ISSN: 2287-688X

Annals of
Plant Sciences

Volume 11, Issue 04 (2022) pp. 5033-5039

Research Article

Environmental Conditions and Macrophytes in Fish Ponds in Oria, Abraka, Delta State Nigeria

Agbogidi, O. M[1], Nwanbueze, A. A[2], Odume, S. C[1], Stephen, O. F[1] and Onoche, P[1]

[1]*Department of Botany, Faculty of Science, Delta State University, Abraka, Delta State, Nigeria*
[2]*Department of Fisheries, Faculty of Agriculture, Delta State University, Abraka, Delta State, Nigeria*

Abstract

The environmental conditions and macrophytic flora of fish ponds in Oria, Abraka Delta State Nigeria were studied between May, and July, 2019 with a view to establishing their physico-chemical parameters as they affect macrophytic vegetation in the pond. The study showed that the physical and chemical parameters showed no significant differences at P ≤ 0.05 in Ph, total hardness, turbidity and ammonia while variations were observed in other parameters including Conductivity, Dissolved oxygen, nitrate and phosphate among others. Although all values obtained fell within World Health Organization standard for pond fish production, out of the 14 macrophytes encountered; Salviniaceae (4), Araceae (3) and Menyamthaceae (3) families had more abundance while Potamogetaceae family had (2) sparse abundance and Nymphaeceae and Leminaceae families had rare abundance of one each .The study established that water in Oria ponds are generally suitable for fish production and growth of macrophytes on which the pond fish depend on directly or indirectly. This study has contributed to knowledge in the area of limnology, aquatic biology and macrophytic diversity.

Keywords: *Environmental conditions, fish ponds, macrophytic flora, biodiversity conservation.*

Introduction

Water according to Agbogidi, (2015) is a very significant climatic or environmental factor. It is life's most essential commodity and all living organisms rely on it existence for survival (Hannington and Emmanuel, 2016). Aquaculture deals with the rearing of aquatic organisms i.e. rearing of aquatic animals or cultivating aquatic plants (for food, business purposes, employment especially in rural areas, increased natural exports and substitution of imports by local productions) in controlled environments such as ponds (Kigbo. *et al*., 2015). A pond is a body of standing water formed either naturally or artificially. A pond ecosystem provides water for agriculture and livestock, aids habitat restoration, serves as fish hatcheries, could store thermal energy and treat waste water (Zelnik. *et al*., 2012). A pond could be freshwater, salt water or brackish (Agbogidi, 2015). Olukunde and Oyewumi, (2012) noted that pond systems are used as important hotspots for biodiversity and are also wonderful for our rich terrestrial wild life.

Aquatic macrophytes also called hydrophytes are plants that live in or close to water (Agbogidi, 2005). They are relatively large photosynthetic organisms visible to the naked eye. They are different from algae and microphytes. They play integral roles in structuring communities in aquatic ecosystem (Agbogidi, 2014). Macrophytes differ in life forms from embankment, emergent, submerged to floating (Bamidele and Agbogidi, 2002). The roles of macrophytes in bodies of water have been extensively researched by many researchers (Agbogidi, 2005; Bamidele and Agbogidi, 2002; Agbogidi. *et al*., 2017). Monitoring of water qualities in

***Corresponding Author:**
Agbogidi, O. M;
DOI: http://dx.doi.org/10.21746/aps.2022.11.4.3

recent time is a growing issue because of the heightened anthropogenic forces stemming from agricultural, urban and industrial wastes that find their ultimate end in water bodies relying on the topography of the land and other factors (Okumagba and Ozabor, 2014; Agbogidi, 2019).This study among other things was undertaken to provide baseline information on the conditions of the environmental and macrophytic flora of ponds in Oria, Abraka, Delta State with a view to establishing physicochemical parameters of the ponds and their influence on the diversity of macrophytes. Such a study will be useful in aquatic biology and biodiversity developments and management.

Materials and Methods

Study Area

The research was carried out in Abraka Delta State, Nigeria (Latitude $5^{0}45^{1}$ and $5^{1}50^{11}$N and Longitude 6^{0} and $6^{1}15^{11}$E).

Sample and Sample Collection

Water sample were collected from three concrete ponds in Oria, Abraka between May, June and July, 2019. Collection of water was done monthly for about three months. A composite sample was obtained by collecting and mixing together, water from three points in each of the ponds. The samples of water were taken to the lab in an ice-packed container at 4^{0}C for analysis for physicochemical parameters. Quality control and assurance procedures were strictly followed to obtain accurate results. Each analysis was repeated about three times and all reagents used were of ANALAR grade. All sampling containers and apparati were thoroughly washed with detergent and properly rinsed with deionised water before use. Sterilized and disposable rubber gloves were worn during analysis. Interferences and cross contamination of results were blank corrected using procedural bank to monitor.

Collection of Macrophytic Species

The ponds were sampled for macrophytes. Only floating macrophytes were encountered. The macrophytes were collected with sieve and taken to the laboratory for identification using relevant materials including Plant Net.

Determination of Physicochemical Parameters

The parameters were determined using the following procedures

S/n	Parameters	Methods of measurement/determination
1	Temperature	Thermometer
2	Ph	Insitu using Hanna pH meter
3	Conductivity	Insitu using Hanna conductive meter
4	Total Hardness	APHA method (2006)
5	Total Dissolved solids (TDs)	APHA method (2006)
6	Turbidity	APHA method (2006)
7	Total Hardness	APHA method (2006)
8	Total suspended solids (TSS)	Radojevic and Bashkin (1999)
9	Alkalinity	APHA method (2002)
10	Dissolved Oxygen (DO)	Radojevic and Bashkin (1999)
11	Biological Oxygen Demand (BOD)	Radojevic and Bashkin (1999)
12	Ammonia	Radojevic and Bashkin (1999)
13	Nitrate	Radojevic and Bashkin (1999)
14	Nitrite	Radojevic and Bashkin (1999)
15	Acidity	Radojevic and Bashkin (1999)
16	Phosphate	Radojevic and Bashkin (1999)
17	Sulphate	APHA (2006)
18	Chloride	APHA (2006)

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) using statistical package for Science and Social Science (SPSS) IBM version 2010 while the significant means were separated using Duncan's Multiple Range Tests (DMRT).

Results and Discussion

The physico-chemical parameters of the ponds (P1, P2 and P3) studied are presented in Table 1a. Temperature values varied between 25.0 and 26.4^{0}C. The pH values were 7.0 in P3, and 7.2 and 7.3 in P1 and P2 respectively. Conductivity ranged between 148.0, 166.8 and 172.4 while total hardness was between 3.0, 3.2 and 3.4. P2 (25.4) recorded the least alkalinity as against P3 (34.6) and P1 (37.4).Total dissolved solids ranged between 27.4, 28.0 and 27.8 while the values for total suspended solids were between 70.1 and 79.6. No significant differences ($P \geq 0.05$) were recorded for turbidity pH, total hardness and ammonia in the three ponds studied; while dissolved oxygen varied significantly from 7.6 in P1, 7.9 in P3 and 8.2 in P2, biochemical oxygen demand was highest in P3 (3.84) and lowest in P1 (2.61). Values for nitrate, phosphate, calcium, magnesium, sulphate, chloride and ammonia are all stated in Table 1. Similarly, Table 2 shows the World Health Organization standards for physical and chemical parameters. No significant variations were observed in the levels of physicochemical parameters and the values given by World Health Organization (WHO) (FEPA, 1991; FAO, 2013). All the parameters measured were found to be within the WHO regulatory body for pond fish production hence, pond waters in Oria are considered generally suitable for fish pond production and the development of aquatic macrophytes because of the physical and chemical parameters of suitable water. This finding is in agreement with earlier reports of Oboh and Egun, (2017) and Tanabe. *et al*., (2019). The occurrence of these macrophytes including *Azolla pinnata, A. africana, Salvina molesta, Pisia stratiotes, Spirodela polyrhiza* and *Lemna minor* and *Lemna minuta* in the ponds confirms the suitability of the water parameters in supporting the growth of these macrophytes. Similar reports have been made by Zelnik, (2012) on Karst ponds in Italy. A total of 14 macrophytes were encountered: *Lemna minor, Lemna minuta, Azolla africana, Azolla pinnata, Nymphaea tetragona, Nymphaea aquatic, Nymphoides indica, Nymphaceae micrantha, Sagillaria sagittifolia, Salvinia molesta, Spirodela polyrhiza, Potamogetum natans, Potamogetum nodosus, Pistia stratiotus* distributed in the following families as: Salviniaceae (4), Araceae (3), Menyamthaceae (3), Potamogetaceae (2) and Nymphaeaceae/Lemnaceae (1) each. This finding also implies that the ponds at Oria favour Salviniaceae, Araceae and Menyanthaceae which were more in abundance when compared to Potamogetaceae with sparse abundance and Nymphaeaceae and Lemnaceae that had rare abundance. These plants should be well managed as they could create a barrier on the water surface that prevents oxygen exchange with the atmosphere and photosynthesis in the water hereby reducing oxygen in the water (Shweta. *et al*., 2013; Shibam. *et al*., 2017; Uneke and Udennafor, 2017) and increase the potential of a fish kill. Free floaters also have the potentials of creating very effective way of adding filtration and surface coverage to a water bodies (Agbogidi, 2014; Dienye, 2015). Concrete shores and bottoms, along with stony walls of the ponds prevented the development of complex aquatic macrophyte communities and species richness in addition to diversity. The occurrence of dissolved nutrients in pond shows that they are used by both the fish species and aquatic macrophytes there and this justifies the interrelationship between the nutrients, fish and aquatic macrophytes (Ajon. *et al*., 2014). Agbogidi, (2005) earlier reported that in aquacultural development, the roles of aquatic macrophytes cannot be overemphasized. The water from the pond can also be used for agricultural purposes (irrigation) which could boost crop yield thereby contributing to food security. The study has contributed to knowledge in the area of aquatic biology, species diversity of macrophytes and aquatic ecosystem management.

Table 1(a): Physicochemical parameters of ponds at Oria, Abraka, Delta State, Nigeria

S/N	Parameters	P1	P2	P3
1	Temperature (^{0}C)	26.0b	25.0a	26.1c
2	Ph	7.2a	7.3a	7.0a
3	Conductivity (S/m)	148.0c	166.8b	172.4a
4	Total hardness	3.0a	3.2a	3.4a
5	Alkalinity	37.4a	25.4c	34.6b
6	TDS (mg/L)	27.4b	28.0a	27.8b
7	TSS (mg/L)	70.1c	74.0b	79.6a
8	Turbidity	4.5a	4.7a	4.6a
9	DO (mg/L)	7.6b	8.2a	7.9b
10	BOD(mg/L)	2.61c	3.62b	3.84a
11	Nitrate (mg/L)	20.0a	19.6b	18.7b
12	Phosphate (mg/L)	29.6a	26.5b	25.8c
13	Calcium (mg/L)	6.7b	6.8b	8.6a
14	Magnesium (mg/L)	2.8b	3.70a	4.0a
15	Sulphate (ppm)	168c	170b	180a
16	Chloride (ppm)	58.6a	56.0c	57.0b
17	Ammonia (mg/L)	0.50a	0.56a	0.53a

Field study (2019)

Table 1(b): World Health Organization (WHO) standards for physical and chemical parameters

S/N	Parameters	WHO Standard
1	Temperature	
2	pH	6.5 – 8.5
3	Conductivity	5
4	TS (ppm)	
5	Alkalinity	200
6	TDS (ppm)	500
7	TSS (ppm)	
8	Turbidity	
9	DO	500
10	BOD	2
11	COD	20
12	Nitrate (ppm)	50
13	Phosphate	0.08
14	Sulphate (ppm)	200
15	Ammonia	0.6 – 2.0mg/L

Table 3: Diversity of macrophytes encountered in ponds at Oria, Abraka, Delta State

S/N	Macrophytes	Common name	Family
1	*Lemna minor*	Lesser duckweed	Araceae
2	*Lemna minuta*	Least duckweed	Lemnaceae
3	*Azolla africana*	Water fern	Salviniaceae
4	*Azolla pinnata*	Water velvet	Salviniaceae
5	*Nymphaea tetragons*	Pygmy water lily	Menoganthaceae
6	*Nymphaea aquatic*	Banana lily	Menoganthaceae
7	*Nymphoides indica*	Banana plant	Menoganthaceae
8	*Nymphaceae micrantha*	Cluster banana lily	Nympheaeceae
9	*Sagillaria sagittifolia*	Arrow head	Salviniaceae
10	*Salvinia molesta*	Giant duckweed	Salviniaceae
11	*Spirodela polyrhiza*	Greater duckweed	Araceae
12	*Potamogetum natans*	Broad leaved pondweed	Araceae
13	*Potamogetum nodosus*	Long leaved pondweed	Potamogetaceae
14	*Pistia stratiotus*	Water lettuce	Araceae

Field survey (2019)

Table 4: Diversity of macrophytes in the ponds at Oria, Abraka, Delta State, Nigeria

S/N	Macrophytes	Study location		
		P1	P2	P3
1	*Lemna minor*	+		
2	*Lemna minuta*		+	+
3	*Azolla africana*	+		+
4	*Azolla pinnata*		+	
5	*Nymphaea tetragona*	+	+	
6	*Nymphaea aquatica*		+	+
7	*Nymphoides indica*	+		+
8	*Nymphaea micrantha*	+	+	
9	*Sagillaria sagittifolia*	+	+	
10	*Salvinia molesta*			+
11	*Spirodela polyrhiza*		+	
12	*Potamogetum natans*	+		+
13	*Potamogetum nodosus*		+	
14	*Pistia stratiotus*		+	+

Table 5: Relative abundance of macrophytes in ponds at Oria, Abraka, Delta State

S/N	Families	No of species		Ponds	
1	Araceae	3		+++	
2	Salviniaceae	4		+++	
3	Nymphaeaceae	1		+	
4	Menyanthaceae	3		+++	
5	Potamogetaceae	2		++	
6	Lemnaceae	1		+	

Key: + = present/rare abundance
++ = Sparse abundance
+++ = more abundance

Conclusion

The study established that the water in Oria ponds is generally suitable for fish production and growth of macrophytes on which the pond fish depend on directly or indirectly. This study has contributed to knowledge in the area of limnology, aquatic biology and macrophytic diversity

References

1. Agbaire, P.O., Samuel O. Akporido. and Emoyan, O. O. "Determination of some physicochemical parameters of water from artificial concrete fish ponds in abraka and its environs, Delta State, Nigeria." *International Journal of Plant, Animal and Environmental Sciences* 5.3 (2015): 70-76.
2. Agbogidi, O. M. "Introduction to ecology and environment." *Ultra Modern Prints*, Ibadan (2015): 324.
3. Agbogidi, O.M. "The role of macrophytes in aquatic systems: a botanical review." *Nigerian Journal of Science and Environment* 4 (2005): 1-9.
4. Agbogidi, O. M., Ojoghoro, O. J. and Oji, O.P. "Macrophytic vegetation and physico-chemical parameters of River Ethiope at Umutu, Delta State, Nigeria." *Nigerian Journal of Water Resources* 3.2 (2017): 1 – 8.
5. Ajon, A.T., Utsev, J.T. and Nnaji, C.C. "Physico-chemical quality of irrigation water in River Kastina-Ala catchment areas of Northern Nigeria." *Current World Environment* 9.2 (2014): 1 – 9.
6. APHA (American Public Health Association). "Standard methods for the examination of water and wastewater (20th Ed.)." *American Public Health Association Washington DC* (2006).
7. Appannagari R.R. "Environmental pollution causes and consequences: a study." *North Asian International Research Journal of Social Science and Humanities* 3.8 (2017): 40 – 48.
8. Bamidele, J. F. and Agbogidi, O.M. "Aquatic macrophytes and their potential uses." *The Nigerian Field* 66 (2002): 139-147.
9. Dienye, H.E. "Species diversity of macrophytes of the New Calabar River, Niger Delta, Nigeria." *International Journal of Fisheries and Aquatic Studies* 3.1 (2015): 409 – 413.
10. Ehigiator, F. A. and A. Obi, A. "Inter-relationships among physical parameters in Ovia River, Niger Delta, Nigeria." *Proceedings of the 30th FISON Annual conference* Delta State University, Abraka Campus (2015): 99 – 103.
11. FAO. "Water quality for agriculture, food and agriculture organization irrigation and drainage payer." (2013) Retrieved 23/4/2019.
12. FEPA (Federal Environmental Protection Agency). "Guideline and standards for environmental pollution control in Nigeria." *Lagos* (1991): 238.
13. Hannington, N.B. and Emmanuel, N. "Effects of seasonal variation in physical parameters on quality of gravity flow water in Kyanamira sub-country, Kabele District, Uganda." *Journal of Water Resources and Protection* 20.8 (2016): 1297 - 1309.
14. Ilondu, E. M. and Agbogidi, O. M. "Macrophytes as biomonitors of aquatic environments." *Proceedings of the 30th Annual conference of the Fisheries Society of Nigeria (FISON) held at the Delta State University, Abraka Campus*, Nigeria (2015): 21 – 23.
15. Kigbo, A. A., Lawee, A. Y. and Intau, A. M. "Studies on the Plankton diversity and physio-chemical parameters of Shabu stream in Nasarawa state, Nigeria." *Proceedings of the 30th Annual conference of the Fisheries Society of Nigeria (FISON), Delta State University, Abraka Campus*, Nigeria (2015): 27 – 32.
16. Oboh, I.P. and Egun, N.K. "Groundwater suitability for aquaculture: a case study of Agbor, Delta State, Nigeria." *Ethiopian Journal of Environmental Studies and Management* 10.9 (2017): 1193 – 1199.
17. Okumagba, P.O. and F. Ozabor. "The Effects of Socio-Economic Activities on River Ethiope." *Journal of Sustainable Society* 3.1 (2014): 1-6.
18. Olukunle, O.F. and Oyewumi, O.O. "Physicochemical Properties of Two Fish Ponds

in Akure, Implications for Artificial Fish Culture." *International Journal of Environment, Agriculture and Biotechnology* 2.2 (2017): 977 – 982.
19. Osimien, E. C., Elakhame, L. A. and Norman, L. D. "Water quality and seasonal variations of Physico-chemical parameters of Orirami resetviour, Edo State, Nigeria." *Proceedings of the 30th Annual conference of the Fisheries Society of Nigeria (FISON), Delta State University, Abraka Campus*, Nigeria (2015): 94 – 98.
20. Radojeric M. and Vladimir, N. B. "Practical environmental analysis." *Royal Society of Chemistry*, Cambridge (1999).
21. Shibam, S., Abrajyoti, M. and Diptimoyee, S. "Study of physico-chemical parameters of three different urban pond water of Nadia district, West-Bengal, India." *International Journal of Fisheries and Aquatic Studies* 5.6 (2017): 23-27.
22. Shweta, T., Bhavfash, S., Prashants, S. and Rejendra, D. "Water Quality Assessment in terms of water quality index." *American Journal of Water Resources* 1.3 (2013): 34 -38.
23. Tanabe, T., Makoto, H., Akiko, N. M., Takashi, O. and Masaki, U. "Light quality determines primary production in nutrient poor small lakes." *Scientific Reports* 9.4639 (2019): 91 – 98.
24. Uneke, B.I. and H. Udennafor. "Aquatic macrophytes diversity and physic-chemistry of Asu River, southeastern Nigeria: implication for aquatic ecosystem management." *American Association for Science and Technology* 4.1 (2017): 1 – 6.
25. Zelnik, I., Mateja, P. and Alenka, G. "Environmental conditions and macrophytes of Karst ponds, Italy." *Polish Journal of Environmenta Studies* 21.6 (2012): 1911 – 1920.

Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Agbogidi, O. M., Nwanbueze, A. A., Odume, S. C., Stephen, O. F. and Onoche, P. "Environmental Conditions and Macrophytes in Fish Ponds in Oria, Abraka, Delta State Nigeria." *Annals of Plant Sciences*.11.04 (2022): pp. 5033-5039.

DOI: http://dx.doi.org/10.21746/aps.2022.11.4.3