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Influence of Land-Use Pattern on Ureje Reservoir, Ado-Ekiti, Southwestern Nigeria

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Abstract: An investigation was conducted between November 2012 to May 2013 to assess the impact of land use patterns around Ureje Reservoir, located in Ado-Ekiti metropolis, Ekiti State, Southwestern part of Nigeria, on the water quality of the reservoir. Standard methods of APHA (1998) was used to determine the physicochemical parameters of water samples collected from the reservoir during dry and raining seasons. Results of the analyses showed that during both seasons, pH, total hardness, chloride, total dissolved solids, calcium, magnesium, zinc and iron had mean values that were above WHO recommended limits for drinking water. It is therefore imperative to impose strict legislative measures and monitoring programmes to prevent further deterioration of the reservoir.

Keywords: Water, Land-Use, Pollution, Ureje Reservoir, Ado-Ekiti

1. Introduction

Water is an essential natural resource that sustains life is used by all living organisms. Therefore the knowledge of the status of water bodies in terms of pollution is quite essential for proper management of water environments. Although water is important to life, it is one of the most poorly managed resources in the world (Fakayode, 2005). The quality of water resources in any ecosystem provides significant information about the available resources for supporting life in the ecosystem (Sharma, *et al.,* 2007). In recent years, both anthropogenic influences such as urban, industrial and agricultural activities have increased exploitation of water resources as well as natural processes such as precipitation inputs, erosion, weathering of crystal materials, degradation of surface waters and thus, rendering the water unsuitable for both primary and secondary uses (Agbaire and Basaran, 2009). In the recent times, water pollution has become a major global problem which requires continuous evaluation and monitoring to enhance the resource conservation at all levels (international down to individual aquifers, rivers and wells). It has been suggested that it is the leading worldwide cause of deaths and diseases and that it accounts for the deaths of more than 14,000 people daily (West, 2006; Pink, 2006).

Human anthropogenic activities are on the increase along the Ureje River, Ado-Ekiti, Nigeria as well as most inland waters of Nigeria. Such activities include a small oil-palm processing mill sited not too far from the riverbank, which uses water from the river in its processing activities and discharges the wastewater, untreated, back into the river system; construction of a resort center is currently ongoing at the river bank, where water from this same river is used in all the construction works with a backwash of cement into the river as surface runoffs. Also, common sights around this river are spots of open refuse dumps from which leachates are easily washed into the river during rainfalls. The pollutants commonly found on the refuse dumps are usually pathogens, silt and suspended solid particles such as soils, sewage materials, disposed foods, cosmetics, plastics/nylons, metal scraps from used electronics and construction debris. When the waste stream contains a complex mixture of toxic substances predominantly natural and synthetic organic substances, metals, and trace elements, as well as pathogens from domestic and industrial sectors enter into streams, rivers and other water bodies, they get dissolved or suspended or deposited on the stream beds and resulted in the pollution of water quality (Islam and Tanaka, 2004). Heavy metals such as Cu, Fe, Pb, Mn, Zn), Cd, Co, etc. are often present in water as trace amounts, but may have significant effect on water environment and thus on human existence (Anonymous, 2004).

The supply of potable water in Ado-Ekiti has become a major problem because of rapid urbanization with its associated problems including indiscriminate waste generation. Ureje River is the main source of water supply to the city and its environs. Ado- Ekiti is gradually becoming an urban area being the state capital. Therefore, the town is witnessing an unprecedented growth in terms of building of residential houses, increase in different types of small-scale businesses, food and agro-allied industries. The increasing growth therefore has implications for municipal waste management among other social services required in the urban communities. Data from many cities showed inadequacy in urban social services like shelter, provision of safe drinking water and efficient management of solid wastes (Ogunrinola and Adepegba, 2012). The cities are therefore littered with mountains of rubbish in landfills and open waste dumps which are covered with flies and thus serve as breeding grounds for rodents and mosquitoes which are carriers of diseases.

There are several studies that confirmed the existence of surface water pollution at various levels in Nigeria (Federal Environmental Protection Agency (FEPA), 1991; NEST, 1991; Adekunle and Eniola, 2008; Chima *et al.,* 2009; Akinbile and Yusoff, 2011; Onwughara *et al.,* 2011; Onuigbo and Madu, 2013). Very few research works are available on Ureje Reservoir and it's quality, it is therefore considered pertinent to assess the impact of land use patterns in the vicinity of the reservoir on the surface water quality of Ureje Reservoir. The findings will throw light on the potability and the quality of Ureje River.

2. Materials and Methods

2.1. Study Area

The study area is located in Ado-Ekiti, a rapidly growing urban city. Ado-Ekiti is located on the southwestern upland area of Nigeria. The topography of the area revealed that most area in the town lies between 1,200meters and 2,200meters above mean sea level, with the North tops taking the heights. This suggests that the North of Ado-Ekiti topographical map with close lines indicate hilly areas, characterized by conical hills and inselbergs. The rivers and streams in Ado-Ekiti include Ureje, Elemi and Ogbesse. The town has always enjoyed abundant rainfall and the loose nature of the soil coupled with the large quantities of runoff from the frequent rainfalls are responsible for erosion and gullies, which are common sights in some streets of the town, especially in the lowland southeast areas like Odo-Ado.

The climate of the study area is divided into two seasons: dry and wet seasons. The dry season ranges from November to March with a high temperature, sometimes reaching above 30°C, the wet season lasts from April to late October. The residents around the study area carry out different activities which may have impacts on the river. Some of the activities around the river include agricultural activities, an oil palm mill, saw mill industry, construction of residential buildings, especially a recent project of construction of a recreational center at the bank of the river, refuse and sewage deposition sites. All these activities impose hazardous threats on the water body.

2.2. Sample Collection and Treatment

The water samples were collected from four different points of the Ureje Reservoir (Fig. 1). Samples were collected in 1litre plastic bottles at a distance of about 50 meters from each other. The physicochemical parameters to analyze include pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), total dissolved solids (TDS), dissolved oxygen (DO), total hardness (TH), phosphate (PO_4), nitrate (NO_3), chloride (Cl), total solids (TS), total dissolved solids (TDS), and total suspended solids (TSS), some minerals like sodium (Na), potassium (K), calcium (Ca), and magnesium (Mg) and heavy metals such as lead (Pb,) copper (Cu), iron (Fe), zinc (Zn) and manganese (Mn) were also analysed. Prior to collection of samples, all bottles were washed with distilled water. Before sampling, the bottles were rinsed again three times with the water to be sampled. A 90ml of water sample from each bottle was transferred to 100ml plastic bottle which contained 10ml 2M Hydrochloric acid solution for the analysis of heavy metals. The HCL solution was used to protect water samples from any fungal and other pathogenic attack. After collection, the bottles containing samples were sealed immediately to avoid exposure to air. The samples were taken from the mid-stream and approximately 0.30 meters below the surface.

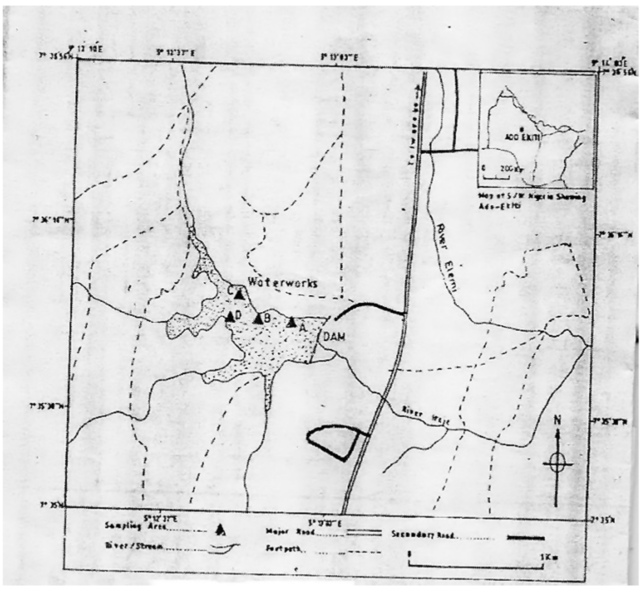

Figure 1. Map of Ado-Ekiti Reservoir (shaded area) showing Sampling Stations (A, B, C, & D).

Water temperature, pH, and conductivity were determined in the field because of their unstable nature. Water temperature was measured with the help of a mercury thermometer, pH with a pH meter pHep Hanna model, conductivity with a pen type DIST 3 model. Dissolved oxygen (DO) was determined by Winkler's titration. Titrimetry was used to determine chloride and Total dissolved solid (TDS) and Total suspended solids were determined gravimetrically by evaporating a known volume of water to dryness in a pre-weighed crucible on a steam bath. Total hardness was determined by titrating with EDTA using Eriochrome black T as indicator while Phosphates (PO_4^{3-}) and Nitrates (NO^{3-}) were analyzed in the laboratory using standard methods of APHA (1998). The concentration of heavy metals including Pb, Cu, Fe, Zn and Mn were determined with flame atomic absorption spectrophotometer. Each sample was analyzed in duplicate and the mean result reported.

Sediment samples were collected with a black nylon bag at the bank of the reservoir. The source of collection was dug to 2m and it was immediately taken to the laboratory. At the laboratory the sample was air-dried, sieved to have uniform particle size and stored in closed plastic containers for further analysis. All the parameters analyzed for water samples were also determined for the sediment samples.

Data were presented in tables with mean values and standard deviations recorded. Analysis of variance (ANOVA) was used to test for statistical differences between the means of the chemical parameters between the dry and wet seasons of the study period.

3. Results

Table 1. *Means of physicochemical parameters of water and sediment in dry season at Ureje Reservoir, Ado-Ekiti.*

Parameters	WHO (2004)	Surface water (A)				Sediment sample (B)			
		A_1	A_2	A_3	Mean±Std	B_1	B_2	B_3	Mean±Std
PH	6.5-8.5	7.30	6.82	7.64	7.25±0.33	6.91	7.64	7.26	7.27±0.30
Temperature (°C)	20-30	33.00	32.00	30.00	31.67±1.25	-	-	-	-
Conductivity (µs/cm)	250	190	213	313	239±53.39	127	124	264	172±30.04
Dissolved Oxygen (mg/L)	5.00	1.90	1.00	2.30	1.73±0.67	0.50	1.02	1.10	0.87±0.33
Total hardness (mg/L)	300	105.30	130.0	165.00	133.43±24.49	63.00	72.25	66.84	45.69±9.09
Phosphate (mg/L)	5	6.70	5.30	6.25	6.08±0.58	4.80	6.28	4.20	5.09±0.38
Nitrate (mg/L)	10	5.50	5.80	6.40	5.90±3.96	6.80	6.60	6.30	6.57±2.40
Chloride (mg/L)	250	23.10	30.25	25.62	26.32±2.96	21.70	25.60	24.64	23.98±1.66
TS (mg/L)	35	189.75	162.52	120.15	157.47±28.63	265.75	260.84	220.50	244.03±26.34
TDS (mg/L)	500	138.45	132.65	128.62	133.24±4.04	82.59	64.21	85.20	77.33±9.34
TSS (mg/L)	35	51.31	40.25	30.24	40.60±8.61	183.24	160.30	168.20	170.50±40.62

Table 2. *Means of physicochemical parameters of water and sediment in wet season at Ureje Reservoir, Ado-Ekiti.*

Parameters	WHO (2004)	Surface water (A)				Sediment sample (B)			
		A1	A2	A3	Mean±Std	B1	B2	B3	Mean±Std
PH	6.5-8.5	7.70	6.25	7.35	7.1±0.62	7.10	7.80	8.82	7.91±0.71
temperature (°C)	10-30	30.00	32.00	31.00	31.00±1.15	-	-	-	-
Conductivity (µS/cm)	250	371	411	360	381±21.92	149.00	210.00	182.00	180.00±24.93
Dissolved Oxygen (mg/L)	5	2.00	1.98	2.30	2.09±0.18	1.08	1.56	1.30	1.31±0.24
Total hardness (mg/L)	300	17.20	18.42	16.50	17.37±6.66	9.32	9.61	8.96	9.30±0.27
Phosphate (mg/L)	5	13.80	9.65	12.35	11.93±1.71	9.45	10.31	8.16	90.3±0.62
NO_3(mg/L)	10	6.50	5.90	6.20	6.20±1.65	7.4	7.50	8.50	7.8±1.56
Chloride (mg/L)	250	48.20	62.50	52.25	54.32±9.64	43.10	42.50	43.24	42.91±9.48
TS (mg/L)	1000	308.26	198.10	260.43	255.60±45.10	343.17	306.50	372.00	320.56±19.44
TDS (mg/L)	1000	24.15	30.18	18.50	24.28±6.38	96.85	82.24	92.36	90.48±6.11
TSS (mg/L)	35	67.11	80.51	90.50	79.38±9.59	246.32	228.11	248.18	240.87±9.06

Table 3. *Means of mineral composition of water sediment of Ureje Reservoir during dry season.*

Parameter	WHO (2004)	Surface water (A)				Sediment sample (B)			
		A1	A2	A3	Mean±Std	B1	B2	B3	Mean±Std
Na (mg/L)	200	37.40	38.20	39.80	38.47±0.62	162.40	170.20	168.24	166.95±3.65
K (mg/L)	-	33.03	35.07	34.02	34.04±1.15	141.00	120.66	126.60	129.44±8.54
Ca (mg/L)	75.00	21.70	25.50	32.34	26.51±1.92	78.80	72.82	84.26	78.62±8.73
Mg (mg/L)	0.10	1.90	2.65	1.24	1.93±0.66	11.68	11.06	14.11	12.28±1.92
Zn (mg/L)	5.0	0.16	0.84	1.62	0.87±0.71	3.42	4.62	3.21	3.75±0.62
Fe (mg/L)	0.30	2.10	3.20	3.62	2.97±0.64	2.10	3.30	2.33	2.58±0.84
Pb (mg/L)	0.05	ND	ND	ND	-	3.01	3.62	3.24	3.29±0.25
Cu (mg/L)	1.00	ND	ND	ND	-	3.60	3.02	3.04	3.22±0.52
Mn (mg/L)	0.10	ND	ND	ND	-	1.13	1.25	1.62	1.33±0.84

Table 4. *Mean of mineral composition of water and sediment of Ureje Reservoir during wet season.*

Parameter	WHO (2004)	Surface water (A)				Sediment sample (B)			
		A1	A2	A3	Mean±Std	B1	B2	B3	Mean±Std
Na (mg/L)	200	53.10	50.13	48.25	50.49±1.10	103.60	98.02	100.64	100.75±2.28
K (mg/L)	-	48.00	46.01	48.68	47.56±1.13	117.30	121.02	113.5	117.27±3.07
Ca (mg/L)	75.00	28.03	30.05	28.96	29.01±0.83	43.10	40.26	43.80	42.39±1.53
Mg (mg/L)	0.10	2.70	3.00	3.02	2.91±0.14	6.21	5.60	5.04	5.62±0.48
Zn (mg/L)	500	0.41	1.02	0.80	0.74±0.59	2.45	3.02	3.09	2.85±0.28
Fe (mg/L)	0.30	3.30	3.02	3.70	3.34±0.46	3.08	3.43	2.65	3.05±2.62
Pb (mg/L)	0.05	0.07	0.25	0.80	0.37±0.35	2.30	2.80	3.00	2.70±0.14
Cu (mg/L)	0.05	0.11	0.18	0.50	0.26±0.30	1.50	1.02	1.01	1.18±1.93
Mn (mg/L)	0.10	1.03	1.62	0.82	1.16±0.41	0.85	0.25	0.18	0.43±0.66

Table 5. *Correlation coefficients (r) for Physicochemical Parameters.*

Physicochemical Parameters	pH	Temp	Cond	DO	TH	PO_4	NO_3	Cl	TS	TDS	TSS
Ph		-0.663*	-0.610*	-0.398	-0.372	0.960*	0.906*	0.071	0.671*	0.300	0.822*
Temp			0.791*	0.894*	0.499	0.540	-0.648*	0.264	-0.661*	-0.051	-0.934*
Cond				0.897*	-0.119	-0.369	-0.333	0.716*	-0.148	-0.643*	-0.629*
DO					0.116	-0.182	-0.260	0.654*	-0.260	-0.295	-0.679*
TH						-0.530	-0.720*	-0.670*	-0.937*	0.762*	-0.683*
PO_4							0.966*	0.349	0.778	0.079	0.780*
NO_3								0.418	0.912*	-0.132	0.875*
Cl									0.546	-0.743*	0.053
TS										-0.493	0.861*
TDS											-0.074
TSS											1

*Correlation is significant at the 0.05 level (1-tailed).

Table 6. *Correlation coefficient table for the mineral parameters.*

Metals	A	B	C	D	E	F	G	H	I
A	1	0.929*	0.983*	0.990*	0.966*	-0.796	0.945*	0.992*	0.581
B			0.846	0.868	0.978*	-0.627	0.999*	0.876	0.422
C				0.998*	0.913*	-0.85	0.869	0.998*	0.613
D					0.923*	-0.822	0.889	1.000*	0.633
E						-0.775	0.987*	0.931*	0.387
F							-0.662	-0.827	-0.169
G								0.896	0.429
H									0.618
I									1

*Correlation is significant at the 0.05 level (1-tailed).
A = Na (mg/L), B = K (mg/L), C = Ca (mg/L), D = Mg (mg/L), E = Zn (mg/L), F = Fe (mg/L), G = Pb (mg/L), H = Cu (mg/L), I = Mn (mg/L).

Table 7. *ANOVA Table showing the significance between Dry season and Wet season mean values for all the physicochemical parameters.*

Physicochemicals	F value	Level of Significance
pH	0.366	0.607
Temperature	0	0.989
Conductivity	0.501	0.552
Dissolved Oxygen	0.475	0.562
Total Hardness	2.994	0.026*
Phosphate	1.35	0.365
Nitrate	1.857	0.306
Chloride	16.234	0.056*
TS	2.605	0.248
TDS	1.223	0.384
TSS	0.277	0.651

*Significant different at the 0.05 level (1-tailed).

Table 1 shows the means values of the parameters of both water and sediment of Ureje Reservoir, Ado-Ekiti during the dry season of the study period which is November to March. The mean value for the pH of sediment was found to be slightly higher than that of the surface water, however, these values are still within the range of WHO (2004) of 6.5-8.5. Temperature in all the sampled locations was high, exceeding the WHO limits of 30°C at locations 1 and 2. The mean temperature was 31.7°C±1.25, slightly exceeding the WHO standard. The sediment temperature was not recorded due to some technical faults at the point of collection. Conductivity for surface water was found to be higher than that of sediment and had a mean value of 239±53.39 (µS/cm) and sediment had a mean of 172±30.04 (µS/cm), these conductivity were found to be higher than the WHO (2004) standard of 100 (µS /cm). The dissolved oxygen content of the water samples were found to be much higher (1.73±0.67) than in the sediment (0.87±0.33). Total hardness for surface water was also found to be higher (133.43±24.49mg/L) than that of sediment (45.69±9.09mg/L), both values were lower compared to the 300 mg/L WHO standards of (2004). Phosphate recorded a higher concentration in surface water with a mean value of 6.08±0.68 mg/L, while it has a mean value of 5.09±0.38 mg/L in the sediment, the values of phosphate were close to that of 5mg/L WHO (2004) recommended limit. Nitrate content of the water samples were lower (5.90±1.96 mg/L) than in the sediment samples (6.57±2.40 mg/L). Both of these values in the two media were lower than the WHO limits (10mg/L) in drinking water and for agricultural purposes. Chloride had a higher value in surface water (26.32±2.96 mg/L) compared to that of the sediment (23.98±1.66 mg/L), both media had values relatively lower than the WHO standard value of 250 mg/L. Total solids (TS) had a mean of 157.47±28.63mg/L in the surface water but the mean value is higher in the sediment, with a mean of 249.03±26.34 mg/L, both values were relatively higher than the WHO standard recommended limits of 35mg/L. Total dissolved solids (TDS) was higher in surface water (133.24±4.04mg/L) than in sediments (77.33±9.34 mg/L), however, both values are relatively lower than the WHO recommended limits of 500 mg/L. Total suspended solids (TSS) was found to be lower in surface water with a value of 40.60±8.61 (mg/l), and higher (170.50±0.62 mg/L) in sediment, both values were higher than the WHO limits of 35mg/L in drinking water and for agricultural purposes.

Table 2 presented the means of the selected physicochemical parameters during the wet season. The mean pH was found to be higher in sediment samples with a mean value of 7.91±0.71 (mg/L) compared with a mean value of 7.10±0.62 found in water samples. Conductivity was higher in the surface water and lower in sediment, the mean value for surface water was 381±21.92 (µm/cm) and that of sediment is 180±24.93 (µm/cm). These values are higher than the 100µm/cm WHO (2004) limits for drinking water. The dissolved oxygen content of water samples were higher (2.09±0.18mg/L) than the recorded mean value for sediment samples (1.31±0.24mg/L). Total hardness was also higher in surface water with a mean of 17.37±6.66 (mg/L) and lower in sediment with a mean value of 9.30±0.27mg/L, both value are relatively low compared with the WHO standard of 300mg/L. Means of phosphate for surface water was found to be higher (11.93±1.71mg/L) than in the sediment (9.03±0.62mg/L) while nitrate recorded a higher mean value in sediment. For chloride, the mean value for both surface water and sediment were low compared to the WHO standard value of 250mg/L, the mean value of chloride in the surface water was 54.32±9.64 mg/L while in the sediment it recorded 42.91±9.48mg/L. The mean value for total solids in surface water samples was 255.60±45.10mg/L while that of sediment was higher (320.56±19. 44mg/L. The values were higher than the WHO recommended limits of 35mg/L. The mean total dissolved solids was 24.28±26.28mg/L in the surface water samples while in sediment, it was higher (90.48±6.11 mg/L), the values were however lower compared to WHO limits of 500mg/L. Total suspended solids was 79.38±9.06mg/L in water samples and for the sediments, the value was higher (240.8±9.06). Both media had higher mean values than the recommended limits of 35mg/L (WHO, 2004).

Table 3 showed the means of mineral composition of water and sediment samples of Ureje Reservoir during dry season. From this table, it can be observed that the mean value of Na in the water sample was lower with a mean of 38.47±1.29 mg/L than in the bottom sediment where it was 166.95±3.65 mg/L. Potassium was found to be 34.04±0.83mg/L in the surface waters and much higher, 129.34mg/L in the sediment samples, thus exceeding the WHO recommended limit of 75.00mg/L in this medium. Calcium was observed to be 26.54±2.60mg/L in surface water and 78.56±8.72mg/L in bottom sediment, this value is slightly higher in sediment and its above WHO recommended limit of 75mg/L. The value for magnesium is higher in bottom sediments with a mean value of 12.28±1.92 mg/L and relatively lower in surface water with a mean value of 1.93±0.66 mg/L. The mean value of zinc was 0.87±0.62mg/L in surface water and recorded a higher value in sediment with a mean value of 3.75±0.62 mg/L. The mean values are lower compared to the WHO standard recommended limit of 5.00mg/L. Iron content of the surface waters was 2.97±0.75mg/L and was found to be higher than that in bottom sediments (2.58±0.84mg/L) these values for result are higher than the WHO recommended limit of 0.30mg/L. Lead, copper and manganese were not detected in the surface water samples, but were found in appreciable quantities in the sediment samples. Lead was found to be high (3.29±0.25mg/L), copper in sediment samples was also high, 3.22±0.52mg/L, while manganese recorded a mean value of 1.33±0.84mg/L. These values were far above the WHO limit of 0.05mg/L for these metals.

Table 4 showed the means of the selected mineral compositions of water and sediment samples of Ureje Reservoir during wet season. The mean value of sodium was higher in soil sediment with a mean of 100.75±2.28 mg/L and lower in surface water with a means value of 50.49±1.10mg/L. Potassium had a mean value of 117.27±3.07mg/l in bottom sediments and a much lower (47.56±1.13mg/L) mean value in surface water samples. These values were however, lower compared to the WHO recommended value of 200mg/L in both drinking water and for domestic uses. Calcium recorded a higher value in bottom sediment samples with a mean value of 42.39±1.53mg/L and had a mean of 29.01mg/ L for surface water samples. These values were lower compared with the WHO limit of 75mg/L. Magnesium had a mean value of 5.62±0.48 (mg/L) in bottom sediments which was higher than the mean value recorded for surface water samples (2.91±0.83mg/L). For zinc, the mean value for sediment samples was higher with a value of 2.85±0.28 mg/L and was lower (0.74±0.59 mg/L) in surface water samples. Iron (Fe) had a higher value in surface water samples with a mean of 3.34±0.46 mg/L and lower in sediments with a mean of 3.05±2.62mg/L. These values in the two media are above the WHO recommended limits of 0.30 mg/L. Lead had a mean with higher value for bottom sediment (2.70±0.14mg/L) and lower (0.37±0.35mg/L) in surface water samples. The WHO recommended limits of 0.05mg/L has been exceeded in both media. Copper had a higher mean value of 1.18±1.93mg/L in bottom sediment samples and it was lower in surface water with a mean of 0.26±0.30mg/L. Manganese content of the surface water samples were higher (1.16±0.41mg/L) than in the sediment samples (0.43±0.66mg/L).

From the Table 5, it can be seen that pH had a strong positive significant ($p< 0.05$) correlation with PO4, and NO3; NO3 is also significantly correlated with TS and PO4. While at negative significant ($p< 0.05$) correlation, temperature correlated significantly with TSS. All the other correlations noticed both positively and negatively are only mild. Table 6 showed that there exist strong significant correlations positively at $P<0.05$ between the metals. For instance, sodium had a positive significant ($P<0.05$) with potassium, calcium, magnesium, lead and copper. Potassium also had a significant correlation with iron and lead; calcium with magnesium, zinc and copper; magnesium with zinc and copper, and zinc with lead and copper. Table 7 also shows that there were significant different in total hardness and chloride at ($P<0.05$) between the dry and wet season, while other parameters shows no significant different during the dry and wet season.

4. Discussion

The aquatic environment receives lots of insult due to man activities, climate change, heavy rainfall, landfills and dumpsite are usually unlined, toxic waste constituents, solvents and leachates leak from them into the soil, where they contaminate underground and surface waters. Under heavy rains, waste from open dumpsites and landfills and landspreads are usually washed into surface water bodies through erosion and run-offs (Kajogbola, 1998). The pH observed in this present study was higher in wet season compared to the dry season. This may be because the study area has channels through which run-off and erosion which composes of domestic waste, wastes from the road and building construction works accumulates and are washed to the river during rainfall. Though the pH of the study area is within the range of WHO recommended limits of 6.5-8.5, it does not give a direct impact to human health but it is an important parameter that is used in ascertaining water quality.

Conductivity is also one of the general indicators of the overall health of rivers and variations from its normal range may indicate pollution. It indicates the presence of dissolved solids and contaminants especially electrolytes but does not give information about specific chemicals. The wet season has higher value of conductivity than the dry season, this may likely be as a result of regular rainfall and direct erosions from various drainage and dumpsites. Most drinking waters have conductivity measurement below 2000 µS/cm but the recommended value is ≈ 250µS/cm (WHO, 2004). The conductivity levels of the water samples from all the sampling sites were greater than 200 µS/cm, except at site A_1indicating the presence of electrolytes confirmed by the presence of the cations (Pb2+ and Cu2+) and anions (NO^{3-}, PO_4^{3-}). Classification of potability based on electrical conductivity ascribes <325µScm^{-1} for fresh and potable water (McKelvie, 2004), while an aesthetic objective of 500 mg/L has been established for total dissolved solids (TDS) in drinking water (USEPA, 2002; Health Canada, 2003). The value of conductivity in this study is high compared to the WHO value of 250 (µS/cm) hence, though the mean conductivity value in this study is close to the permissible limit, for portable water, the reservoir water is portable and could be utilized in fisheries project and agricultural activities (USEPA, 2002; Nikiladze, and Mints, 1989)

Total hardness was high in wet season than the dry season for the surface water. This could be as a result of high water level and concentrations of ions, this agrees with the result of Kolo and Oladimeji (2004) for Shiroro River, Ufodike, et al. (2001) also recorded similar results for Dokawa Lake. For sediment the result is high in dry season than wet season and the value of the result were low compared to the WHO recommended limit (2004) of 250mg/L. Although hardness may have significant aesthetic effects, a maximum acceptable level has not been established because public acceptance of hardness may vary considerably according to the local conditions. Water supplies with hardness greater than 200 mg/L$CaCO_3$ are considered poor but have been tolerated by consumers; those in excess of 500 mg/L$CaCO_3$ are unacceptable for most domestic purposes (WHO, 2004), while values above 200mg/L do not have any health-related effects on humans but is an indication of deposits of Ca and/or Mg ions. It has been suggested that a hardness level of 80 to 100 mg/L (as $CaCO_3$) provides an acceptable balance between corrosion and incrustation (WHO, 2004). Total hardness is most commonly associated with the ability of water to form lather with soap. As hardness increases, more soap is needed to achieve the same level of cleaning due to the hardness ions with soap, thereby preventing economic management of water resources. One of several arbitrary classifications of water by hardness include: Soft up to 50 mg/L$CaCO_3$; Moderately Soft 51 - 100 mg/L$CaCO_3$; Slightly Hard 101 - 150 mg/L$CaCO_3$; Moderately Hard 151 - 250mg/L$CaCO_3$; Hard 251 - 350 mg/L$CaCO_3$; Excessively Hard over 350 mg/L$CaCO_3$ (EPA, 2001). The values recorded for the surface waters of Ureje Reservoir were within the moderately hard classification. Hardness in water comprises of calcium and magnesium as the main constituents and their widespread abundance in rock formations leads often to very considerable hardness levels in surface waters (USEPA, 1976).

Dissolved oxygen mean values was observed to be generally low in both the water and sediment samples. However, higher mean values for both media were observed in the wet season. The threshold for DO is 5.0 mg/L for drinking water and should be more than 5 mg/L for agricultural purposes (Cruise and Miller, 1994). Very low DO may result in anaerobic conditions that cause bad odors.

Results revealed that the reservoir water quality with respect DO is not suitable for agricultural and fisheries project and low enough to cause anaerobic conditions in drinking water. Several factors determine the DO levels in water including water temperature, which has inverse relationship with DO (as evidenced in Table 5), photosynthesis by green algae, salinity and pollution resulting from both natural and anthropogenic activities (Ireland EPA, 2001). Organic materials contained in leachates and other nutrient inputs from sewage and industrial discharges, agricultural and urban runoff can result in decreased oxygen levels.

Phosphate was observed to be high in dry season for the surface water and it is higher in dry season than wet season in sediment. The result compared with WHO of 5mg/L showed that the reservoir water had values greater than this. The high dry season value of phosphate could be due to concentration effects because of reduced water volume, it could also be due to lower water hardness, thus less CO precipitation of phosphate. is calcium carbonate, a phenomenon that has often reported to occur in many fresh water (House, 1990; Heleen et al; 1995) made similar findings in cross River State in Eastern Nigeria. Phosphate may occur in surface water as a result of domestic sewage, detergents, and agricultural effluents with fertilizers, phosphate can be found as a free ion in water system and as a salt terrestrial environment used in detergents as water form (Turner, 2012). Phosphate can be in organic form (including organically-bound phosphate) or inorganic form (including Orthophosphate and polyphosphate). Phosphorous get into water in both urban and agricultural settings, phosphorous tends to attach to soil particles and, thus moves into surface-water bodies from runoff. Phosphorous is an essential element for plant life, but when there is too much of it in water, it can speed off eutrophication (a reduction in dissolve oxygen in water bodies).

Nitrate in this study had values that were lower in both media than the WHO recommended limits of 10mg/L during both dry and wet seasons. These values were within the values of what is normally found in unpolluted natural fresh waters (Irenosen *et al.,* 2012). Relatively little of the nitrate found in natural waters is of mineral origin, while most coming from organic and inorganic sources, including waste discharges and artificial fertilisers. Also, bacterial oxidation and fixing of nitrogen by plants can both produce nitrate (SAWQG, 1996; Ireland EPA, 2001). The result however showed appreciable presence of pollutants in the reservoir that necessitates concern for monitoring and checkmating further increase. Excess nitrate in drinking water can react directly with heamoglobin in human blood to produce methaemoglobin, which destroys the ability of the blood cells to transport oxygen, especially in infants. In aquaculture, nitrate is considered a less serious environmental problem, it can be found in relatively high concentrations where it is relatively nontoxic to aquatic organisms, but stimulates the growth of plankton and water weeds that provide food for fish. This may increase the fish population, but when concentrations become excessive, and other essential nutrient factors are present, eutrophication and associated algal blooms can become a problem (Irenosen *et al.,* 2012).

Chloride concentration serve as indicator of pollution by sewage people accustomed to higher chloride in water are subjected to laxative effects. Chloride is completely soluble and very mobile, toxic to aquatic life and impacts vegetations negatively. It's concentrations in surface and ground water comes from both natural and anthropogenic sources such as sedimentary rocks, runoffs containing de-icing salts, the use of in-organic fertilizers, landfill leachates and septic tanks (Bond *et al.,* 1973; Netzel, 1975). In water, it is mostly in form of sodium chloride, potassium chloride and calcium chloride and concentrations in excess of 100mg/L impacts a salty taste (Bond *et al.,* 1973). The value of chloride in this study is high in dry season than wet season for surface water and higher in wet season than dry season in sediment, these values are however lower than the WHO recommended limit of 250mg/L. Based on this result, the water is suitable for aquatic life and suitable for drinking. Consumption of water containing more than 250mg/L of chloride can lead to incidence of high blood pressure in man.

Total dissolved solid is a measurement of inorganic salts, organic matter and other dissolved materials in the water and bottom sediments. TDS concentrations are used to evaluate the quality of fresh water systems (Menora-Online, 2012). Excess TDS is not suitable for aquatic life and crops, high concentration of TDS may reduce water clarity, contribute to a decrease in photosynthesis, combined with toxic compounds and heavy metals, leading to increase in water temperature. The wet season had a high value of TDS than dry season for surface water and wet season also had a high value of TDS than dry season in sediment sample, the values of result for TDS fell below the permissible limit of 500mg/L WHO (2004).

Total suspended solids are solids in water that can be trapped by a filter. TSS can include a wide variety of materials, such as silt, decaying plant and animal matter, domestic wastes. High concentration of suspended solids can cause many problem for river health and aquatic life, the result for wet season is higher than that of dry season this may be as a result of regular run off of organic and inorganic chemicals into the river during the wet season, the value of the sediment are relatively high than the WHO limit of 35mg/L. The decrease in water clarity by TSS can affect the ability of fish to see and catch food, high TSS in a water body or sediment can mean high concentration of bacterial, nutrients, pesticides and minerals in the water. Calcium and magnesium maintain a state of equilibrium in most waters more magnesium can affect crop yield in soil sediment as the soil become more saline. Calcium occurs in water naturally, one of the main reason for abundance of calcium in water is its natural occurrence in earths crust, calcium is an important determinant of water hardness, and it also function as a pH stabilizer, because of its buffering qualities, calcium also gives water a better taste. Calcium value is high in wet season and low in dry season, and are low compared to the WHO recommended limit of 75mg/L.

The concentration of lead in water surface with the range of the WHO recommended limit of 0.05 mg/L the concentration is higher in the sediment, than the WHO recommended value. The value is higher in dry season for sediment than the wet season. The higher concentration of lead observed in sediment is similar to that reported by Dara (1993), According to (Aluko *et al.,* 2003), the mean concentration of lead in soil at Ibadan dumpsite ranged from 1.34mg/L to 1.69mg/L but since lead is a cumulative pollutant (Dara, 993), the pollution of soil and water by lead remains a very serious problems that should be given serious attention by environmental chemist in collaboration with government agencies.

From this study soil sediment recorded higher value of iron than surface water, the result for wet season is slightly high than that of wet season for surface water, while the value of dry season is higher than wet season for sediment, the result were high than the WHO limit of 0.30mg/L. Eddy et al. (2004) suggested that different location revealed results that are comparable to the one obtained in the study. Iron can be important to aquatic life and human, According to WHO (1998), the deficiency of iron in man can cause weak muscular coordination, diarrhea and other serious defects. Despite the fact that iron is a micro nutrient, it should be properly monitored to maintain its concentration in the accepted range to avoid health defect caused by the deficiency or excess amount of it.

The concentration of zinc in surface water was high in dry season and low in wet season, while they values were relatively low in sediment sample. The result were not high than WHO recommended limit of 5.0mg/L. The deficiency of zinc in man can lead to impaired growth, low energy balance low protein metabolism, while excessive intake of zinc can lead to vomiting and dehydration (Udosen, 2000).

5. Conclusion

The surface water and sediment samples Ureje Reservoir were analyzed for some physicochemical parameters in relation to land-use patterns in the vicinity of the reservoir located in Ado-Ekiti. The results gave an insight into how activities such as open dumpsites, landfills, farmlands, domestic wastes, construction activities etc impacts on the water environment. Some of the parameters analyzed exceeded the limit set by World Health Organization, thus confirming that these activities rendered the water unfit for drinking and other domestic use except they are treated. It is therefore suggested that most of these activities should be zoned out of the vicinity of the reservoir to improve the environmental quality of life. Also, the observed high level of some of the analyzed parameters, such as total solids, total suspended solids, lead, copper and manganese may pose high degree of health hazards and therefore it is urgent that extensive study be carried out in which more representative samples would be used in order to go beyond the preliminary assessment as reported in this study.

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