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Physico-Chemical Analysis of Wetland Water of Iba Community in Lagos State Nigeria

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Abstract The pollution level of wetland water in Iba area of Lagos state was studied. Water samples were collected from different spots on the wetland three times a week for a period of six weeks and analyzed for pH, total dissolved Solid (TDS), chemical oxygen demand (COD), alkalinity, acidity, chloride, nitrite, phosphate, sulphate, dissolve oxygen (DO), biochemical oxygen demand (BOD), calcium, sodium, iron, zinc, potassium, cobalt, nickel, cadmium, and chromium respectively. The trace metals were investigated using atomic absorption spectrophotometer (AAS). The average values of 6.30 ± 0.01 and 6.40 ± 0.01 were obtained for the pH of the wetland water during the normal and raining atmospheric conditions which is an indication that the wetland ecosystem is less acidic and the pH is within the set standard of 6.50-8.50 for portable water. The average values obtained for the physicochemical parameters ranged from 28.050- 28.433mg /L temperature, 6.36-6.40 mg /L pH, 57.05-56.97 mg /L total dissolved solid, 46.00-46.70 mg /L chemical oxygen demand, 84.42-84.67 mg /L alkalinity, 4.53-4.62 mg /L acidity, 130.53-130.95 mg /L, 5.10-5.12 mg /L chloride, 5.20-5.12 mg/L nitrite, 1.04-1.05 mg /L phosphate, 100.60-100.83 mg /L sulphate, 1.38-1.45 mg/L dissolved oxygen, 30.63-30.84 mg /L biochemical oxygen demand, 185.33-185.58 mg/L Ca, 84.68-84.83 mg /L Na,7.82-7.83 mg/L Fe, 0.35-0.36 mg/L Zn, 29.73-29.85 mg/L K, 0.51-0.52 mg /L Ni, 0.17-0.18 mg /L Cd and 0.42-0.43 mg /L Cr. The result revealed that the wetland is highly contaminated with cadmium. On comparison of the result obtained from the investigated wetland with other literature value there were variation in the physico-chemical properties of the water which may be attributed to change in temperature and in flow as the atmosphere changes. Most of the physicochemical parameters were within the standard limit set except for dissolved oxygen (DO) and biochemical oxygen demand (B0D) while majority of the trace metals were above the Standard Organization of Nigerian (SON) and World Health Organization (WHO) standard set limit.

Keywords Wetland, Ecosystem, Biological cycle, Eutrophication, Aquatic fauna

1. Introduction

Wetlands are defined as “areas of marsh, fen, peat land” or water, whether natural or artificial, permanent or temporary, with water that is stationary or flowing, fresh, brackish or salt, as well as areas of marine water, the depth of which at low tide does not exceed six meters and are the interface water and land [Ramsar (2006), USEPA (1995), Firehock et al (1998), NRC (1995)]. Wetlands covers 4-6% of the earth’s surface and are very productive ecosystems, which assist in the regulation of biological cycles, maintenance of water quality, nutrient movement and support for food chains. It provides important fish and wildlife habitat and also supports hunting, fishing and other recreational activities and the primary factor controlling the environment and the associated plant and animal life is water [Ramsar (2006), USEPA (1995)]. Wetland usually occur where the water table is at or close to the surface of land or anywhere the land is covered by shallow water beneath the text of their arms or convention [Ramsar (2006), USEPA (1995), NRC (1995)]. They possessed good biological diversity which makes the world productive environment [Mitsch, W.J. and J.G. Gosselink (1994), Mitsch, W.J. and J.G. Gosselink (1993), Kadlec R H, and Wallace S (2008)]. The domestic and industrial discharges into the wetlands will adversely affect the micro flora and fauna that dwell in them [Muwanga, A. and Banfago, I. (2006)] conversely, wetlands provide refuge for endangered species of plants and animals and economic benefits in aquatic fauna. They reduce the impact of floods by acting as storage areas [Muwanga, A. and Banfago, I (2006), Zhang B.Y (2010)]. Stored water percolates downward, getting purified in the process, and replenishing the ground water [Muwanga, A. and Banfago, I (2006)]. Interestingly, wetlands cover a tiny portion of the earth surface, but by the nature of their distinctive ecosystem, it becomes very important to protect and conserve them. Wetlands are important mechanism of watersheds and make

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available many important functions to the environment and to society at large [Mitsch, W.J. and J.G. Gosselink (1994), Mitsch, W.J. and J.G. Gosselink (1993), NRC (1995)]. However, as a result of the exponentially increasing demands of human expansion, and resource exploitation, urbanization and industrialization, natural wetland ecosystems are shrinking rapidly hence cannot always function efficiently for desired objectives and stringent water quality standards [Kadlec R H and Wallace S (2008), Wetzel, R G (1993)]. To assess the ecological nature of the wetlands physico-chemical quality of the wetland water can be investigated. It is a well known fact that discharges from domestic sewage and industrial effluent usually leads to changes in water quality and eutrophication. Several sources of water pollution which include mass bathing, rural waste matter, agricultural runoff and solid waste disposal has been reported by Wetzel, RG (1993), Olowu R. A et al (2010) and Adeniyi A.A et al (2007). In 2005, Rajar and his co worker investigated the physicochemical parameter of lakes wetland and reservoir in order to understand there water quality. Similar studies were also carried out by Jindal et a l 2007 and Kambele et al 2009 respectively.

As a result this study is geared toward assessing the physicochemical parameter of wetland water around Iba community in Lagos state, Nigeria in order to ascertain the ecological nature of the wetland.

2. Materials and Methods

2.1. Study Location

Iba village is situated within Iba Local Government Area of Lagos State. The Local Government share boundary with Ikotun-Igando Local Development area at the edge of the Obadore bridge to the north to include Iba community, to the south, Okokomaiko to the other side of Badagry expressway from Iyana-Iba up to the boundary of Oto-Awori Local Government, to the east, Iba road from Obadore bridge to the junction of Iba-Lasu road on Badagry expressway and to the west, Ketu bridge on Badagry expressway up to the boundary with Ogun State. In Iba village the wetland is a typical Bottomland Hardwood Forested Swamp wetland. It's kind of wetland is characterized by a river (Odo-Isan), which flows through the village from inside Obadore village up to Ishasi and beyond. Over the years, the community have used and are still using the river as a means of transporting logs of wood from inside the swamp to a more open place where they are cut into pieces as firewood. Other activities engaged in by the people include fishing, hunting, palm wine taping, farming etc. The entire Iba village is a wetland, but in the recent years the wetland have been converted to various usage like construction of roads, construction of bridge, construction of drainage and building of houses. Despite these developments, wetlands still cover about 15 to 20 percent of the village landmass.

2.2. Sampling Collection and Preparation

Water samples were collected for physico-chemical analysis from different sampling spots within the Iba wetland. Samples were collected, thrice, weekly for six weeks within a period of April 2010 –June 2010 in the morning between the hour of 6am-8am. The samples were collected in previously acid (5% HNO_3) soaked and washed polypropylene. The samples in polypropylene bottles were refrigerated at 40 ^oC prior to all analysis procedures.

The collected sample were analyzed for parameters such as (i) pH (ii) Total Suspended Solid (TSS) (iii) Chemical Oxygen Demand (COD) (iv) Alkalinity (v) Acidity (vi) Chloride (vii) Nitrites (viii) Phosphate (ix) Sulphate (x) Dissolved Oxygen (DO) (xi) Biochemical Oxygen Demand (BOD) (xii) Calcium (xiii) Sodium (xiv) Iron (xv) Zinc (xvi) potassium (xvii) Cobalt (xviii) Nickel (xix) Cadmium (xx) Chromium were analyzed in the laboratory following the standard methods of APHA, 2005. The trace metals were determined by a BUK scientific, VGP 210 model flame atomic absorption spectrophotometer.

3. Results and Discussion

Table 1 presented the average value and standard deviation of the wetland analysis results during normal and raining atmospheric conditions while figure 1 showed the variation between the two atmospheric conditions considered. The temperature of the water during the normal was 28.4 $^{\circ}C$ and 28.05 $^{\circ}C$ for raining atmospheric conditions. The average value of pH obtained was in the range of 6.30 ± 0.01 for the normal atmosphere and 6.40 ± 1.04 for raining atmospheric condition which revealed less acidic nature of the wetland. The value obtained for this wetland was lower than the value reported earlier by Kulakarni et al 2009 and the values are within the range recommended by standard organization of Nigeria (2007) of pH 6.5-8.5, suitable for drinking water SON (2007), Olowu et al (2010), WHO (1993), BIS (1991)]. On the order hand the chloride concentration obtained was in the range of 130.53 ± 0.82 mg/L for normal and 130.95 ±1.0 mg /L for raining conditions which was found to be higher than what was reported by Karnataka et al (2011) but was well within the allowed level of 200-250 mg/L recommended standard for portable water [SON (2007), Olowu et al (2010), WHO (1993), BIS (1991)] as shown in Table 1.

The amount of calcium which determine the total hardness of the water was also found to be in the range of 185.33 ±0.26 mg/l for normal and 185.58 ±0.20 mg/l Ca for raining atmospheric conditions and the higher value obtained for calcium may be attributed to pollution and eutrophication of the wetland. The obtained value fell within the recommended value of 200mg/l (Table 2) set for water SON (2007), Olowu et al (2010), WHO (1993), BIS (1991)] which is an indication that the water hardness of the water body

from the wetland is appropriate for use as portable water which is in agreement with what was reported earlier by Hadade S.A. and M.B Mule. 2003.

Table 1. Average value of the physicochemical parameter of Iba water wetland at different atmospheric condition

Parameter	Normal atmosphere	Raining atmosphere
Temperature	28.43±0.24	28.05±0.58
pH	6.30±0.01	6.40± 0.02
TDS	57.05±1.1	56.97±0.95
COD	46.00±0.63	46.7±0.82
Alkalinity	84.42±1.2	84.67±.0.02
Acidity	4.53± 0.08	4.62± 0.16
Chloride	130.53±0.82	130.95±1.07
NO_2	5.10±0.11	5.12±0.18
PO_4^{-3}	1.050±0.11	1.04±0.10
SO_4^{-2}	100.60 ± 0.79	100.83 ±0.93
DO	1.38±0.10	1.45±0.01
BOD	30.63±0.73	30.84±0.38
Ca	185.33±0.26	185.58±0.20
Na	84.68±0.18	84.83±0.27
Fe	7.833±0.10	7.82±0.11
Zn	0.36±0.04	0.35±0.05
K	29.73±0.85	29.85±0.46
Co	0.53±0.02	0.53±0.011
Ni	0.52±0.01	0.51±0.01
Cd	0.18±0.01	0.17±0.01
Cr	0.42±0.01	0.43±0.01

Table 2.

Parameter	Normal atmosphere	Raining atmosphere	SON	WHO	APECL
Temperature	28.43±0.24	28.05±0.58			
pH	6.30±0.01	6.40±0.02	6.5-8.5	6.5-8.5	
TDS	57.05±1.1	56.97±0.95	500		
COD	46.00±0.63	46.7±0.82			<25
Alkalinity	84.42±1.2	84.67±.0.02			
Acidity	4.53± 0.08	4.62± 0.16			
Chloride	130.53±0.82	130.95±1.07	250	250	
NO_2	5.10±0.11	5.12±0.18	0.2	0.2	
PO_4^{-3}	1.050±0.11	1.04±0.10			
SO_4^{-2}	100.60 ± 0.79	100.83 ±0.93	100	500	
DO	1.38±0.10	1.45±0.01	5	5	5
BOD	30.63±0.73	30.84±0.38		6	<25
Ca	185.33±0.26	185.58±0.20	200	200	
Na	84.68±0.18	84.83±0.27	200		
Fe	7.83±0.10	7.82±0.11	0.3-50	0.5-50	
Zn	0.36±0.04	0.35±0.05	3	3	
K	29.73±0.85	29.85±0.46			
Co	0.53±0.02	0.53±0.011			
Ni	0.52±0.01	0.51±0.01	0.02		
Cd	0.18±0.01	0.17±0.01	0.003		0.01
Cr	0.42±0.01	0.43±0.01	0.05	0.05	

Table 3. Table of t-test for comparison of mean for the two atmospheric conditions

Parameter	Significance (95% confidence level)
Temperature	0.001*
pH	0.064
TDS	0.212.
COD	0.226
Alkalinity	0.313
Acidity	0.146
Chloride	0.142
NO_2	0.073
PO_4^{-3}	0.699
SO_4^{-2}	0.252
DO	0.873
BOD	0.572
Ca	0.234
Na	0.095
Fe	0.696
Zn	0.149
K	0.366
Co	0.808
Ni	0.247
Cd	0.290
Cr	0.055

The total alkalinity of water which is an index of the presence of the carbonates and bicarbonates was found to be in the range of 84.42 ± 1.20 mg/L during the normal period and 84.77 ± 0.02 mg/L during raining atmospheric conditions which were below the allowed permissible level set for alkalinity [SON (2007), Olowu et al (2010), WHO (1993)]. The total dissolved solids (TDS) values achieved in the study wetland varied between 57.05±1.10 and 56.97 ± 0.95 mg/L for normal and raining atmospheric conditions respectively which were below the limits for drinking water standards of 500 mg/L set by standard organization of Nigeria (2007). However, it is interesting to note that atmospheric oxygen enters the aquatic system by direct diffusion during the shakeup of the surface. Dissolved oxygen (DO) is very important in water body and the main source of DO in water is the atmosphere and by the photosynthetic activity of aquatic plants. The amount of dissolved oxygen obtain for the studied wetland are 1.38 ± 0.10 mg/L and 1.45 ± 0.01mg/L for normal and raining atmospheric conditions respectively which is below the set standard [SON (2007), Olowu et al (2010), WHO (1993)]. Acidity content of the wetland as shown in table 1 were in the range of 4.53 ± 0.08 mg/L and 4.62 ± 0.16 mg/L during the normal and raining days. The biological oxygen demand (BOD) of the wetland was evaluated and the value obtained were 30.63 ± 0.73 mg/L and 30.84 ± 0.38 mg/L for normal and raining conditions which are higher than 6mg/L set by WHO (1993) and Olowu et al (2010). The higher value obtained is an indication of high organic load and that the amount of oxygen utilizes by the microorganism is high which a pointer to the low dissolved oxygen obtained in the wetland. The chemical oxygen demand values were 46.00 ± 0.63 mg/L and 46.7± 0.83 mg/L respectively. Phosphate and Nitrite contents obtained during the normal and raining atmospheric conditions ranged from 1.05 ± 0.11 mg/L and 1.04 ± 0.10 mg/L and 5.10 ± 0.11mg/L and 5.12 ± 0.18 mg/L respectively. The obtained values were higher than what was reported earlier on wetland from India by Kamataka et al (2011) and the nitrite values are above the standard set by WHO and EU [Olowu et al (2010)]. The mean value observed for sulphate were 100.6 ± 0.79 and 100.83 ± 0.93 mg/L and the highest concentration was found during raining condition but the value were still within the recommended standard of 500mg/L and 250mg/l set by WHO and EU respectively [Olowu et al (2010)]. The water samples were screened for Ca, Na, Fe, Zn, Co, Ni, Cr and Cd. The trace metal composition of the wetland revealed slightly higher values of iron (Fe) in the wetland which was found to be above what was reported by Kamataka et al (2011) from two wetlands in India and the standard set by SON, WHO and Olowu et al (2010). The value obtained for sodium ranged between 84.68 ± 0.18 and 84.83 ± 0.27 mg/L during the normal and raining atmospheric conditions in the wetland which was below the standard limit set. The concentration of some of the determined metals in the wetland water during normal and raining atmospheric conditions were found to be higher than the allowed permissible level set for this metals which signify the pollution level of the wetland water studied. The values obtained for nickel during the normal and raining atmospheric conditions were 0.52 ± 0.01 mg/L and 0.51 ± 0.01 mg/L compared to 0.02 mg/L recommended for portable water and accumulation this metal as been reported to be a possible carcinogen (SON (2007). The wetland is highly contaminated with cadmium during the normal and raining atmospheric conditions with a value of 0.18 ± 0.01 mg/L and 0.17 ± 0.01 mg/L respectively which are above 0.003 mg/L recommended standard limit set by Nigeria standard organization and the world health organization (WHO) respectively. The high value obtained may be attributed to various domestic discharges such as plastics, oils from generating sets as well as paint pigments and batteries used to power torchlight due to incessant power shortage in the area. Cadmium has been reported to be highly hazardous and at certain concentrations, it is toxic to humans and other living organisms especially when present in the aqueous medium (Olowu et al 2010, Adewuyi G.O 2010). The concentration of Cr in the water sampled, was 0.43 ± 0.01 mg/L and 0.42 ± 0.01 mg/L respectively for normal and raining atmospheric condition which is far above the recommended standard of 0.05 mg/L for portable water (Olowu et al 2010, SON 2007) which may result to cancer in human when it is accumulated in the body.

Statistical analysis at 95% confidence level shown in Table 3 also revealed that there exist no significant

difference between the physicochemical parameter during the two atmospheric conditions except for the temperature that showed some level of significant which is expected, due to cooler condition during or after rain.

The present study revealed a rise and fall in the physicochemical parameter of the wetland during the normal and raining atmospheric couple with the fact that the pollution level of the wetland is high due to higher cadmium contamination which is an indication that the wetland water investigated is not suitable for use as portable water as well as for consumption.

4. Conclusions

Wetlands are important mechanism of watersheds and make available many important functions to the environment and to society at large. The physicochemical parameters and trace metal concentration level of the Iba wetland investigated was found to be highly polluted with trace metals most especially with cadmium when compared with standard limit set for portable water which may be attributed to various domestic discharges such as plastics, oils from generating sets as well as paint pigments and batteries used to power torchlight due to incessant power shortage in the area. The research work revealed that the wetland is highly polluted and hence is unsafe to be use as portable water for domestic usage. On the other hand the need to grow required plants that can absorbed the contaminants is very essential for phytoremediation of the Iba wetland is necessary so as to clean up the wetland for safety of the populate.

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