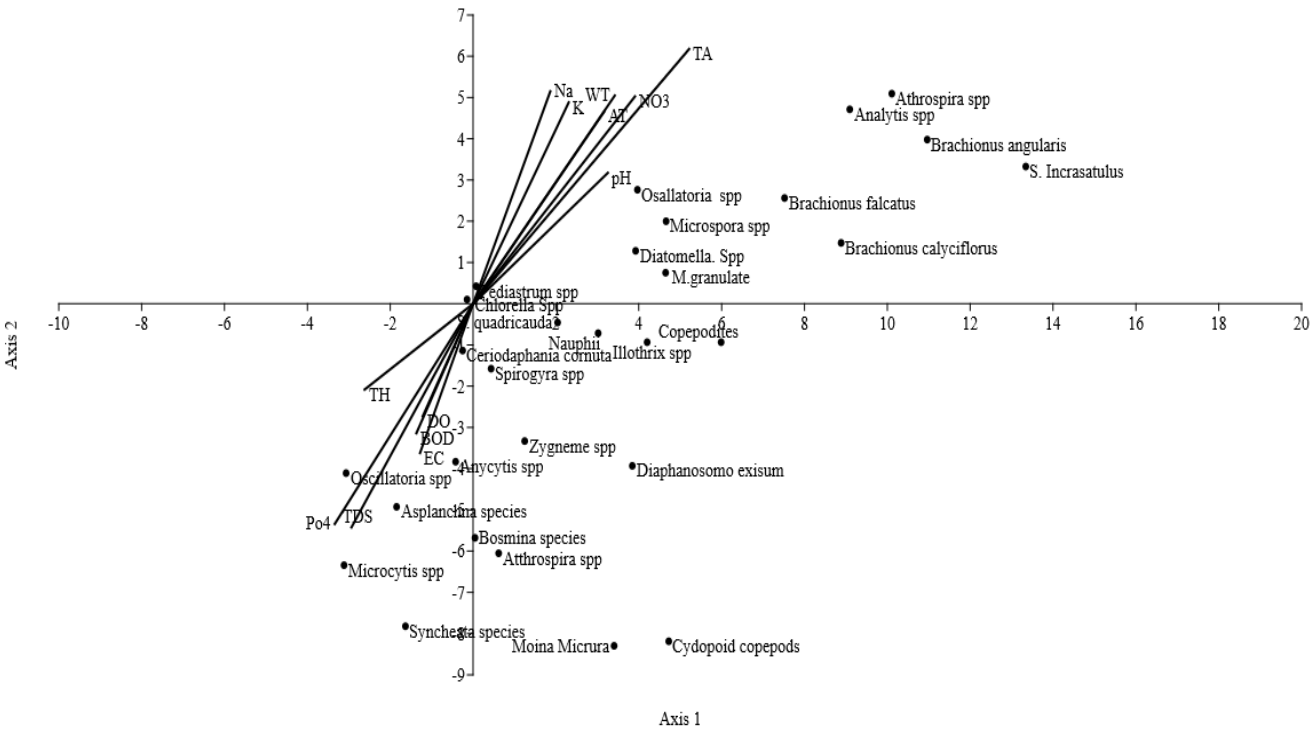

Fig 4 Correlation Of Physico-Chemical Variables and Plankton Interaction in Mosgola Fish Pond

(Wt.)=Water Temperature; (At)=Air Temperature; (BOD)=Biochemical Oxygen Demand; (EC)= Electrical Conductivity; (TDS)=Total Dissolved Solid; (TA)=Total Alkalinity; (TH)=Total Hardness; (DO)=Dissolved Oxygen; (Na)=sodium; (NO_3)=Nitrate; (PO_4)=Phosphate; (K)=Potassium

ISSN No:-2456-2165

- *Tables:*

Table 1 Physico-Chemical Variables of Lapai Gwari Fish Earthen Pond from March to June 2021

PARAMETERS	MARCH	APRIL	MAY	JUNE	WHO	NIS
Wt (°C)	21.77± 0.31[a]	21.53±0.27[a]	31.43±0.52[b]	31.40±0.17[b]	30-32	- -
At (°C)	29.10±0.00[a]	29.30±0.00[b]	37.10±0.00[c]	37.30±0.00[d]	-	-
TDS(mg/L)	138.50±22.07[b]	200.00±37.02[b]	1.00±0.41[a]	22.50±5.04[a]	600	600
pH	6.65±0.22[a]	7.03±0.18a[b]	6.99±0.05[ab]	7.79±0.58[b]	6.5-85	6.5-8.5
EC(μs/cm)	393.25±22.42[c]	425.50±25.49[c]	323.00±25.05[b]	180.50±10.92[a]	1000	01000
DO(mg/L)	7.48±0.36[ab]	7.98±0.46[b]	6.43±0.28[a]	6.15±0.68[a]	7.5	-
BOD(mg/L)	4.88±0.36[b]	4.90±0.20[b]	4.38±0.26[ab]	3.83±0.28[a]	6	-
TA(mg/L)	67.00±2.12[a]	82.25±9.33[ab]	96.50±9.07[b]	79.50±9.17[ab]	100	100
TH(mg/L)	89.25±1.49[b]	103.50±8.30[b]	95.50±4.27[b]	67.00±7.23[a]	150	15O
PO_4 (mg/L)	1.56±0.11[b]	1.95±0.10[b]	0.55±0.06[a]	0.45±0.05[a]	-	-
NO_3(mg/L)	0.59±0.11[a]	0.62±0.20[a]	0.87±0.15[a]	1.84±0.55[b]	22	50
Na(mg/L)	4.99±0.94[a]	5.04±0.84[a]	7.59±0.49[b]	8.13±0.82[b]	-	-
K(mg/L)	2.11±0.08[a]	2.02±0.46[a]	3.88±0.17[b]	3.87±0.17[c]	-	- -

(Wt)=Water Temperature; (At)=Air Temperature; (BOD)=Biochemical Oxygen Demand; (EC)= Electrical Conductivity; (TDS)=Total Dissolved Solid; (TA)=Total Alkalinity; (TH)=Total Hardness; (DO)=Dissolved Oxygen; (Na)=sodium; (NO_3)=Nitrate; (PO_4)=Phosphate; (K)=Potassium ; Superscripts with the same letter in each role are not significantly different ($P \geq 0.05$). The measurement were compared to the standard by World Health Organization (2014) and Nigerian Industrial Standard- (NIS, 2015).