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Survey of macrophytes evaluation in response to physico-chemical condition of some sewage ponds in Gwale Local Government Area, Kano State, Nigeria

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Abstract
A survey on the distribution abundance of macrophytes in response to some selected physicochemical parameters in surface water was conducted in four (A, B, C, D) selected sewage ponds in Gwale Local Government Kano State. The survey lasted for a period of two weeks during which pH, transparency, temperature, Dissolved Oxygen (DO), Biochemical Oxygen Dem BOD_5 measurements were conducted between the months of December January 2015. Macrophytes species were sampled analyzed using the stard established procedures. Results showed that, sewage pond C have recorded the highest readings in DO, BOD_5 temperature. Pond D records the least DO pH while least temperature BOD_5 were recorded in pond B. Highest pH was recorded in pond A. specie distribution was highest in pond C (7) followed by B (3) then ponds A & D with one each. The macrophytes species identified include Pistia stratiotes, Cynodon dactylon, Echinochloa pyramidalis, Clerodendrum capitatum, Mitracarpus hirtus, Hygrophila auriculata Typha domingensis. P. stratiotes E. pyramidalis were most prevalent. There was a significant correlation between species diversity extremes in physicochemical parameters at ponds C D. The study recommend the need to enlighten neighboring household on the potential risks of sewage discharge into the freshwater environment in order to mitigate the short long term effects on freshwater resources.

Keywords*: DO, BOD_5, Temperature, Specie diversity, Pistia sratiotes, Echinochloa pyramidalis.*

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I. Introduction

The term 'aquatic macrophytes' refers to large plants visible to the naked eye having at least their vegetative parts growing in permanently or periodically aquatic habitats. These plants colonize a variety of aquatic habitats can be divided into the following life forms: rooted submerged plants that grow completely submerged are rooted into the sediment such as elodea, Elodea Canadensis, free-floating plants that float on or under the water surface e.g. water hyacinth, Eichhornia crassipes); emergent – plants rooted in the sediment with foliage extending into the air e.g. cattail, Typha domingensis; floating-leaved plants rooted in the sediment with leaves floating on the water surface e.g. water lilies, Nymphaea spp. An additional two life forms have been proposed: epiphytes – plants growing over other aquatic macrophytes (e.g. Oxycarium cubense); amphibious plants that live most of their life in saturated soils, but not necessarily in water (e.g. Polygonum spp) (Ali, et al., 1999).

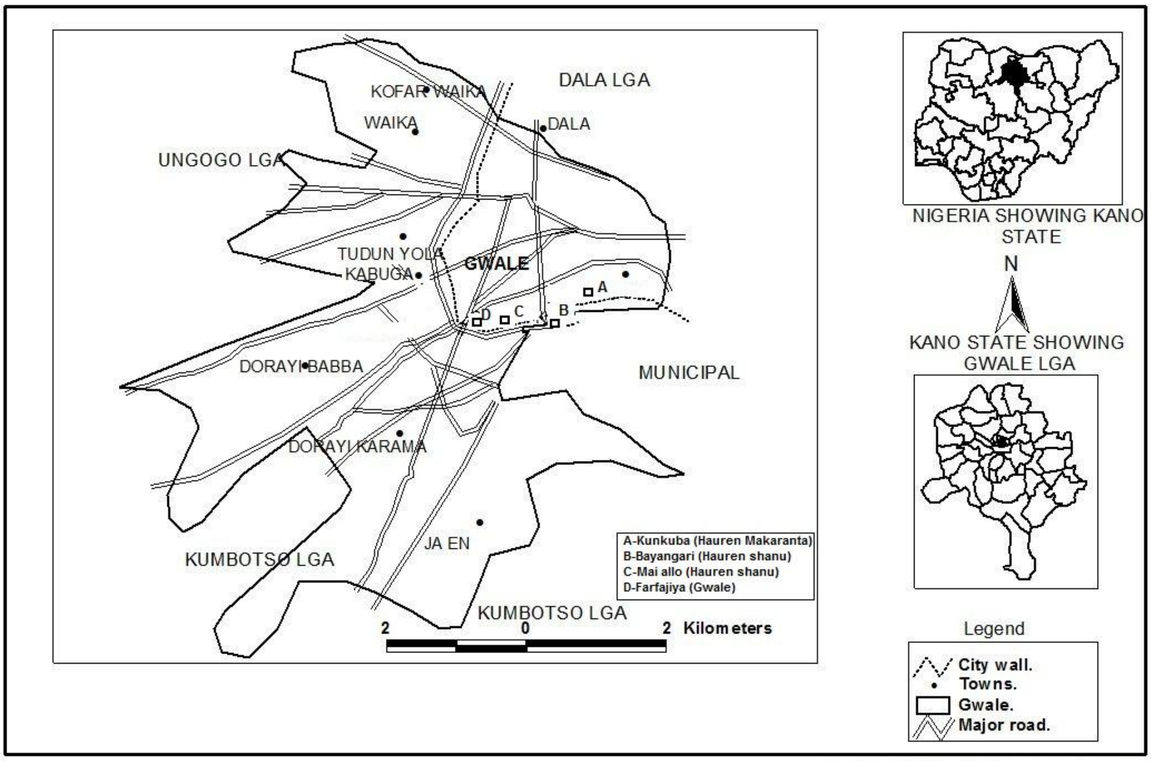
Macrophytes include macro algae of the divisions Chlorophyta (green algae), Xanthophyta (yellow-green algae), Rhodophyta (red algae) the "blue-green algae" (more correctly known as Cyanobacteria); Bryophyta (mosses liverworts); Pteridophyta (ferns); Spermatophyta (seed-bearing plants). However, most of the literature devotedto freshwater macrophytes has investigated three major groups: the Charales (an order of Chlorophyta comprisingy large up to 2 m relatively complex multicellular algae), together with the vascular plant groups, Pteridophyta Spermatophyta. Macrophytes colonize virtually all freshwater habitats, from the tiny "living ponds "provided by Bromeliaceae (e.g. Utricularia spp), to thermal springs (e.g. Najas tequefolia) waterfalls (e.g. members of the Podostemaceae colonize even the giant Iguaçu Falls,Brazil/Argentina). Most rivers, lakes, lagoons reservoirs are colonized to differing degrees by macrophytes,whilst wetls are characterized as areas where macrophytes dominate. (Mageed and Heikal, 2007).

Studies on aquatic macrophytes, especially their ecology, were few in number before the 1960s. The reasons are historical because the science of limnology primarily originated in north-temperate countries, where deep lakes are characteristic: such Freshwater systems are amongst the least favorable of habitats to support aquatic macrophytes. Consequently, phytoplankton was considered as the main primary Producer pelagic food webs were prioritized in those studies. A great increase in the Literature concerning macrophytes occurred after 1960, caused probably by the recognition that a great number, if not most, aquatic ecosystems were in fact shallow, with extensive littoral regions favorable for supporting aquatic macrophytes communities. A second factor was increasing recognition of the role played by macrophytes in the biodiversity-support functioning of freshwater systems: vital for many animal communities, such as aquatic Invertebrates, fish aquatic birds (Murphy and Abernethy, 1999). The aim of this study is to determine the distribution abundance of macrophytes in some selected sewage pond

II. Material Methods

Four sewage ponds within Gwale Local Government in Kano Metropolis were chosen for the purpose of this survey. Three of these are located closely together along Bayero University, Kano (BUK) Road while the other one was found a little bit far from them behind the residence of Gwale ward head. The sewage ponds selected were designated as ponds A, B, C D (Fig. 1) all receive sewage discharge from the neighboring residential houses.

Pond A this is known as **'Kunkuba Pond'** located within the coordinates of (Latitude 11.98221^{o}, Longitude 8.50899^{o}) at '*Hauren Makaranta'* along BUK road opposite to Nigerian police headquarter Kano zone 1. It is large, turbid greenish in appearance. **Pond B** this is known as **'Bayan Gari Pond'** located within the coordinates of (Latitude 11.98153^{o}, Longitude 8.50481^{o}), behind Kano city tower (Ganuwa) at '*Hauren shanu'* along BUK road. **Pond C** this is known as **'Mai Allo Pond'** located within the coordinates of (Latitude 11.98197^{o}, Longitude 8.5^{o}) near 'Gwale grave yard'. The pond is large but not as clear as Pond B. **Pond D** this is known as '**Farfajiya Pond'** located within the coordinates of (Latitude 11.9843^{o}, Longitude 8.50312^{o}), located outside the 'Gwale graveyard' behind the residence of Gwale ward head.



Source: Dept. of Geog. BUK (2014)

Fig. 1: Map of Gwale Local Government showing the Four Sewage Ponds

Sample Collection

Fourteen water samples were collected using plastic bottles at each of the four ponds over a period of 5 weeks between 23/12/2014 to 26/01/2015 around 7:45am to 10:30am. pH, temperature transparency were obtained at the time of sampling while samples for DO BOD_5 were sampled as described by Bennett David 1974. These are determined using Microprocessor DO meter model HANNA HI 9146. Samples for macrophyte identification were collected in polythene bags and taken to the laboratory with their local names obtained from the residents to assist in the identification process.

Analyses of physicochemical parameters

Temperature & pH were determined using a dual purpose digital meter model JENWAY pH Meter, 3150. This was conducted after rinsing the meter electrode with distilled water, it was then dipped in the pond with constant stirring for few seconds later the fixed value appeared which is recorded as described by Adoni *et al.,* (1985) and APHA, (1998). Water transparency was obtained using a black & white coated secchi disc as described by Reid & Wood (1978), and APHA, (2005) where the average of two readings gives the actual measurement.

Dissolved oxygen (DO) & Five day biochemical oxygen demand (BOD_5) were measured using digital meter model HANNA HI 9146 Microprocessor Dissolved Oxygen Meter. The meter was calibrated first before taking the readings after calibration, the tip of the meter probe was then immersed in the distilled water, then to the sample which was transferred in the rubber beaker by manually stirring the probe until the probe reached thermal equilibrium value displayed on the screen and reading was recorded. Samples for BOD_5 were incubated at 25° for five days after which the difference between initial and final DO was calculated as 5 day BOD.

III. Results

The results of physico-chemical and biological parameters are presented in tables 1, 2 and 3 plates 1 to 7 respectively. The values obtained were analyzed in form of means and ranges.

Table 1: Average recordings of physico-chemical parameters for all ponds

Parameters Ponds	**pH**	**Temperature (°C)**	**Transparency (cm)**	**Dissolved Oxygen (mg/L)**	**Biochemical Oxygen Dem (mg/L)**
A	7.58	18.47	19.57	6.05	3.03
	(6.62-8.93)	(15.0-20.7)	(15.25-26.25)	(3.75-8.02)	(0.05-5.22)
B	6.86	17.56	56.09	4.91	1.6
	(6.25-7.82)	(14.5-19.3)	(36.75-70.0)	(2.73-7.23)	(0.38-4.35)
C	7.33	18.69	51.21	6.16	3.30
	6.66-7.97	(15.3-21.6)	(30.75-80.25)	(3.81-8.83)	(0.67-5.91)
D	6.65	17.97	20.02	4.23	2.04
	6.12-7.62	(14.5-19.3)	(11.75-38.5)	(2.75-5.6)	(0.89-3.31)
Mean	7.1	16.0	36.7	5.3	2.49
Range	6.12-8.93	(14.5 – 21.6)	(11.75-80.25)	(2.75-8.83)	(0.05-5.91)

*****values in brackets denote range of parameters

Table 2: Diversity of Macrophyte species identified at each pond

Ponds	Species identified
A	*Echinochloa pyramidalis*
B	*Pistia stratiotes* *Echinochloa pyramidalis* *Typha domingensis*
C	*Pistia stratiotes* *Cynodon dactylon* *Echinochloa pyramidalis* *Clerodendrum capitatum* *Mitracarpus hirtus* *Hygrophila auriculata* *Typha domingensis*
D	*Pistia stratiotes*

Table 3: Classification of Macrophyte Species Identified for all ponds

Division	Class	Order	Family	Genus	Species	Pond(s)
Magnoliophyta	Liliopsida	Alismatales	Araceae	*Pistia*	*P. stratiotes*	B, C D
		Cyperales	Poaceae	*Echinocloa*	*E. pyramidalis*	A, B C
	Magnoliopsida	Lamiales	Lamiaceae	*Cynodon*	*C. dactylon*	C
				Clerodendrum	*C. capitatum*	C
Tracheophyta	Magnoliopsida	Scrophulariales	Acanthaceae	*Hygrophila*	*H. auriculata*	C
		Gentiales	Rubiaceae	*Mitracarpus*	*M. hirtus*	C
Spermatophyta	Monocotyledonae	Typhales	Typhaceae	*Typha*	*T. domingensis*	B C

Below are the pictures of the macrophyte species identified in form of plates from plate I to plate VII:-

Plate I: *Pistia stratiotes* from pond B, C, D

Plate II: *Echinocloa pyramidalis* from pond A, B, C

Plate III:*Typhadomingensis,* collected from pond B C

Plate IV: *Cynodon dactylon,* collected from pond C

Plate V: ***Mitra carpushirtus*****, from pond C**

Plate VI:***Hygrophila auriculata*** **from pond C**

Plate VII: *Clerodendrum capitatum* from pond C

IV. Discussions

Freshwater bodies are subjected to variations in the environmental factors such as pH, temperature, dissolved oxygen, light penetration, turbidity, density etc. These factors are responsible for distribution of organisms in different freshwater habitats according to their adaptation, which allow them to survive in that specific habitat. The addition of various kinds of pollutants nutrients through sewage, industrial effluent etc. into water bodies bring about a series of changes in physico-chemical biological characteristics of fresh water. These changes have been the subject of various investigations (Grinberga, 2011; Lawson 2011).

The result of this study shows that the distribution of macrophytes varied with the variation in physicochemical factors of their environment such as pH, temperature, transparency, dissolved oxygen and biological oxygen demand as posited by Grinberga, (2011). pH readings are within the acceptable level of 6.0-8.5 (Huett, 1979). It favours the growth of macrophytes as supported by Boyd, (1979). This is evident from the readings in Table 1 the diversity of species in table 2. The relationship between macrophytes and water temperature is positively correlated as photosynthetic activity is increased by the increase in temperature (Paul 2010). This is witnessed in pond C into consideration where highest diversity was recorded. Results of transparency recordings in ponds A & B agrees with Kendirim (1990), that higher values are attributed to the absence of flood water, surface run offs the settling effect of suspended materials. Thus high productivity by species diversity at ponds B and C corresponds to high transparency vice versa for pond A that records low productivity from low transparency. This observation could be attributed to light penetration which affects photosynthetic rate (USEPA, 1991; APHA, 1992).

The relationship between oxygen production specie distributions is clearly seen in ponds Cand D with highest and least distributions respectively. Thus, macrophyte increase with increase in DO concentration due to cool harmattan wind which increase wave action that might have contributed to the high oxygen value in pond C during this study. Likewise the occurrence of low oxygen value has been attributed to the process of decomposition of organic matter involving the utilization of oxygen by them as posited by Rochford, (1951) and Jameel, (1998).

Pond C records the highest value of BOD_5 followed by ponds A & D while pond B records the least BOD_5. The variations in BOD values could be attributed to the amount of organic matter in form of municipal domestic wastes discharged into ponds. There is no clear relationship between species diversity BOD_5 values. A total of seven macrophyte species were recorded in the ponds (Table 2). This indicates rapid growth of macrophytes with maximum species diversity in pond C and B. A floating specie *Pistia stratiotes* was recorded while the rest are emergent. There was no submerged specie in the ponds. Pond A is dominated by *Echinocloa pyramidalis*, B by *Typha domingensis Echinocloa pyramidalis while* Pond C is dominated by *Cynodon dactylon*

Echinocloa pyramidal. Pond D is dominated by *Pistia stratiotes.* The species belongs to the divisions Magnoliophyta, tracheophyta spermatophyta.

V. Conclusion

Ponds have always been one of the most important fresh water resources. They support vast biodiversity of flora fauna which provide food & shelter to aquatic organisms. This study concludes that species diversity is affected by extremes in temperature, pH, transparency, dissolved oxygen concentration over the period of this survey that conditions in pond C are much safer for aquatic macrophytes compared to the remaining ponds. It is recommended that further research shall encompass other parameters not tested here. The role of temporal variations (by considering longer periods in the investigation) shall be taken into account. There is also the need for local health environmental officials to inform the residents on the dangers associated with indiscriminate discharge of raw sewage into the ponds. In addition, safer alternatives to sewage disposal shall be provided and encouraged. Bathing by children or grown up adults shall totally be stopped as these sites could be a reservoir of pathogenic microorganisms.

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