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POLLUTION AND PORTABILITY ASSESSMENT OF GROUND WATER SOURCES IN MAIDAN-ORILE, MILE-12, LAGOS STATE

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ABSTRACT

Pollution of groundwater sources is a major concern, as this source of supply is categorized as relatively safe for abstraction; as such monitoring of this source is of high importance. The physico-chemical and micro-biological parameters of water from two (2) boreholes and nineteen (19) hand-dug wells in Maidan-Orile around Mile-12 area, within Ikosi-Isheri Local Council Development Area (LCDA) which was part of old Kosofe local government (LGA). Some selected ground water sources in the LCDA was analyzed to evaluate the pollution level. Water samples were collected with laboratory conditioned plastic bottles for analysis. The mineral content was determined using Atomic Absorption Spectro-photometer while the t-test method was used to examine the major physical and chemical variables for water quality parameters in the study area.

The results of the water analysis were compared with the World Health Organization (WHO) and the Nigerian Standard for Drinking Water Quality (NSDWQ). Most of the physico-chemical parameters were not within WHO standards, over 40% of the wells has pH below 6.0, with a mean of 6.11 for boreholes and wells; they tends towards acidic condition below the average of 6.27 for Ogun river. The maximum Iron (fe) content of 15.07 mg/l recorded is in excess of the limit of 0.3 mg/l. Total coliform count ranges from 0 - 30×10^1 cfu/ml above the WHO standard of 0.00 cfu/ml and the mean of 23.33×10^1 cfu/ml for Ogun river. These results shows that the ground water sources has been polluted by other observed sources of pollution which includes; open cow ranches for grazing, septic tanks leakages, fish pond waste water discharge, surface solid waste disposal. Recommendations includes; groundwater sources to be treated for microbial contaminants before consumption, needs for routine quality checks to ascertain pollution status, and more importantly, high sanitary condition should be maintained around boreholes and wells.

Introduction

Urban population growth has been an accelerating phenomena throughout this century, in which Lagos and Nigeria at large is not excluded. The rapid urbanization growth of the Maidan-Orile Community in Ikosi-Isheri LCDA (Kosofe LGA) is not an exception, as this area is largely a low level flood plain along the Ogun-Osun river path in Lagos before its discharge into the lagoon. The increase demand in housing has resulted in mushrooming of unplanned settlements and slums with inadequate or lack of potable water supply and sanitation services in the area.

Most rural settlements in Africa, traditionally rely on raw surface water from sources such as streams, rivers, ponds and lakes, but the quality of which are usually in doubt, such water consumption do manifest in waterborne related diseases such as cholera, diarrhea, guinea worm, river blindness, dysentery etc. The idea of providing groundwater as a replacement for the seemingly poor quality surface water sources, is due to the fact that ground water is not exposed to the atmosphere and would be less vulnerable to pollution. Nevertheless, it is evidenced based that groundwater can also be vulnerable to pollution due to human activities and natural processes. (Shivendra & Ramaraju, 2015)

The assessment of water quality in wetland due to the effect of river flood waters on floodplains was studied, the collected water on wetland water column shows that conductivity, total phosphorus and nitrogen decreases to the same level as the river during high tide with flooding, while during the low tide the results was higher. (Weilhoefer, Pan and Eppard 2008)
Previous studies has confirmed that contaminants such as heavy metals, nitrates, salts, bacteria and viruses have polluted water supplies as a result disposal of waste from humans and livestock, industrial discharges, and over-use of limited water resources, without treatment. (Singh and Mosley, 2003)

Research has found chlorides, nitrogen compounds, heavy metals, organic carbon, hydrocarbons, chlorinated-aromatic-halogenated hydrocarbons, fecal coliform and fecal streptococci, pesticides, ethylene glycol and many other contaminants items as constituents of surface runoff from urban impervious surfaces. Runoff water can carry numerous contaminants from dump sites, leaky tanks and infiltration of human wastes, from septic tanks or direct waste dumping into aquifer . Waste from urban, municipal and domestic communities placed in landfills or open dumps are subjected to either ground water underflow or infiltration from precipitation, the dumped wastes gradually release some of it's decomposed by- products into the groundwater bodies. Disposal of liquid effluent, sludge and landfills have been identified as one of the major threats to groundwater resources. (Drasar, Foster & Lewis, 1990)

Most areas near effluent and surface solid waste disposal sites have a greater possibility of contaminating the groundwater sources and poses substantial risks to local resources, user and natural environment. Water has been identified as the major means of the spread of infectious diseases such as typhoid, dysentery and cholera and therefore, needs to be constantly monitored. (US EPA, 2005)
The report of the ground water source quality in Ife North of Osun State, Nigeria, reveals that ground water quality in terms of the physical and chemical parameters assessed were all within the set limit of the Nigerian Standard for Drinking Water Quality (NSDWQ), confirming the seemingly assumed good quality of ground water sources, but with heavy metals parameter in excess of the standards. (Oluyemi et al, 2010)

The greatest risk from microbes in water is associated with consumption of drinking water that is contaminated with human excreta, although other sources and routes of exposure may also be significant. WHO guidelines suggest that the optimum pH required in drinking water should be in the range 6.5-8.5 (WHO, 2008).

Methodology

Study Area

Maidan-Orile is a small settlement located around Mile-12 linked to Unity Estate on longitude and latitude of (3.404716, 6.616489), which leads to Ikorodu road around Owode-Onirin. It is located in Ikosi-Isheri LCDA under Kosofe LGA, which is one of the twenty (20) LGA in Lagos and lies in the northern neighborhood of Lagos, the commercial capital of Nigeria. The Maidan-Orile Community has a population of about 15,000 people. (Latlong, 2020)

The climate is same as Lagos and characterized by the distinct seasons (wet and dry). The wet season picks up from April to October while the dry season picks up from November with mean annual rainfall of about 950mm, the wettest month being August and September. Temperatures are generally normal ($24^{o}C - 39^{o}C$) throughout the year except between December and January when harmattan winds tends to reduce temperature. However, minimum temperature can be as low as $22^{o}C$ during the harmattan. Ikosi-Isheri LCDA was carved out from Kosofe LGA to ease administration, by getting closer to the grass root. (Lagos State Government, 2020)
The area is a low land flood plain, next to the Agboyi creek and lies along the path of Ogun river from Iju - Adiyan axis through the

Lagos-Ibadan expressway to Kosofe LGA, which is used for the Lagos State water works projects at Iju and Adiyan, Ogun State area. Human activities around Mile-12 area from markets, slums and high density residence contributes negatively to the environmental pollution of the Ogun river, with domestic and food market waste dumps, toilet and baths discharges and surface run-off from periodic over flow of the river during high tide periods and dam discharges at peak precipitation season.

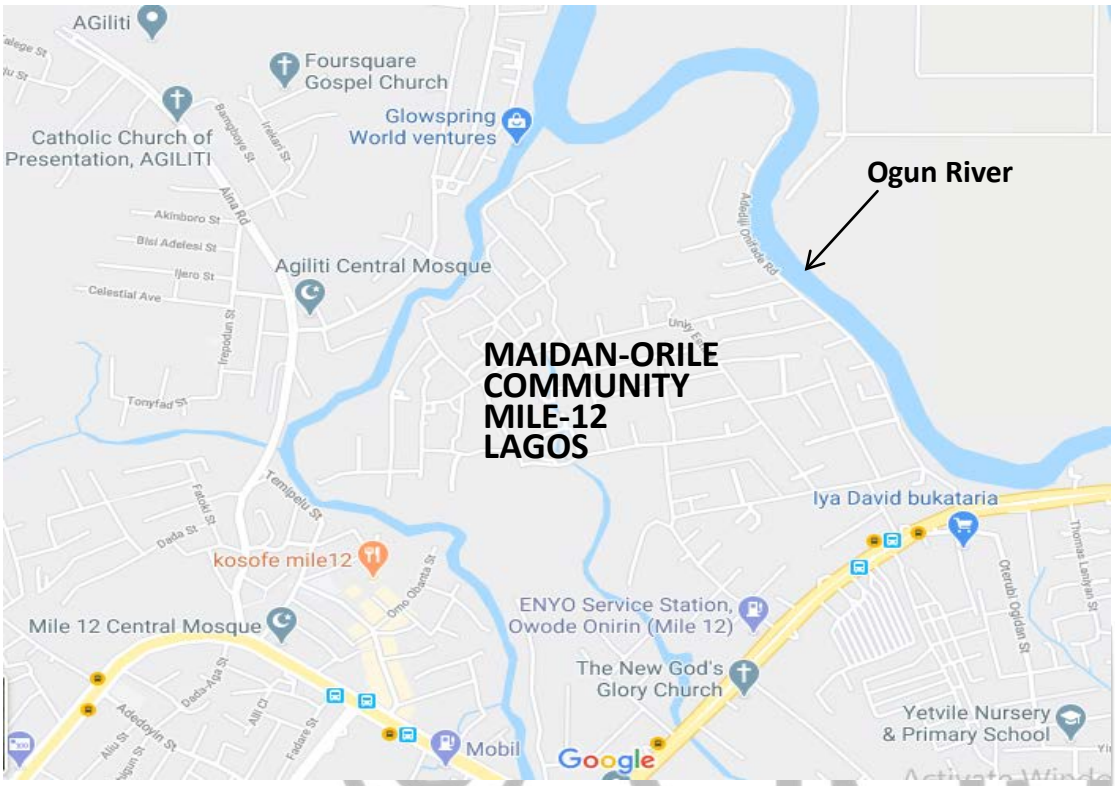

Figure 1.0: Google Map showing Maidan-Orile Community, Kosofe LGA, Lagos, Nigeria

Reconnaissance Survey

The survey of Maidan-Orile community shows that it has seven (7) Community Development Area (CDA), namely Teledalashe CDA, Imole-Oluwa CDA, Alatishe CDA, Ifelodun CDA, Progressive CDA, God first CDA and Greenland CDA across the Maidan-Orile village and Unity Estate, adjoining Ikorodu road, around Owode-onirin area. The area has sandy-clayey soil over a large extent, which is usually very slippery during the wet season. This reconnaissance survey gave an insight into the layout of the area with CDA mapping and grouping, location of water sources (boreholes and wells), its ease of access, distribution pattern and selection criteria.

Sampling of Water

The seven (7) Community Development Area (CDA), were grouped into two based on their nearness and close human activities pattern; the first group consist of Teledalashe CDA, Imole-Oluwa CDA and Alatishe CDA, while the second group consist of Ifelodun CDA, Progressive CDA, God first CDA and Greenland CDA. The characterization of the first group of CDA's are; high population density, close location of buildings with poor layout, mainly residential and low-middle class residents while the second group CDA's are; dispersed building location, low population density, grazing area for cow ranches, fish pond water discharges, open solid waste disposal, leakages in septic tanks and middle class residents. The water sampling were taken during the rainy (wet) season period in May 2019.

Three samples were taken for each periods for all selected water sources in each CDA's, and also from Ogun river to ascertain the level of pollution in the river and its correlation with the pollution in the ground water sources (boreholes and wells). The location of all sampling point was recorded using the global positioning (GPS) device for the east and north location on the longitude and latitude.

Result and Discussion

The samples collection were labeled A, B, C, D, E, F, G and H, with the first sample A1, A2 and A3 being from the river source and others (B1, B2, B3, C1, C2, ……) from ground water sources wells (covered and uncovered) and boreholes, for three (3) locations in each CDA's with sampling depths over the seven (7) CDA's in the community. Table 1 below shows the sampling location from the river and the CDA's, type of water source, depth of sample relative to the natural ground level (NGL) and the longitude and latitude. During the period of sample collection, the water level were between 0.33m - 1.4m for the first three CDA's with samples number B1, B2, B3, C1, C2, C3, D1, D2 and D3, while it ranges between 0m and 60m in wells for the second group of CDA's towards the Unity Estate area, but the depth of the boreholes could not be ascertained.

The analysis of the samples collected were carried out using the standard procedure for water sampling with temperature taken on the spot using a thermometer, while the samples were taken in sterilized, well labeled sampling bottles rinsed with part of the samples at each location and transported in box with ice packs to preserve the natural content for delivery to laboratory for samples for physical, chemical and micro-biological analysis. Table 2 below shows the minimum and maximum values of the test parameters of micro-biological, physical and chemical analysis of the samples over the seven (7) CDA's in Maidan-orile community, Mile-12. The values were in comparison with mean values of the analysis of the water samples from Ogun river and the standards of World Health Organization (WHO) and the Nigerian Standard for Drinking Water Quality (NSDWQ), Nigeria industrial standard. (SON, 2007)

Table 1: Water Samples details

SN	Samples	Location	Type of Sample	Sampling Depth below NGL (m)	Easting	Northing
1	A1	Ogun River	River water	1.65	03^0 23.891'	06^0 36.703'
2	A2	Ogun River	River water	1.65	03^0 23.90'	06^0 36.709'
3	A3	Ogun River	River water	1.65	03^0 23.94'	06^0 36.713'
4	B1	Teledalase CDA	Open well	1.2	03^0 23.894'	06^0 36.759'
5	B2	Teledalase CDA	Open well	1.22	03^0 23.974'	06^0 36.855'
6	B3	Teledalase CDA	Open well	1.2	03^0 24' 12''	06^0 36.710'
7	C1	Imole Ayo CDA	Open well	1.01	03^0 24' 05''	06^0 36.846'
8	C2	Imole Ayo CDA	Open well	0.5	03^0 24' 38'	06^0 36.854'
9	C3	Imole Ayo CDA	Open well	2.05	03^0 24' 27''	06^0 36.827''
10	D1	Alatise CDA	Open well	1.2	03^0 24' 05''	06^0 36.963'
11	D2	Alatise CDA	Open well	1.4	03^0 24.126'	06^0 37.041'
12	D3	Alatise CDA	Open well	0.33	03^0 24' 17''	06^0 36.993'
13	E1	Progressive CDA	Borehole	Not Determined	03^0 24' 27''	06^0 36' 50''
14	E2	Progressive CDA	Covered Well	0, Ground level	03^0 23' 29''	06^0 36' 50''
15	E3	Progressive CDA	Covered Well	6	03^0 24' 18''	06^0 36' 50''
16	F1	Ifelodun CDA	Open well	19	03^0 24' 20''	06^0 36' 43''
17	F2	Ifelodun CDA	Covered Well	60	03^0 24' 18''	06^0 36' 38''
18	F3	Ifelodun CDA	Open well	10	03^0 24' 24''	06^0 36' 30''
19	G1	God First CDA	Open well	6	03^0 24' 39''	06^0 36' 39''
20	G2	God First CDA	Covered Well	0, Ground level	03^0 24' 34''	06^0 36' 34''
21	G3	God First CDA	Open well	6	03^0 24' 26''	06^0 36' 32''
22	H1	Greenland CDA	Covered Well	8.5	03^0 24' 22''	06^0 36' 58''
23	H2	Greenland CDA	Open well	3	03^0 24' 29''	06^0 36' 50''
24	H3	Greenland CDA	Borehole	Not Determined	03^0 24' 29''	06^0 36' 44''

Also most of the physical and chemical parameter values are in excess of the mean value for the river source, and at the same time higher that the standards of WHO and SON, except for the heavy metals having values below the standards, but still in excess of the mean river value.

The micro-biological result of the analysis of samples shows maximum value of total coliform count as 30 $x10^1$ cfu/ml well above the mean for Ogun river. These indicates pollution trend from the ground water sources occurs due to other human activities carried out directly on the surface and sub-surface layers, and not linked to the pollutants discharge into the river from toilets and food waste disposals.

Table 2: Samples Quality Analysis over Seven Community Development Association (CDA)

Quality Parameters	Minimum value	Maximum value	Mean value for Ogun River	WHO Standards	NSDWQ Standards
Total Coliform Count (cfu/ml)	0	30×10^1	23.33×10^1	0	10
Faecal count (cfu/ml)	0	6×10^1	0	0	0
Temperature (^oC)	25	28.5	27	-	Ambient
pH	4.4	7.4	6.27	6.5 - 8.5	6.5 - 8.5
Conductivity (µs/cm)	500	8030	610	1200	1000
Total Solids (mg/l)	923	15,157	613.7	1200	500
Total Dissolve Solids (mg/l)	793	17,200	438.7	1200	500
Hardness (mg/l)	124	1,460	84	200	150
Calcium (mg/l)	43.7	357.2	33.67	75	75
Magnesium (mg/l)	18.06	850.8	12.23	0.5	0.2
Alkalinity (mg/l)	40	620	113.33	200	150
Acidity (mg/l)	20	70	16.67	100	100
Dissolve Oxygen (mg/l)	5.03	7.53	6.52	-	-
BOD (mg/l)	5.06	33.42	6.43	-	-
Fe (mg/l)	0	15.07	0.017	0.3	0.3
Cu (mg/l)	0	0.08	0.002	2.0	1.0
Zn (mg/l)	0.065	8.532	1.15	3.0	3.0
Pb (mg/l)	0	0.007	0	0.01	0.01
Cr (mg/l)	0	0.008	0	0.05	0.05
Cd (mg/l)	0	0.004	0	0.003	0.003

Information in Table 3 below displays the correlation of the CDA's grouping. Toluwalase, Imoleayo and Alatise CDA's in the first group, while we have Progressive, Ifelodun, God first and Greenland CDA's in the second groupd. The first group has mean values of micro-biological and physical parameters for CDA's group B, C and D above the mean values for the second CDA's group E, F, G and H. But the chemical parameters in the second CDA's group were higher than those in the first group; these may be due to the composition of the naturally occurring soil profile in the areas. At the same time, both the first and second group CDA's have mean values above those of the river mean results. This implies that the river pollution level is lower that the ground water sources in all the entire community of Maidan-Orile, and as such the river do not in any way contribute to the contamination of the ground water sources, but rather due to other human activities from the dense population of residents, animal grazing, solid waste disposal and septic leakages observed in the area.

The results obtained from the overall mean for ground water and river water analysis were above the limits of the World Health Organization for most parameters considered except for the pH (6.27) which is within, and for alkalinity (213.61 mg/l and 113.33 mg/l), the heavy metals; Copper (0.013 mg/l and 0.002 mg/l), Zinc 2.342 mg/l and 1.15 mg/l), Lead, Chromium and Cadmium (0.001 mg/l and 0 mg/l) respectively.

Table 3: Mean Samples Quality Analysis based on Community Development Association (CDA's) Grouping

Quality Parameters	Mean values in B, C & D CDA's	Mean values in E, F, G & H CDA's	Overall Mean for Seven CDA's	Mean for Ogun River	WHO Standards
Total Coliform Count (cfu/ml)	11.11×10^1	53.75×10^1	32.43×10^1	23.33×10^1	0
Faecal count (cfu/ml)	0×10^1	15.08×10^1	7.54×10^1	0	0
Temperature (^oC)	24	27.34	25.67	27	-
pH	5.31	6.91	6.11	6.27	6.5 - 8.5
Conductivity (µs/cm)	4,126.67	2,422.5	3,274.59	610	1200
Total Solids (mg/l)	5,433	4,816.17	5,124.59	613.7	1200
Total Dissolve Solids (mg/l)	2,511	4,645	3,578	438.7	1200
Hardness (mg/l)	365.78	768.33	567.06	84	200
Calcium (mg/l)	146.6	130.82	138.71	33.67	75
Magnesium (mg/l)	49.6	342.68	196.14	12.23	0.5
Alkalinity (mg/l)	62.22	365	213.61	113.33	200
Acidity (mg/l)	53.34	30	41.67	16.67	100
Dissolve Oxygen (mg/l)	5.63	6.43	7.37	6.52	-

BOD (mg/l)	9.99	11.96	10.95	6.43	-
Fe (mg/l)	2.104	1.263	1.68	0.017	0.3
Cu (mg/l)	0.017	0.009	0.013	0.002	2.0
Zn (mg/l)	3.02	1.664	2.342	1.15	3.0
Pb (mg/l)	0.001	0.001	0.001	0	0.01
Cr (mg/l)	0.001	0.001	0.001	0	0.05
Cd (mg/l)	0.001	0	0.001	0	0.003

Conclusion

The conclusion of the quality of the ground water sources in Maidan-Orile is clear to be contaminated from the human activities in the area, which includes open grazing of live animals (cow) and discharge of the waste water of man made fish ponds for fish rearing. The river source is also not safe for human consumption and use, due the micro-biological condition; human discharge into the river in the form of placing commercial bathrooms and toilets, over the river for use of homeless group of workers from the the northern part of the country and the drivers of trucks in transit for delivery and evacuation of food stuffs from the adjoining Mile-12 markets largely contributes to the level of contamination.

The residents of the area are at high risk of water borne disease that may arise due the continual use of the ground water source from household activities of washing, bathing, cleaning and drinking without proper treatment, considering the limits stated in the Nigerian Standard for Drinking Water Quality, published by the Standards Organization of Nigeria (SON).

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