FULL LENGTH RESEARCH ARTICLE

POLLUTION ASSESSMENT OF THE IMPACT OF COASTAL ACTIVITIES ON LAGOS LAGOON, NIGERIA

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ABSTRACT

Tributaries of Lagos lagoon at Oworonsoki and Ebute Meta, known for residential and commercial activities were studied to assess the impact of coastal activities on Lagos lagoon. The mean levels of some parameters at the activity points gave evidences of pollution in the studied areas. The mean values for dissolved oxygen was 2.09 mg/l and chemical oxygen demand was 267 mg/l at Oworonsoki, while at Ebute meta, mean values for same parameters at the activity points were 1.16 mg/l and 786.5 mg/l respectively. The results obtained confirmed that the leachates generated from the activities at the studied locations contributed to the levels of some of the water quality parameters in Lagos lagoon.

Keywords: impact, anthropogenic, open dumpsite, Lagos lagoon, in-situ, pollution, coastal activities.

INTRODUCTION

Water is essential for the survival of life on earth (Osibanjo 1994; Hart 2007) as all organisms contain it. Some live in it, and some drink it. If water becomes polluted, its value is lost economically and aesthetically, and can become a threat to our health and to the survival of the lives living in it.

Human health and environmental quality are undergoing continuous degradation by the increasing amount of wastes being produced (Agenda 21 1992; Osibanjo 2001). Although some environmental pollution is as a result of natural causes, most is caused by human activities (Engelking 2007). There are increasing direct and indirect costs to society and to individual citizens in connection with the generation, handling, and disposal of such wastes.

Solid wastes of anthropogenic sources have polluted virtually all the lagoons and creeks in Lagos (Ajao *et al.* 1996). Most of these debris, e.g. high & low density polythene, empty cans of food/sprays, glass bottles, used needles and syringes, used car tyres, e.t.c. are non-biodegradable. Consequently, they remain floating on the surface of the waters, reducing its aesthetics and leaching heavy metals and other pollutants into the water body.

In recent time, more attention is paid towards pollution of industrial sources, with very little attention to pollution of domestic and other sources. Another added problem is the proliferation of urban settlement and slums in the city of Lagos resulting in increased human pressure and the generation of domestic effluents which eventually find their way into Lagos lagoon. This paper reports on the impact of coastal activities at Oworonsoki and Ebute meta on the Lagos lagoon.

MATERIALS AND METHODS

Study area: Lagos, the largest city in Nigeria, is located on the Gulf of Guinea, an arm of the Atlantic Ocean in western Africa. It occupies Lagos Island, Ikoyi Island, and Victoria Island, as well as a large area on the mainland, all connected by a series of bridges and freeways.

The study was conducted at the tributaries of Lagos lagoon at Oworonsoki, a residential area with open dumpsite on the surface of water (Figs. 1 & 2) and Ebute meta, a commercial sawmill zone (Fig. 3), known for residential and commercial activities.

Impact assessment: In assessing the impact of coastal activities on Lagos lagoon, the regions under study were divided into 3 portions for sample collection:

- Activity point – this is the point at which leachates from both sawmill and refuse dumping activities are formed and introduced into the water body.
- Dilution points. These are distances away from the activity points into the central lagoon.
- Control point

Collection of samples: The sample collection design used was as follows:

- Two (2) surface water samples were collected at each of the activity points of the study area at about 50m apart.
- Six (6) samples of surface water were collected at 50m, 100m, 150m, 200m, 300m, and 400m away from the activity points, into the central lagoon. These are dilution points.
- One (1) surface water sample was collected at about 2000m (2km) into the lagoon. This served as control point.

The design was to enable the determination of the impacts of various coastal activities on Lagos lagoon; and using the control points as the background conditions, both the concentration pattern of some parameters, and impacts of these coastal activities along the course of the lagoon were evaluated.

Samples were collected at various points from a depth of about 10 cm below the water surface. Samples were collected for physico-chemistry, nutrients and heavy metals of the surface water at 10 points, (starting from the activity point to the control point) in each study area.

FIG. 1. TRIBUTARY OF LAGOS LAGOON AT OWORONSOKI (ACTIVITY POINT 1), SHOWING THE POINT USED FOR REFUSE DUMPING AND TOILET BY THE COASTAL DWELLERS.

FIG. 2: TRIBUTARY OF LAGOS LAGOON AT OWORONSOKI (ACTIVITY POINT 2), SHOWING ABANDONED CANOES AND THE POINT USE FOR REFUSE DUMPING BY THE COASTAL DWELLERS.

FIG. 3. TRIBUTARY OF LAGOS LAGOON AT EBUTE META, SHOWING SAWMILL ACTIVITIES.

Water samples for heavy metal determination were acidified in pre-cleaned plastic containers on the field. Each sample was collected in an acid-cleaned polypropylene bottle, which was rinsed three times with the sample solution prior to collection.

Samples for nutrients were filtered with Whatman GF/C, 1.2 mm pore size filters immediately to remove any large particles, plankton and bacteria. Poisoning with mercuric chloride (1 drop saturated solution per 100ml of sample) was also used to further aid in the preservation of the samples.

During transport back to the laboratory the samples were kept in an ice cooler and upon arrival they were refrigerated at 4 °C and analysed within 1 wk.

Oxygen was fixed according to Winkler's method using manganus sulphate and alkaline potassium iodide. The summary of the methods used in the determination of all the parameters are as presented in Table 1.

TABLE 1. SUMMARY OF THE METHODS USED FOR THE PARAMETERS

Parameters	Method Used	Reference
Available Phosphate.	Ammonium molybdate method	(APHA-AWWA-WEF 2005)
Nitrate - Nitrite Determination	Cadmium reduction method	(APHA-AWWA-WEF 2005)
Silicate	Ammonium molybdate method	(APHA-AWWA-WEF 2005)
Dissolved Oxygen	Azide modification procedure.	(APHA-AWWA-WEF 2005)
pH, Conductivity, Total dissolved solids – TDS.	In-situ HANNA and HORIBA U 10 multi-parameter meters.	-
Salinity%	HORIBA U 10 multiparameter meter.	-
Chemical oxygen demand (COD)	Standard dichromate procedure	(APHA-AWWA-WEF 2005)
Heavy metals	Acid Digestion / Atomic Absorption Spectrophotometer	(APHA-AWWA-WEF 2005)

RESULTS
The levels of parameters studied are as presented in Tables 2 and 3 for Oworonsoki and Ebute meta study areas respectively. Concentration pattern of the studied parameters along Oworonsoki and Ebute meta sample points are shown in Figs 4 and 5 respectively.

DISCUSSION
There were significant contributions from the coastal activities at both Oworonsoki and Ebute meta to the levels of COD, DO, conductivity, and salinity of Lagos lagoon (Figs 4 & 5). The concentration patterns of the studied sites also show some levels of recovery along their dilution points. This is evident due to marked difference in the values reported for these parameters at both the activity points and the dilution points.

The levels of pH and temperature were almost uniform throughout the sample points for both studied sites (Figs. 4 & 5). This translates to an insignificant contribution to the values of these parameters by the activities at sites.

The levels of nitrate at the activity points of both studied areas were significantly lower than their respective control values. Activities at both sites contributed to the levels of phosphate. There was little or no contribution to the levels of silicate and nitrite by the activities at both sites.

TABLE 2. RESULTS OF ANALYSES CONDUCTED ON WATER SAMPLED AT OWORONSOKI STUDY AREA.

Parameters	OAP1	OAP2	OAPA	ODP1	ODP2	ODP3	ODP4	ODP5	ODP6	ODPA	Control
pH	8.29	8.30	8.30	8.18	8.05	7.80	8.10	7.92	8.20	8.04	7.95
Cond. (mS/cm)	0.55	0.67	0.61	2.80	4.23	3.98	8.64	7.82	14.46	6.99	17.71
DO (mg/l)	2.48	1.69	2.09	3.44	3.86	4.02	3.99	5.14	5.33	4.30	6.01
Temp. (°C)	30.2	29.7	29.95	30.2	30.6	30.4	29.3	30.5	31.8	30.47	30.2
Salinity ppt	8.6	7.2	7.9	12.8	11.7	15.2	18.5	18.8	18.3	15.9	20.6
COD (mg/l)	280	254	267	185	120	80	62	68	53	94.67	40
Nitrate ppm	0.078	0.066	0.072	0.418	2.718	3.240	2.659	3.846	2.098	2.497	3.728
Nitrite ppm	0.039	0.025	0.032	0.011	0.056	0.144	0.021	0.523	0.021	0.129	0.047
Phosphate ppm	1.697	1.324	1.511	0.352	0.087	0.073	0.106	0.051	0.007	0.113	0.005
Silicate ppm	3.98	3.43	3.71	2.49	3.06	2.44	3.15	2.84	4.37	3.06	2.18
Fe ppm	0.638	1.390	1.014	0.738	0.742	0.053	0.185	0.056	0.023	0.300	0.012
Cd ppm	0.011	0.027	0.019	0.019	Nd	nd	nd	nd	nd	0.019	Nd
Cu ppm	0.022	0.018	0.02	0.014	0.025	nd	nd	0.017	nd	0.019	Nd
Ni ppm	0.015	0.018	0.017	0.011	0.003	0.005	0.002	0.005	0.002	0.005	0.003
Zn ppm	0.029	0.036	0.033	0.007	Nd	nd	nd	nd	nd	0.007	Nd
Cr ppm	0.008	0.007	0.008	0.002	nd	nd	nd	nd	nd	0.002	Nd
Pb ppm	0.477	0.521	0.499	0.205	0.318	0.246	0.231	0.065	0.392	0.243	0.026

OAP=Oworonsoki Activity Point, ODP=Oworonsoki Dilution Point
ODPA=Oworonsoki Dilution Point, OAPA=Oworonsoki Activity Point Average

TABLE 3. RESULTS OF ANALYSES CONDUCTED ON WATER SAMPLES AT EBUTE META AREA

Parameters	EAP1	EAP2	EAPA	EDP1	EDP2	EDP3	EDP4	EDP5	EDP6	EDPA	Control
pH	8.85	8.76	8.81	8.55	8.47	8.33	8.18	8.12	7.94	8.27	7.83
Cond.(mS/cm)	0.13	0.10	0.12	0.64	0.96	1.86	3.77	3.65	11.46	3.72	20.71
DO (mg/l)	1.27	1.04	1.16	1.97	2.84	3.18	4.90	5.13	5.08	3.85	5.45
Temp. (°C)	34.5	33.7	34.1	30.5	30.2	29.6	28.4	28.8	29.5	29.5	28.5
Salinity ppt	0.4	0.5	0.45	0.9	1.9	2.6	7.4	9.7	15.8	6.38	22.5
COD (mg/l)	442	418	786.5	265	230	152	140	128	94	168.17	65
Nitrate ppm	0.021	0.034	0.028	0.216	1.472	3.512	3.379	4.275	3.942	2.799	4.563
Nitrite ppm	0.001	0.002	0.002	0.001	0.008	0.072	0.648	0.293	0.947	0.328	0.056
Phosphate ppm	2.385	2.256	2.321	0.675	0.492	0.178	0.125	0.084	0.064	0.270	0.058
Silicate ppm	2.66	2.30	2.48	3.14	2.96	1.47	2.32	3.18	2.79	2.64	3.16
Fe ppm	0.456	0.374	0.415	0.183	0.257	0.086	0.184	0.172	0.266	0.191	0.185
Cd ppm	0.021	0.013	0.017	0.011	0.006	0.003	0.002	0.002	0.008	0.005	nd
Cu ppm	0.042	0.037	0.040	0.014	nd	0.005	nd	0.004	0.005	0.007	nd
Ni ppm	0.017	0.054	0.036	0.007	0.003	0.004	0.002	0.003	0.005	0.004	0.003
Zn ppm	0.045	0.027	0.036	0.016	0.004	0.005	0.003	0.011	nd	0.008	nd
Cr ppm	0.008	0.005	0.007	nd	nd	nd	nd	nd	nd	-	nd
Pb ppm	0.525	0.376	0.451	0.338	0.282	0.132	0.175	0.327	0.213	0.245	0.147

EAP=Ebute meta Activity Point, EDP=Ebute meta Dilution Point
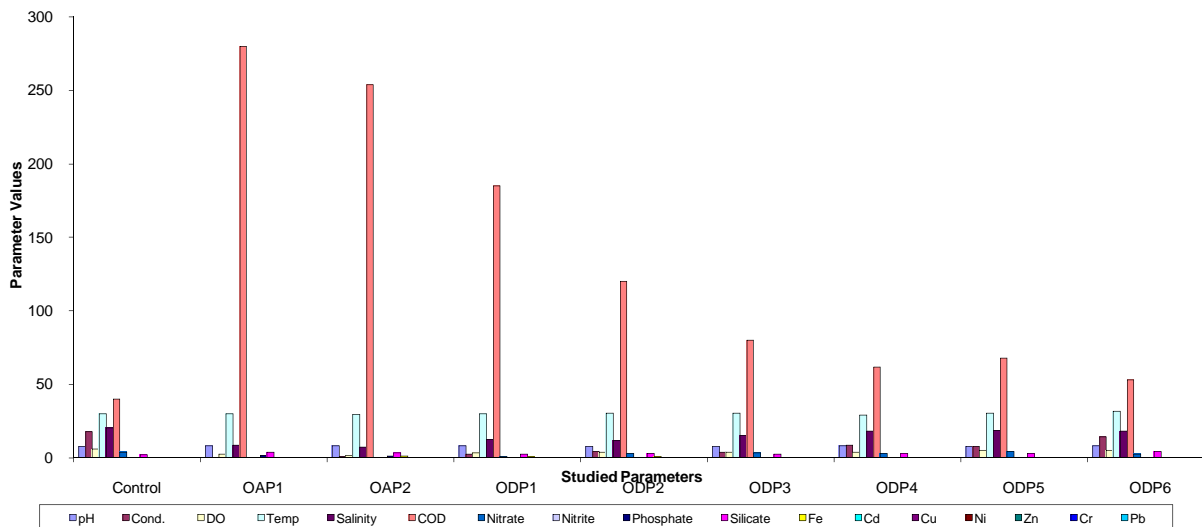EAPA=Ebute meta Activity Point Average, EDPA=Ebute meta Dilution Point Average

**FIG. 4. CONCENTRATION PATTERN OF THE STUDIED PARAMETERS
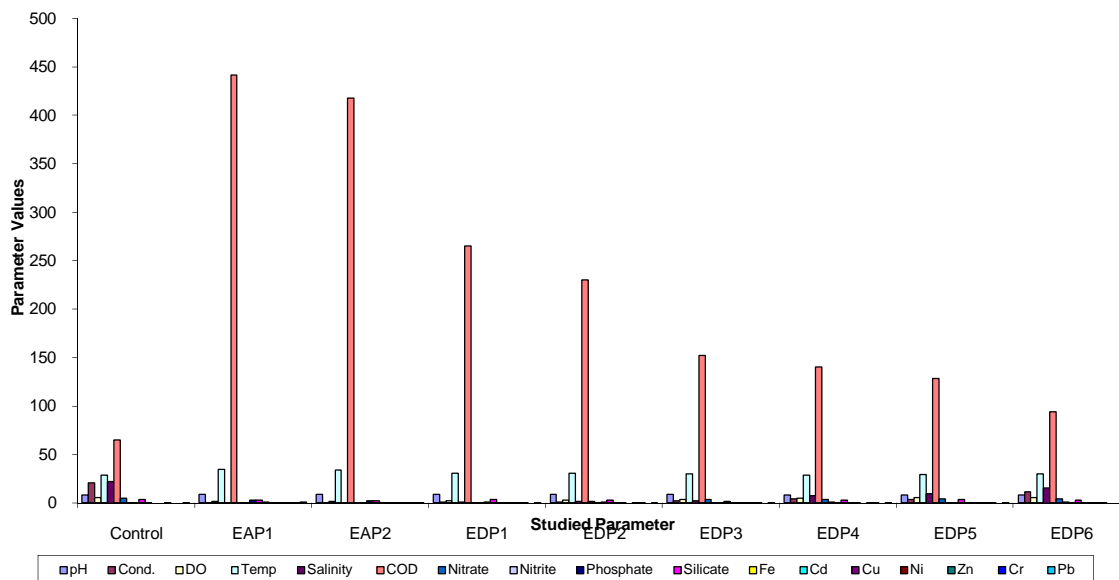ALONG OWORONSOKI SAMPLE POINTS**

**FIG. 5. CONCENTRATION PATTERN OF THE STUDIED PARAMETERS
ALONG EBUTE META SAMPLE POINTS**

The levels of lead at all the points in the two locations were found to be higher than the value quoted for international fresh and sea waters (0.005 mg/l) (Kakulu & Osibanjo 1992). The levels of other metals were found to be lower than the respective quoted values.

Except for lead, iron and zinc, the contribution to the heavy metals levels by the activities at both sites is insignificant. The relatively high levels of lead reported for the activity points at both studied sites might be due to vehicular emissions and/or fuel used in commercial operations e.g. sawmill, engine boat transportation, fishing, e.t.c.

In conclusion, Lagos lagoon could be said to be organically polluted at the activity points up to dilution point 2 (DP2) at both locations, and the levels of these pollution indicators ascribed to contributions from activities along its course. Based on the studied areas, the framework for requisite action should be founded on the following recommendations:

- Periodic assessment of Lagos lagoon, data collation and analyses, and systematic reporting to appropriate agencies are highly recommended.
- Chemical analysis of biota, for quantitative evaluation of the impact of leachates generated from coastal activities on the receiving water body is imperative.
- Health and environmental personnel need to visit coastal dwellers, to see to their waste management problems and make ways to solving them. Awareness campaign should also be organized to get them informed of the dangers associated with water pollution.

ACKNOWLEDGMENT

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