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DELIVERING WATER, SANITATION AND HYGIENE SERVICES
IN AN UNCERTAIN ENVIRONMENT

Drinking water service level of groundwater sources in Lambo Lasunwon Community, Ikorodu, Lagos

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Groundwater from aquifers is a major source of potable water supply, particularly for communities not connected to municipal drinking water system. This paper discusses the performance of the service level of on-site private water system from ground water in Lambo Lasunwon Community, Ikorodu. Reconnaissance survey, co-ordinates and heights above sea level of water sample points were obtained. Structured questionnaires were administered on two hundred and seven (207) inhabitants within the community. Social parameters were examined; physical, chemical and microbiological test were carried out samples. The result shows 56% of those interviewed have water in their compound, with 78.4% being borehole, with 77.3% residential. Average water cost is $0.13 per 50liters, daily water usage 50-150litres. Coliform count was zero, with Lead (Pb) of 0.03 – 0.557mg/l, Iron (Fe) 0.181 – 0.367mg/l but slightly acidic with pH value range of 4.76 -5.31.

Introduction

Ground water occurs below the surface of the earth in one form or another, as water moving down to greater depths under the influence of gravity, or moving in columns and thickness of saturated rocks (aquifers), under definite hydrostatic pressure or flowing as ground streams and is also referred to as sub-surface water. Challenges abound, due to the social pressures of population growth, rapid urbanization leading to migration, and increasing user awareness of safe water; thus individuals' families or house-hold has taken it upon themselves to put in place on-site water supply system for private use and commercial purposes (selling post) in their community by tapping into the ground water source.

Olaleye, 2011 shows the high reliance on open well water source, as the most predominant source of water supply in Ikorodu area of Lagos State, with 48.1% of the sources highlighted. The results of water quality test on ground water, carried out in Mubi, Adamawa State, Northern-Eastern Nigeria, shows favorable values of physical, chemical and heavy metals occurrence. (Alexander, 2008)

The Nigerian Standard for Drinking Water Quality, by the Standards Organization of Nigeria (SON), identifies that it is the responsibility of the state to supply drinking water through her agencies, i.e. State Water Boards or Corporations, serving urban areas greater than 20,000 inhabitants; Small Water Town Agencies, serving semi-urban areas with population between 5,000 to 20,000 and Rural Water Supply and Sanitation Agencies operating in rural areas and usually serve communities of 500 to 5,000 inhabitants. "Drinking Water Service Level is the Measure of quality, quantity, accessibility, coverage, affordability and continuity of drinking water supplied to the population" (SON, 2007).

The World Health Organization (WHO), revised background document for development of guidelines for drinking-water quality, for pH in drinking water, records vital information on the pH values of naturally occurring waters. Ground water can be of lower pH as a result of acid rain percolating to the water table, or higher pH in limestone areas. Values of pH in water are a measure of the acid–base equilibrium and, it is found in most natural waters, to be controlled by the carbon dioxide –bicarbonate – carbonate equilibrium system. An increased carbon dioxide concentration will therefore lower pH, whereas a decrease will cause it to rise. Temperature also has effect on the pH value, as decrease in pH of about 0.45 occurs as the temperature is increased by 25 °C. (WHO, 2007)

Generally, groundwater contains no or low levels of harmful pathogens, but it can be polluted with naturally occurring chemicals, when water sources are not properly protected with water seals and apron. (WHO/WEDC, 2010). Individually contaminated sites generally are not large, but once degraded, ground water may remain in an unstable or even hazardous condition for decades or even centuries, as they are very expensive to treat. Contaminants from the surface of the earth could reach ground water sources causing impairment on the naturally occurring quality. Leached waste water was found to contaminate ground water sources around the Abule-Egba waste dump-site, presently used for washing, public toilets and human consumption. The pH, conductivity, Chloride and BOD at 5 days result, shows contamination effects up to 100 meters from the perimeter fence of the site, thus making it unsafe for consumption as portable water, (Ogunbajo, 2011) and up to 200m in well water sources analyzed in Igbo Ora, Oyo State. (Adekunle *etal*, 2007)

Methodology

Study area

Lambo Lasunwon Community is located in Ikorodu local government area of Lagos State, with her entrance by Shagamu road, Ikorodu, located on co-ordinates 0734588 Northing and 0557280 Easting, with height above sea level of about 73m. It is located adjacent to the Lagos State Polytechnic, a non-residential higher institution with over 50% of the students living around the institutions communities. The community is an emerging peri-urban settlement with increase in residential buildings due to the demand. The community is largely located on an undulating terrain with far reaching depth to the ground water source, on lateritic soil, with high rate of surface run-off in slope areas, causing erosion and water-logs swamps in the valleys. Predominated abstraction of ground water in this area is more of boreholes than deep wells.

Reconnaissance survey

The survey of Lambo Lasunwon community shows that it is highly undulating in nature owing to the topography of the area within the few streets covered. This reconnaissance survey gave an insight into the location of water sources, its accessibility level and the need of the structured survey through questionnaire were later used to gather information.

Information gathering using questionnaire

Questionnaires were administered by students of Civil Engineering Department, Lagos State Polytechnic, Ikorodu, Lagos. The distributed questionnaire covers Lambo Lasunwon down to the valley at Oke Igbegun. The survey includes personal details, such as education, occupation and type of housing, others are, source of water supply, initial and maintenance cost, distance from source, palatability, usage volume and so many more. The result of the information was gathered from two hundred and seven (207) questionnaires from the highest point of 73m to the lowest developed area Lambo Lasunwon Primary School water source with at height of 14m above sea level.

Water sample collection

Five water samples was selected after the reconnaissance survey of ground water sources in the community, four of which were ground water sources in its natural form, without treatment, while the fifth was sampled from a commercial water packaging outlet, Emalyne Table Water. The water samples were taken to the laboratory for physical, chemical and microbiological test, to determine its suitability for consumption. The analysis of samples was later compared with standards of the Nigerian Standard for Drinking Water Quality by Standards Organization of Nigeria (SON), World Health Organization (WHO), European Union Standards (EU) and the United States, Environmental Protection Agency Standards (US-EPA).

Result and discussion

The results in Table 1, summarizes the sample numbers collected, location of the streets, water source type, height of location above mean sea level and the co-ordinates. The legend below Table 1 shows the water source and usage. Three boreholes and two covered deep wells were examined within the area.

Table 1. Water sample collection

No	Street names	Water source	Height (m)	Northing (N)	Easting (E)
A	Lambo Lasunwon	BH, SP	56	0734679	0556674
B	Hagler Osakwe	BH, PU	24	0734115	0555861
C	Yemi Onileowo	CW, PU	57	0734323	0557047
D	Oniwonlu	CW, PU	17	0734660	0556235
E	Remi Adebayo	BH, PW	28	0734771	0556421

Legend: BH = Borehole, CW = Covered Well, SP = Selling Post, PU = Private Use, PW = Packaged Water

Information's from the questionnaires are presented in Tables 2 to 4. Table 2 shows the personal respondent data, with the highest value of 58% of the respondent in the age category of 18 -32 years, and student dominance of 41.1%, showing their population spread in the community, with high educational level of 67.6% undergraduate and graduates.

Table 2. Respondent data

Parameters	Category	Frequency	Percentages
Gender	Male Female	104 103	50.2 49.8
Age class	18 - 32 33 - 49 50 and Above	120 76 11	58 36.7 5.3
Employment status	Civil Servant Self Employed Student	40 82 85	19.3 39.6 41.1
Education	Primary Secondary Undergraduates Graduates	13 65 75 54	6.3 31.4 36.2 26.1

Table 3 shows the distribution of the housing types built in the community, 44% being room apartment typical of the housing type for students and 50.2% are single/blocks of flats used by the civil servant, mainly those who migrated from metropolitan Lagos and staff of the Polytechnic living around the institution. 77.3% of the housing types are residential.

Table 3. Property types

Parameters	Category	Frequency	Percentages
Building layout	Room apartments	91	44
	Single/Blocks of flat	104	50.2
	Duplex	12	5.8
Property use	Residential	160	77.3
	Commercial	25	12.1
	Institutional	19	9.2
	Industrial	3	1.4

The source of water, cost/affordability and access to water by private own residence and for the residence without water source in their compound are as displayed in Table 4a and 4b. The current exchange rate of #158.55 to a Dollar has been used in this paper as seen on the Nigerian national statistics, indicators for Nigeria (Trading Economics, 2013). Inhabitants with water in their compound accounts for 56%, while 44% do not; out of those with water, borehole takes a large percentage of 78.4 with balance of 21.6% for deep wells. Survey reveals that the initial cost of waters source ranges between $758 - $1,135 showing

47.4% in this category, while monthly maintenance cost stands between $38 - $63 for 68.1% of private residence with water source in their compound. Most of the water sources are above 70 feet deep.

Table 4a. Water source, cost and accessibility – owner

Parameters	Category	Frequency	Percentages
Water within residence	Yes No	116 91	56 44
If Yes, water source	Borehole Deep Well	91 25	78.4 21.6
If Yes, average initial cost	$315 - $757 $758 - $1,135 $1,136 - $1,261 Above $1,261	48 55 9 4	41.4 47.4 7.76 3.44
If Yes, average monthly maintenance cost	$38 - $63 $64 - $126 Above $126	79 30 7	68.1 25.9 6
If Yes, water source	50 – 70 feet 71 – 100 feet Above 100 feet	25 46 45	21.6 39.5 38.8

From Table 4b, it could be seen that 76.9% of those without water source in their compound also rely on the use of water from the borehole, with means of buying from selling post owned by private individuals, around their houses. For households who could use only 50liters per day the average cost would be a $0.13 per day; while $0.4/day would be incurred if they can use up to 150liters. Expected maximum expenditure per 30 days/month would be $11.4, with 48.3% falling into this category.

Table 4b. Water source, cost and accessibility – non owners

Parameters	Category	Frequency	Percentages
If No, water source	Borehole Deep well	70 21	76.9 23.1
If No, average daily cost	$0.03 per 25 liters $0.06 per 25 liters Above $0.06 Free	25 33 15 18	27.5 36.3 16.5 19.7
If No, supply means	Selling post Vehicle supply Men supply	66 4 21	72.5 4.4 23.1
If No, average daily water usage	50 – 150 liters 151 – 300 liters 301 – 500 liters 501 – 1000 liters	44 33 10 4	48.3 36.3 11 4.4
If No, water source	Borehole Deep well	70 21	76.9 23.1

The physical, chemical and microbiological test results are shown in Table 5a and 5b. The overall evaluation shows that the ground water supply sources are fairly safe for consumption, with color, odor, turbidity and total dissolved solids all within limits as specified, as compared with the standards of WHO, EU, US-EPA and NIG-SON listed just below the samples parameters.

Also the inorganic chemical constituents of chloride, nitrate, copper and manganese are all tolerable, while some iron content above 0.3 was observed in sample A. Color impact was also noticed at the taps during reconnaissance survey and this could be due to the iron (Fe) and or low pH value, as it has been observed that the lower the pH, the higher the potency of corrosion. Acidic water would leach of copper, lead and iron along a pipeline, and would also inhibit disinfectant potency. The ground water source is completely free from microbiological infections with zero total coliform counts.

Table 5a. Physical / Chemical parameters of water sample

	pH	Color (TCU)	Odor	Turbidity (NTU)	Conductivity (μ S/cm)	TDS (mg/l)	TH	Calcium (mg/l)	Mg (mg/l)
Sample A	5.17	Clear	Un-obj	0.54	49	24.5	517.56	8.02	2.91
Sample B	5.31	Clear	Un-obj	2.14	65	32.5	141.8	4.8	1.74
Sample C	5.15	Clear	Un-obj	2.05	125	62.5	191.4	6.4	2.33
Sample D	4.76	Clear	Un-obj	0.89	146	73	163.1	8.02	2.91
Sample E	5.15	Clear	Un-obj	0.45	80	40	205.6	4.01	1.46
STANDARDS									
WHO	6.5 – 8.5	Clear	Un-obj	5	-	1000	-	-	-
EU	6.5 – 8.5	Clear	Un-obj	1.5	-	-	-	-	-
US-EPA	6.5 – 8.5	Clear	Un-obj	5	-	-	-	-	-
NIG-SON	6.5 – 8.5	15*	Un-obj	5	-	500	150	-	0.2

Legend: Un-obj –Unobjectionable, TDS –Total Dissolved Solid, TH –Total Hardness, Mg -Magnesium

Table 5b. Chemical/Microbiological parameter of water sample

	Chloride (mg/l)	Nitrate, $N0_3$ (mg/l)	Copper, Cu (mg/l)	Manganese (mg/l)	Iron, Fe (mg/l)	Lead, Pb (mg/l)	Total Coliform (mg/l)
Sample A	20	36	0.056	0.01	0.367	0.03	0.0
Sample B	12	28	0.07	0.2	0.28	0.35	0.0
Sample C	16	19	0.115	0.019	0.181	0.185	0.0
Sample D	20	32	0.160	0.013	0.201	0.557	0.0
Sample E	10	29	0.139	0.02	0.36	0.132	0.0
STANDARDS							
WHO	-	50	-	-	-	-	0
EU	-	50	2.0	-	-	-	10
US-EPA	250	10	1.0	0.05	0.3	0.0015	0
NIG-SON	250	50	1.0	0.2	0.3	0.1	0
Sample A	20	36	0.056	0.01	0.367	0.03	0.0

Conclusion

The questionnaire reveals that more housing units get their source of water from the boreholes, and the area is wholly residential, and the average initial cost of borehole water supply of between $952 and $1,142 could be avoided if the State government has meet the water demand challenge in this community, this is clearly seen from the World Bank data of 43% rural population with access to potable water (World Bank, 2010), this initial cost is in addition to the average monthly maintenance cost of about $98. Families who cannot afford the on-site private water system, has to bear the accessibility burden of distance and haulage by children and women or an extra cost by vendors, and would also need to pay up to $11 monthly ($0.4 per day) out of the expected daily income of $2.5 assuming the couples are gainfully employed even with the ever increasing unemployment rate of 23.9% of 162.47 Million as at December, 2011 (Trading Economics, 2013). Using the global 2010 new poverty threshold of $1.25 per person and Nigeria has over 58% of her population below this threshold. (This Day Live, 2011)

The family unit without water in their compound accounts for 44% of the interviewed inhabitants in this area, under the South-west zone of Nigeria, where poverty is less evident, this would project to us what could be case in the North-east area of Nigeria where poverty is clearly evident; indicating that about 32% of the daily income is expended on potable water only, for a family where only of the couple is employed. Other basic necessity such as shelter, feeding, clothing and transport even demands more. This cost would be reduced if the public water supply is connected to these peri-urban settlements, wholly residential, to an average monthly bill of $1 per month per family units in shared apartments in Lagos metropolitan area, supplied by the Lagos State Water Corporation (LSWC).

Water generally becomes more corrosive with decreasing pH, which explains the traces of stain observed on ceramics receiving the water drops as it mixes with oxygen to form a stable iron oxide salt. Traces of lead in the water source is of concern, as a cumulative poisoning with toxicity in small concentration, can cause lethargy, loss of appetite, constipation, anemia, abdominal pain, gradual paralysis in muscle (SON, 2007). The different in elevation of the area does not show significant correlation of increase in chemical inorganic constituents washed down the slopes, except for lead with higher values of 0.35mg/l and 0.557mg/l in samples B and D on elevation 24m and 17m respectively. Overall the water sample quality is fairly alright for consumption in the absence of municipal water supply.

The quality of sample E, i.e. water sample from a small scale government approved water packaging company, is of no significant difference, except for slightly reduced turbidity likely due to filtration treatment applied before packaging in plastic bottles and polyethylene bags; because all samples fall below the 5NTU threshold of WHO, US-EPA and the Nigerian SON standards.

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