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ASSESSMENT OF THE PHYSICO-CHEMICAL PARAMETERS AND HEAVY METAL CONCENTRATION IN SABIYAL LAKE, ALIERO LOCAL GOVERNMENT, KEBBI STATE, NIGERIA.

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ABSTRACT: *This study was conducted to determine the physico-chemical parameters and heavy metal concentration in water from Sabiyal Lake. The water samples were collected for three weeks in three sampling sites (1, 2, and 3) within the Lake. The temperature ranged from 27-30°C in station B, where the highest mean temp°C was recorded in week 3 and lowest in week 2. The range of turbidity in station A was within 80-110 cm, where the highest mean of turbidity was recorded in week 3 and least in week 1. The pH ranged from all the three stations (A, B and C) 7.1-8.5, all the highest mean pH were observed in week 1 and least in week 2. The range of (Do) in station C was within 5.6-6.6 mg/l where the highest mean was recorded in week 1 and least in week 3. The concentration of heavy metal in Water from Sabiyal Lake; the highest mean value of Cr was observed in station A (3.6 ± 1.34 mg/l), while the lowest mean was observed at station C (2 ± 1). The highest concentration mean value of Pb was observed in station A (6.3 ± 1.77 mg/l), while the lowest mean (4.6 ± 1.51 mg/l) was observed at station C. The result of physico-chemical parameters were found to be within the normal range while others were above or below the normal range as given by (WHO, 2006), (FEPA) and (SON, 2007) limit. The study infers that samples contain higher concentration of heavy metals which were also above the permissible limit.*

Key words: Physico-chemical, Parameters, Heavy metal, Sabiyal Lake and Water

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INTRODUCTION

Water is a medium in which fish live, grow, and reproduce. The physico-chemical parameters of water are temperature, depth, turbidity, pressure, and the color, Chemical parameters such as pH, total hardness, carbon dioxide, ammonia, calcium, phosphorus, conductivity, dissolved oxygen, biological oxygen demand, chemical oxygen demand, alkalinity, carbonates, bicarbonates, calcium, magnesium, hardness, chlorides, sulphates, nutrients like nitrates and phosphates, turbidity and total dissolved solids (Adeyeye, 1994).

However, in recent times, Nigeria inland water bodies have been subjected to various forms of degradation due to pollution arising from domestic wastes, industrial effluent, agricultural run-offs, oil spillage, minning effluents and obnoxious fishing practices (Ndimele, 2008). The result is that the associated fishery, the biota and the ecosystem upon which fishers depend for a living are destroyed and consumption of fish caught from such polluted water bodies poses severe danger to the consumers (Kumolu-Johnson *et al.,* 2004). One of such pollutants is heavy metals.

The term "heavy metals" refers to any metallic element that has a relatively high density and is toxic or poisonous even at low concentration (Lenntech, 2004). "Heavy metals" is a general collective term, which applies to the group of metals and metalloids with atomic density greater than 4 g/cm^3 or 5 times or more, greater than water (Garbarino *et al.,* 1995). Heavy metals are pollutants that have been a source of concern for aquatic ecologists because most of them are non-biodegradable; once they enter the system of a biota, they persist there and bio-accumulate along the food chain (Ndimele *et al.,* 2009). The presence of heavy metals in aquatic ecosystems is the result of two main sources of contamination; natural processes or natural occurring deposits and anthropogenic activities.

Studies on heavy metals in rivers, lakes, fish have been a major environmental focus especially during the last decade (Fernandes *et al.*, 2008). Water is commonly employed as a pollution indicator by heavy metals can provide a deeper insight into the long-term pollution state of the water body (Ikem *et al.*, 2003). However, variation in concentration of parameters depends on concentration from processes operating within the catchments. Changes in the physico-chemical parameters and heavy metal concentration may bring about changes in water quality in relation to its colour, odour, density, taste, and thermal properties, all these changes can adversely affect the fish. The important chemical producing bad taste and odour in aquatic body are Salt, Iron, Manganese, Phenols, Unsaturated hydro carbon etc. In the aquatic bodies taste and odour also develop, because of odourous substances produced by algae.

Domestic wastes are discharged into Sabiyal lake almost exclusively without adequate treatment which results in water pollution, the accumulation of toxic compounds in biomass and sediments loss of dissolved oxygen in water and other nuisances. Dunbabin. (1992). Downlake, the water is highly coloured, turbid and the vegetation along the lake appears scorched despite the fact that water from this lake is a major resource in the area. It is used for cleaning, building, irrigation, drinking by animals and birds, recreation, human consumption and transportation. Wetlands are known to act as natural filters for nutrients and contaminants that originate from the catchments area, thereby protecting the water quality Kansiime and Nalubega (2000). Regrettably, Sabiyal wetland is expected to filter contaminants carried by the lake but has been degraded and reduced in size due to increased human activities causing a reduction in its cleaning potential thus allowing waste to seep into the lake. This creates an urgent need to assess the impact of wastewater in that Lake. The aim

of this study is to assess the physico-chemical and heavy metal parameters in water from Sabiyal lake.

MATERIALS AND METHODS

Study Area

The Sabiyel Lake, Aliero Local Government of Kebbi State, is a eutropic, perennial standing fresh water body, located between latitude 130 6"- 4015" North and longitude 12027"- 47" East. The lake is at the centre of Sabiyel, Kashinzama, Laga, Tari, Kambaza, Bami Mairuwa, and Kyara villages, 13km away from Aliero town, Aliero Local Government Area, Kebbi state, Nigeria. It covers a length of 9km between the one extreme to other extreme of the lake. It is almost covered by emergent plants, dominantly cattail.



Figure 1: Sabiyal Lake

Design and Sampling

The study involved sampling of water from three sampling sites within the Sabiyal Lake, where domestic wastes are discharged. Samples were collected for three weeks in three sampling sites 1, 2, and 3 within the Lake.

Determination of Physical and Chemical Parameters of Water in Sabiyal Lake

Temperature was determined by mercury thermometer in the sample to the proper depth for accurate reading, value was taken after every steady figure that last for two minutes were obtained. Turbidity was determined using a secchi disc. The secchi disc was inserted into the lake and the reading was obtained. p^H was determined by pH meter; the pH meter was inserted into the water samples and stir and the glass electrode was also immersed and allowed to stay for 2minutes to stabilize before reading the pH value. Dissolved oxygen was determined by Winkler's method. The water samples were collected in amber glass bottles, one hundred ml of the sample was poured into a conical flask and 2 drops of starch indicator was added to form a dark blue colour. The dark blue sample solution was titrated against 0.037M sodium thiosulphate and turned colourless.

Digestion of Water Sample in Sabiyal Lake

The water sample was digested by measuring 100ml of each of the representative water samples were transferred into Pyrex beakers containing 10ml of concentrated HNO3. The samples were boil slowly and then evaporated on a hot plate to the lowest possible volume

(about 20ml). The beakers were allowed to cool and another 5ml of Conc HNO3 was added. Heating was continued with the addition of Conc. HNO3 as necessary the digestion is complete. The samples were evaporated again to dryness (but not baked) and the beakers were cool, follow by the addition of 5ml of HCl solution. The solutions were warm and 5M of NaOH was added, then filtered. The filtrates were then be transfer to 100ml volumetric flasks and diluted to the mark with distilled water.

Determination of Heavy Metal Concentration of Water in Sabiyal Lake

The heavy metal concentration was determined using Atomic absorption spectrophotometer, for the analysis of Cr (chromium), and Pb (lead) of the water were done using Atomic absorption spectrophotometer.

Statistical Analysis

The data obtained was analyzed using descriptive statistic (Mean and standard deviation).

RESULT AND DISCUSSION

Physico- Chemical Parameters of Water from Sabiyal Lake

Table 1 shows the physico-chemical parameters of water as determined over the duration of three weeks in the study area. The temperature ranged from 27.60-28.00°C in station A, where the highest mean temperature was observed in week 1 and lowest in week 2. The temperature ranged from 27-30°C in station B., where the highest mean temp°C was recorded in week 3 and lowest in week 2. However, station C followed the same trend as that of station A, where the highest mean temperature was observed in week 1 and least in week 2.

The range of turbidity in station A was within 80- 110cm, where the highest value was observed in week 3 and lowest in week 1. Stations B and C followed the same trend as station A where the highest mean of turbidity was recorded in week 3 and least in week 1 from the both stations.

The pH ranged from all the three stations (A, B and C), were 71- 8.0, 7.2- 7.9, 7.3- 8.5 respectively. However, all the highest mean pH were observed in week 1 and least in week 2 with respect to all the three stations.

The range of (Do) in station A was within 4.6- 6.4 mg/l where the highest mean (Do) was recorded in week 2 and the lowest in week 1. In station B (Do) ranged from 3.6- 6.4 mg/l where the highest mean (Do) was observed in week 2 and least in week 3. However, station C ranged from 5.6- 6.6 mg/l where the highest mean was recorded in week 1, and least in week 3.

Table 3.1 Physico-chemical Parameters of Water from Sabiyal Lake

Temperature	**Week 1**	**Week 2**	**Week 3**
A	28 ± 3.74°C (26-30)	27.6 ± 3.76°C (27-29)	28 ± 3.74 °C (26-30)
B	27 ± 3.67°C(25-29)	27 ± 3.67°C (25-29)	30 ± 3.87°C (28-32)
C	29 ± 3.80°C (27-31)	28 ± 3.74°C (27-29)	29 ± 3.80°C (27-31)
Turbidity	80 ± 6.32 (98-82)	100 ± 7.07 (98-102)	110 ± 7.41 (109-111)
A	85 ± 6.51(83-87)	105 ± 7.24 (103-107)	115 ± 7.58 (113-117)
B	90 ± 6.70 (88-92)	110 ± 7.46 (108-112)	120 ± 7.74 (118-122)
C			
pH	8 ± 2 (7.9-8.1)	7.1 ± 1.88 (7-7.2)	7.4 ± 1.92 (7.4-7.5)
A	7.9 ± 1.98 (7.8-8.0)	7.2 ± 1.89 (7.1-7.3)	7.5 ± 1.93 (7.4-7.6)
B	8.5 ± 2.06 (8.4-8.5)	7.3 ± 1.91 (7.2-7.4)	7.6 ± 1.94 (7.6-7.8)
C			
DO (Mg/l)	4.6 ± 1.51 (4.6-4.8)	6.4 ± 1.78 (6.3-6.6)	4.7 ± 1.53 (4.6-4.8)
A	4.7 ± 1.53 (4.6-4.8)	6.4 ± 1.78 (6.2-6.6)	3.6 ± 1.34 (3.4-3.8)
B	6.6 ± 1.81 (6.4-6.8)	6.5 ± 1.80 (6.4-6.6)	5.6 ± 1.67 (5.4-5.8)
C			
WHO 2006	8-8.5	7.0-8.5	
SON 2007	8-8.5	7.0-8.5	
FEPA 2003	3.6-6.6		

Results are means of triplicate determination ± standard deviation (S.D)

Concentration of Heavy Metals in Water from Sabiyal Lake.

Table 2 shows the concentration of heavy metals in water from Sabiyal Lake. The highest concentration mean value of Cr was observed in station A (3.6 ± 1.34 mg/L), while the lowest mean value was observed at station C (2± 1 mg/L). The highest concentration mean value of Pb was observed in station A (6.3 ± 1.77 mg/L), while the lowest mean, (4.6 ± 1.51 mg/L) was observed at station C.

Table 3.2 Concentration of Heavy Metals in Water From Sabiyal Lake

STATION	**Cr mg/L**	**Pb Mg/L**
A	3.6± 1.34	6.3± 1.77
	(3.4-3.8)	(6-6.6)
B	2.4± 1.09	5.6± 1.67
	(2.3-2.5)	(5-6.4)
C	2± 1	4.6± 1.51
	(1.9-2.1)	(4.3-4.9)
WHO 2006	0.05mg/l	
FEPA 1991	0.05mg/l	

Results are means of triplicate determination ± standard deviation (S.D)

Discussion

The Importance of good water quality in the aquatic environment cannot be over emphasized, as it necessary for the sustenance of aquatic life. There are recommended limits of certified organizations such as the World Health Organization (WHO), Federal Environmental Protection Agency (FEPA) and Standard Organization of Nigeria (SON).

The Temperature is probably the most important environmental variable as it affects metabolic activities, feeding, growth, reproduction, distribution and migratory behaviour of aquatic organisms. Results obtained from the present study showed that water temperature varied between 27ºC and 30ºC. These values were within the acceptable levels for survival, metabolism and physiology of aquatic organisms as Afzal *et al.* (2007) recommended a temperature range of between 27ºC and 30ºC for optimum survival and performance of aquatic life. The range of water temperature in this study is in agreement with Allison *et al.* (2007) of 27ºC to 30ºC for the Nun Lake and Otobo (1995) of 27ºC to 30ºC for the Nun Lake. It is also within the reported range of 27ºC to 30ºC in the Niger Delta (Ewa, 1988) and may not be considered significantly different from the range of 27ºC to 30ºC typical for African Lakes (Mecan, 1963).

The pH values throughout the study period ranged between 7 to 8.5, showing a moderately neutral condition in the study area. However, a mean pH value of 8.5 indicated an alkaline condition in the lake. This observation is similar with the findings of Oso and Fagbuaro (2008) as well as Morrison *et al*. (2001) and suggested that the water quality may not be healthy for the aquatic biota as pH value between 7 and 8.5 is necessary for sustenance of aquatic life. According to the authors (Oso and Fagbuaro, 2008; Morrison et al., 2001), severe changes in the pH of water bodies can have a drastic effect on aquatic life as these organisms have adapted to life in water of specific pH and even slight changes may result in death. Values obtained in the present study indicated that in the sampling site with a pH value (8.5) which fall in line with the (WHO, 2006), (FEPA) and (SON 2007) limits are suitable for aquatic life, pH values according to (WHO 2006) and (SON 2007) for domestic use is 7.0 to 8.5. Sabiyal Lake water is suitable for both aquatic life and domestic purpose.

The Turbidity is a measure of light penetration in to water. Turbidity values obtained during the study period ranged between 80cm to 120cm. Low turbidity values signifies high turbidity in a water body and the more turbid the water, the less chances of light penetration. Light is essential for aquatic flora (microphytes and macrophytes) for photosynthesis therefore, insufficient light penetration will result in reduced primary productivity and the end result will be reduced dissolved oxygen level, reduced nutrients, low growth rate and migration of aquatic organisms to more nutrient level.

Low turbidity values were observed (80cm), the high turbidity values were more during the rainy season (120cm) which may have resulted especially during the rainy season (Lucinda and Martin, 1999). Low turbidity values were also reported for the lower Nun lake, Niger delta, Nigeria (Allison, 2007). These findings agreed with the Otobo (1995) who also observed lower turbidity values in the lower water period (80cm) than during the flood period (120cm).

The dissolved oxygen (D.o) values obtained during the study period ranged between 3.4mg/l to 6.6mg/l which is similar with the findings of (FEPA) minimum limit (6.6 mg/l). The values obtained in this study was similar to those reported for many other Nigerian waters including 5.6mg/l – 6.4mg/l for Lagos lagoon (Ogunwenmo and Kusemiju, 2004), 4.00mg/l

– 6.50mg/l for Luubara creek in Niger Delta (Deekay *et al.*, 2010) and 1.20mg/l – 6.40mg/l documented in Edokpayi and Osimen (2001) for some polluted water bodies in Nigeria. The highest value of 6.6 mg/l dissolved oxygen was obtained but seems to be unlinked with the fact that rainfall was actually the lowest (3.6 mg/l), bearing in mind that some authors (Akpan, 1993) have argued that dissolved oxygen increases with increase in rainfall due to the increased current flow that enables the diffusion and mixing of atmospheric oxygen into the water. However, some authors have also argued the fact that dissolved oxygen does not increase with the rains. Kemdirin and Ejike (1992) while working on an upland and lowland lake in Plateau State argued that dissolved oxygen concentration is high in the dry seasons due to high photosynthetic activities of the phytoplankton at this period. They argued that low DO levels during rainy months is likely caused by high aquatic vegetation cover that flourish favourably in the rainy months at the expense of dissolved oxygen used in respiration. Thus, the high value of dissolved oxygen could be as a result of an increase in primary productivity by aquatic flora, that led to the release of oxygen during photosynthesis during the daytime bearing in mind that the samples were collected during the hours of 7:00 am to 9:00am when dissolved oxygen in water is usually at its peak. It could also have been because of the mean surface water temperatures, which ranged between 27ºC - 30ºC; as the solubility of oxygen decreases with high temperature and increases with low temperature. Generally, the study area can be said to have sufficient dissolved oxygen for the sustenance of aquatic life, as the values did not fall below the FEPA limits of 6.6 mg/l.

The Chromium (Cr) during this study, chromium concentration ranged between 2 to 3.6 mg/l. The highest concentration of chromium (3.6 mg/l) was recorded and lowest (2 mg/l). Concentrations of chromium obtained throughout the study period were higher than (WHO) (0.05mg/l) and FEPA (0.05mg/l) permissible limits. High concentration of chromium can affect the proper functioning of gills skeletal deformities and impaired functioning of kidneys, but could be used for other domestic purposes. The concentrations were also higher than the values (0.06mg/l) reported for Warri river by Egborge (1991) and lake Challawa by Salisu and Bichi (2010). The high concentration of chromium in Sabiyal Lake could be as a result of domestic waste which is the major source of chromium in water. Chromium oxidizes easily from trivalent to hexavalent and while Cr3+ ion is a non-toxic, essential nutrient, Cr6+ ion is very toxic and damages the livers and lungs. Exposure of man to high concentration of Cr6+ may cause dermatitis, ulcer, destruction of mucus of nose and cancer of the stomachs.

The Lead (Pb) during this study, the mean concentration (6.3 mg/l) of lead obtained during the study period was higher than the level (0.05mg/l) recommended by both (WHO) and (FEPA) and the lowest concentration (4.6 mg/l). The high concentration of lead can affect the proper functioning of gills, skeletal deformities and impaired functioning of kidneys. The results obtained from this study is similar to the one reported for Shanomi creek by Igbinosa *et al.* (2012).

CONCLUSSION AND RECOMMENDATIONS

Conclusion

The study concluded that the physico-chemical parameters in freshwater of Sabiyal Lake were within the normal range while others were either above or below the normal range as given by (WHO, 2006), (FEPA) and (SON 2007) with regard to the physico-chemical parameters there are indications that the water of Sabiyal Lake is considerably convenient for aquatic life and also for domestic use. The study also concluded that contamination of heavy

metals was observed to be higher in the samples indicating pollution of water, these contaminants when consumed by fish and other aquatic organism may cause a lethal effect; this could lead to fast deterioration of good quality water. However, apart from Cr, Pb concentrations are above the acceptable limits for aquatic organisms and also domestic life.

Recommendations

a. The public, particularly farmers that live within the lake, should be sensitized on the health risk associated with the aquatic organisms of polluted water.
b. Adequate waste and sewage disposal methods should be employed and projects on waste recycling should be adopted and funded by government.
c. With respect to the present level of metals contamination of water in Sabiyal Lake, effective management of the lake and bio-monitoring assessments should be done more frequently in order to monitor the pollution status of the lake.
d. It is advisable to initiate effective pollution control and management strategies for the lake.

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