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ENSURING AVAILABILITY AND SUSTAINABLE MANAGEMENT
OF WATER AND SANITATION FOR ALL

Service level delivery of municipal and private water sources in Olodi-Apapa, Ajeromi-Ifelodun LGA, Lagos

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The service level delivery of municipal water supply and private groundwater sources in Olodi-Apapa, Lagos was evaluated. Reconnaissance survey, co-ordinates and heights above sea level of water sample points were obtained. Structured questionnaires retrieved from two hundred and forty seven (247) inhabitants (98.8%) were analyzed. The result shows a low income area with 72.9% in room apartments, 90.3% uses untreated water supply, with only 6.5% from the municipal source, while private borehole and well accounts for 55.8% and 37.7% respectively. Use of generating set for water abstraction was by 77.3%, while 93.5% do not have access to public water supply, 100% of the sources have high calcium hardness and over 60% have high chloride content. Municipal micro water works limitations include expansion, electricity supply, and good network of public standing pipes.

Introduction

Water is essential need of life and just as other social amenities it is better provided by the municipality or its authorized agency directly or privatized as the case may be, but the case in some Lagos metropolitan areas remains unexpected as water supply is far from meeting the demand. Residents then have to incur additional cost of providing, maintaining and protecting sources of water as applicable. The cost of power supply is further added to the cost bored. The poor transportation system, wholly poor road network has made increase in population in city centre's to continue to rise, causing so much social pressures of population growth, rapid urban decadence and increasing water demand; 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. "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 results of Microbiological assessment of well waters in Samaru, Zaria, Kaduna, State, Nigeria shows contamination of all well water samples with total coliform counts >180+/100 ml with varying percentages of bacterias, *Escherichia coli* 20%, *Klebsiella pneumoniae* 100% and *Proteus mirabilis* 40%. (Aboh *et al*, 2015). Analyses of Groundwater in Ikere township, Ekiti State, Southwestern Nigeria, shows compliance with standards for physical and chemical parameters, but *Escherichia coli* and Coliforms were found in the 12 well water sources examined. (Aturamu, 2012)

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, Small Water Town Agencies and Rural Water Supply and Sanitation Agencies serving urban areas greater than 20,000; 5,000 to 20,000 and 500 to 5,000 inhabitants respectively (SON, 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).

Calcium and magnesium hardness in water is the most common, no health effect is recorded for the presence of calcium hardness, but there is in-conclusive research on the possible effect of calcium on cardiovascular disease mortality due to consumption of hard water. Indications of hardness are numerous

from the formation of soap curd on the skin surface, which may cause irritation due to non return of skin to the acidic condition, soap curds deposit on plates, showers, glass and any water fixtures. Dull surface of clothing washed constantly with hard water and scaling on boiling container, thus increasing boiling time; scaling could also block pipes. (Water Research Centre, 2016a & 2016b)

Methodology

Study area

Olodi-Apapa, in Ajegunle-Boundary area is located in Ajeromi-Ifelodun local government area (LGA) of Lagos State; it is bounded by the Surulere, Amuwo-Odofin and Apapa LGA, with height above sea level of about 15m to 37m. The census of Ajeromi-Ifelodun LGA as at 1991 was 593,591 over 12.3 km^2, with a population density of 48,135 in every square kilometer (Demographia, 1994). The projection of the population for March, 2015 is 1,905,700 for the LGA (City Population, 2015). It is a purely residential low class area of Lagos, the community is an urban settlement with increase in population due the proximity to the city centers and corresponding increase in cost of living. The Lagos State Water Corporation has a micro water works in the area to distribute pumped water from Iju water works far away, and to augment with treated water from an industrial borehole, but the shortage of power supply has been the limiting factor for the performance of the water works, aside the challenge of dilapidated old network system of pipes. Abstraction of ground water in this area is more of drilled boreholes than hand-dug wells, by the helpless residents who have to provide for themselves.

Reconnaissance survey

The survey of Olodi-Apapa in Ajegunle area of Ajeromi-Ifelodun LGA shows a built up area with low sanitation and large plain topography over the streets covered. This reconnaissance survey gave an insight into the location of water sources, the municipal water network distribution failures and 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 Olodi-Apapa, from the Ajegunle end to the Amuwo-Odofin end towards Oshodi-Apapa expressway. The survey includes personal details, such as education, occupation and type of housing, others are, source of water supply, maintenance cost, portability, usage volume, power source for water and so many more. The result of the information was gathered from two hundred and forty seven (247) questionnaires, out of the two hundred and fifty (250) earlier distributed. The questionnaire was administered to any available adult, with residence in the area of survey over a week to include a weekend, and distributed to spread across all the major streets in Olodi-Apapa area.

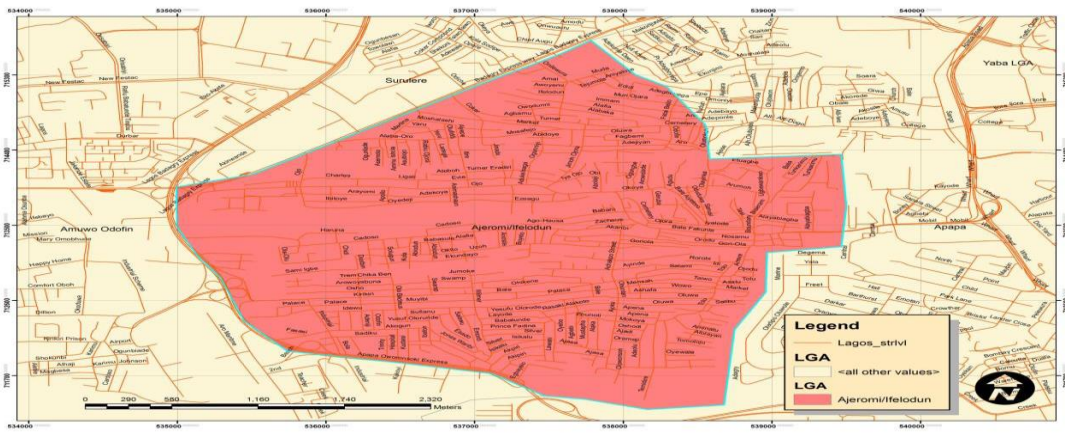

Figure 1. Map of Ajeromi-Ifelodun LGA

Source: WEDC - Source

Table 1. Water sample collection

No	Street names	Water Source	Height (m)	Northing (N)	Easting (E)
A	Alayabiagba Market	BH, SP	37	0713271	0533655
B	Orodu	BH, PU	15	0713274	0538685
C	Amore	CW, PU	13	0713062	0538812
D	Salami	BH, SP	12	0711263	0538242
E	Kirikiri	BH, SP	16	0712705	0537492
F	Ibafon Market	CW, PU	13	0711821	0537095
G	Tolu Road	CW, PU	15	0712372	0538333
H	Ojoku Sec. School	CW, PU	15	0711512	0538190

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

Water sample collection

Eight water samples was selected after the reconnaissance survey of ground water sources in the area, four (4) of which were ground water sources from borehole and the other four (4) from wells, all the water source were without treatment, the water from the municipal supply was not available over a long period of a over a month, the samples were collected in the early part of August 2015. 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. Four (4) boreholes and four (4) covered wells were examined within the area.

Information's from the questionnaires are presented in Tables 2 to 4. Table 2 shows the personal respondent data, female dominant with 65.2% due being more available at homes, with the highest value of 36.8% of the respondent in the age category of 31 - 45 years, married dominance of 66%, the population spread in the area shows it's a densely populated area with a high number of adults, including retirees and self employed with percentages data contribution of 8.1% and 53.4% respectively; who has stayed in the area for a long time, with over 58% having lived there in the last 11 to 20 years, respondents with secondary school education tops the list at 50.2%.

Table 2. Respondent data

Parameters	Category	Frequency	Percentages
Gender	Male Female	86 161	34.8 65.2
Marital Status	Married Single	163 84	66 34

Age Class	15 - 30 31 - 45 46 – 60 61 and Above	68 91 72 16	27.5 36.8 29.2 6.5
Employment Status	Civil Servant Private Sector Employed Self Employed Retiree	67 28 132 20	27.1 11.4 53.4 8.1
Education	No Formal Education Primary Secondary Graduates	10 20 124 93	4.0 8.1 50.2 37.7

Table 3 shows the distribution of the housing types built in the community, 72.9% being room apartment typical of the housing type for low income areas in Lagos metropolitan areas, with 23.1% occupants in single/blocks of flats mostly inhabited by the civil servant, mainly due to proximity to work place at Apapa and Lagos Island areas. Household size of 4 – 6 persons represents about 49.4% of the representative respondent in this survey.

Table 3. Property types

Parameters	Category	Frequency	Percentages
Building Layout	Room Apartments	180	72.9
	Single/Blocks of flat	57	23.1
	Duplex	10	4.0
Household Size	1 - 3	70	28.3
	4 - 6	122	49.4
	7 - 9	45	18.2
	10 and above	10	4.1

The source of water, cost/affordability and access to water by private own residence and for the residence without any water source/connections are as displayed in Table 4. The current exchange rate of #199 to a Dollar has been used in this paper as seen on the Nigerian national statistics, indicators for Nigeria (Trading Economics, 2016), though the rate in the open market is over #300 per dollar, clearly indicating a worse scenario that the displayed inflation rates of 9.6%. Inhabitants with water in their residence (individual connection) accounts for 72.1%, while only 27.9% do not; this shows the effort of the individuals making provision for their water supply personally compared to municipal irregular source accounting for only 6.5 %. Those without water mainly relies on borehole as its' believed to be saver than well sources. The survey shows monthly maintenance cost of $25 - $50 for 77% of private residence with water source within per household, most of the water sources are not treated (90.3%). From Table 4, it could be seen that 76.9% use an average of 50 – 150 litres of water per family on a daily basis. The households would have to bear extra cost of using fuel based electrical generating set to pump water from boreholes (77.3%), rather than the cheaper public power source by the privatized body Power Holding Company, Nigeria (PHCN).

Table 4. Water source, cost and accessibility

Parameters	Category	Frequency	Percentages
Water within Residence	Yes No	178 69	72.1 27.9

Water Source	Borehole Deep Well Municipal Borehole (Free or bought)	69 93 16 69	27.9 37.7 6.5 27.9
Average Monthly Maintenance Cost (Includes electricity/fuel for pumping) per household	$25 - $50 $51 - $100 Above $100	137 36 5	77.0 20.2 2.8
Average Daily water usage	50 – 150 litres 151 – 300 litres 301 – 500 litres Above 500 litres	190 37 16 4	76.9 15.0 6.5 1.6
Is your Water Treated	Treated Not Treated	24 223	9.7 90.3
Pumping of Water Source	PHCN Power Generating Set Solar Power Inverter Power system	56 191 0 0	22.7 77.3 0 0

Table 5a and 5b shows the physical, chemical and microbiological test results. The overall evaluation shows that the ground water supply sources have pH, color, odor, turbidity, manganese, copper, nitrate, Iron, lead and total coliform all within limits as specified, as compared with the standards of WHO, EU, US-EPA and NIG-SON listed just below the samples parameters.

But the water sources around Alayabiagba market, Orodu and Amore borehole and well shows the worse results of higher values against standards for Conductivity, Total Dissolve Solids, Total Hardness, Calcium Hardness and Chloride well above the standards recommended after treatment. 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)**	**PO_4^{3-} (mg/l)**
Sample A	7.12	Clear	Un-obj	0.0	1714.0	1230	436	280	0.00
Sample B	6.65	Clear	Un-obj	0.0	1633.0	1170	368	220	0.01
Sample C	7.01	Clear	Un-obj	0.0	1780.0	1280	336	188	0.00
Sample D	7.90	Clear	Un-obj	0.0	1200.0	837	380	188	0.00
Sample E	6.06	Clear	Un-obj	0.0	372.0	250	148	100	0.01
Sample F	7.88	Clear	Un-obj	0.0	602.0	409	228	136	0.00
Sample G	6.79	Clear	Un-obj	0.0	1095.0	726	244	180	0.00
Sample H	7.96	Clear	Un-obj	0.0	635.0	433	292	152	0.01
Standards									
WHO	6.5 – 8.5	Clear	Un-obj	5	1200	1000	200	75	0.03
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	1000	500	20	75	0.3
Legend: Un-obj –Unobjectionable, TDS –Total Dissolved Solid, TH –Total Hardness, PO_4^{3-} -Phosphate									

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	424	12.8	0.0	0.012	0.018	0.0	0.0
Sample B	340	14.68	0.0	0.018	0.024	0.0	0.0
Sample C	540	8.63	0.0	0.022	0.036	0.0	0.0
Sample D	288	7.36	0.242	0.036	0.046	0.0	0.0
Sample E	96	6.28	0.324	0.019	0.026	0.0	0.0
Sample F	116	16.28	0.028	0.022	0.034	0.0	0.0
Sample G	248	8.15	0.625	0.032	0.046	0.0	0.0
Sample H	52	3.28	0.0162	0.0182	0.032	0.0	0.0
Standards							
WHO	-	30	1.5	0.5	0.3	0.01	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	0.01	10

Conclusion

The questionnaire reveals that more housing units get their source of water from the boreholes, and the area is wholly residential with adult population, and the average monthly maintenance cost of $25 and $50 tops the data collation, by a household with cost of power being a significant one; recently in February 2016, tariff paid for electricity supply was increased by 100% to about $0.125 per kwh units; this could however be avoided if the State government has meet the water demand challenge in this area. It takes over seven months for a new building to get connected to the National grid, by PHCN. (World Bank Group, 2016)

The World Bank data of 43% rural population with access to potable water (World Bank, 2016), also testify. 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 i.e. $0.4 per day; (Ogunbajo & Olaleye, 2013).

Using the global 2010 new poverty threshold of $1.25 per person; a household with both partners employed who earns $2.5 dollar per day would spend ($0.83) 33.2% on water daily, if they can afford to even own the water source in the first instance and Nigeria has over 58% of her population below this threshold. (This Day Live, 2011)

The quality of samples F, G and H from wells around Ibafon market, Tolu road and Ojoku secondary school has the best quality, signifies that the quality is dependent on the location area, and the boreholes

from Alayabiagba, Orodu and well from Amore area delivers hard water which reduces lather of soap and high total dissolve solids. The service level (accessibility to drinking water) in the area via the municipal micro water works is reported as below required standards; while the quality could not be ascertained as water was not available; private water sources could be rated above average. Provision of safe water by municipal remains a challenge, provision of new network lines in old urban settings required; quality test and treatment of water sources encouraged by government agencies, intensified effort to ensure steady power supply is important, as it would have positive impact on the municipal water supply system.

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