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# CHALLENGES FACING WATER INFRASTRUCTURE IN DEVELOPING CITIES: CASE STUDY OF EPE TOWN LAGOS NIGERIA

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ABSTRACT

Provision of facilities in any habitat needs planned infrastructures to deliver the expected service to the municipality. Sustainable Development Goal (SDG), Goal 6 is to "Ensure access to water and sanitation" by 2030. This study was carried in Epe town, Lagos State, to evaluate the current situation of safe water supply and the contributing effects of water infrastructure provision. Questionnaire were administered on the residents and officials of the Lagos Water Corporation Agency, facilities were inspected. Presently municipal water supply infrastructure is disconnected due to the recent road project, while the Odomola water supply scheme is in the new Lagos Water master plan. Water supply now mainly by personal effort via boreholes, wells and packaged water, with almost 100% water supply self-provided by residents. Implications includes over 54.6% resident drinks unsafe water from borehole, high cost of water supply, and man hour wastage. Public private partnership investment would be the way out, considering fund limitations to address series of infrastructural challenges.

## Introduction

Treated water source from the pipe-borne water is often equated to safe water. It is pathetic to observe that access to pipe-borne water among Nigerians has decreased extensively from 14 per cent in 1990 to 6 per cent in 2008 (WHO/UNICEF JMP, 2010). In the developing countries where the development of water is mostly government-driven, failure to develop efficient water supply system has been established as a product of the interplay of several factors. Among them are, securing finances to build, maintain and expand the systems is perhaps the most important. The availability of finance especially for day-to-day operations and maintenance is a challenge and most corporation find difficult to break even due to the poor bill payment attitude for utilities i.e. Water supply, Solid Waste disposal, electricity etc. (World Bank, 1994)

Yaro et al. (2019) reported the spacial distribution of water infrastructure in Okene town, Kogi State and found out that borehole is the major source of water supply for residential with 56.5per cent and 17.2 per cent private and public ownership with breakdown in the mechanical part being the major challenge for the non-operation of about one-third of the existing boreholes. Most Koreans have access to pipe-borne water supply, but the fast deterioration of infrastructure will reach about 72.3 per cent of all water infrastructure by 2035, implying that the standard of water supply services then would be even lower than the current standard. (Hyeongsik, 2019)

Achieving the Sustainable Development Goals call for universal and equitable access to water, sanitation and hygiene by 2030 and it will require about three times the current level of investment and a need for a total capital cost of about $114 Billion per year. New infrastructure will minimize water scarcity and will reduce the economic impacts of floods, droughts, inadequate water access and poor sanitation. (Braga B., 2016)

Chepyegon, and Kamiya (2018), relates the development of the Kenyan water sector is characterized by non-sustainability of water supply systems, low social acceptance of interventions, low investment in the sector and water-related conflicts. It is also observed that the sector management has opportunity for improving the current situation through adoption of elaborate monitoring strategies for water services and water resources, embracing sustainable technologies and involving target beneficiaries in water supply development.to resolve the technical, economic and social problems associated with water supply.

Stephen, (2018) highlighted the solutions to five (5) major challenges of the water sector in Australia and are as listed here; Aging infrastructure & asset maintenance, Managing costs amid rising electricity prices, Population growth in urban centers, rural services, Environment and sustainability, Skills shortage & aging workforce and Skills shortage driven by technology and industry.

## Methodology

### Study Area

The location of the study area is Epe town, Lagos State, it is located approximately on Latitude 6o 35’ 3” North, and Longitude 3o 58’ 43” E, with an average height above sea level of about 137 feet. Epe town is bounded in the north by Ogun State, on the west by the Lekki lagoon, in the south by Eti-Osa local government area (LGA) and to the east by Ikorodu LGA. It was established under the rule of the Awujale of Ijebu land with migration of the hunters and later the Oloja (king of Epe) in the mid of 18th centuries. The major business of the inhabitants is fishing and farming, while the major source of water provision at present is from boreholes. (Nigeria Galleria, 2017)

Population records for Epe LGA as at the 2006 National Census is 181,734 and projected to be about 250,300 by 2016. (City Population, 2017)

### Reconnaissance Survey

Reconnaissance survey of the study area was carried out to identify the various sources of water supply, water supply infrastructures for the municipal and private sector were inspected, prior to the water sampling collection for quality analysis in the laboratory. The reconnaissance survey facilitated a better understanding of the spatial distribution of wells and boreholes in the town and the condition of the government water supply infrastructure. The areas covered includes Marina market (Ayetoro), Ijako village (Poka), Itun Olamiji (Odomola), Oke Oyinbo, Oke Balogun, Mojoda, Agric and Papa area. The highest elevation above mean sea level of 57m was recorded at Oke Balogun area and the lowest area along Ashabi Ewenla Street, Agric area at a height of 22m.

### Information Gathering Using Questionnaire

Questionnaires were administered to cover all the areas covered by the survey and distributed spatially for wide spread coverage of residents. The total questionnaire received for analysis is three hundred (300) numbers, with One hundred (100) each spread across the three mapped area for the purpose of the research. The survey includes personal details, such as gender, age group, marital status, education, occupation and years of residency, others are sources of supply, availability/regularity of municipal water supply,

reason of non-supply and quality assessment information. Results of the information gathered were presented in groups of related questions with simple percentages of respondents answers. Oral interview was also conducted on staff of the Lagos State Water Corporation (LSWC) at the Epe mini water works,

## Water Sample Collection and Analysis

Eleven (11) water samples was selected after the reconnaissance survey of ground water sources in the community, eight (8) of which were from Boreholes, one (1) from a Well water source and two (2) from treated (boreholes) sachet water (Swaga an PDG Water) produced and sold around Epe. Laboratory analysis for physical, chemical and microbiological parameters was done to determine its suitability for consumption. The analysis of samples was later compared to Standards of the Nigerian Standard for Drinking Water Quality (NSDWQ) by the Standards Organization of Nigeria (SON).

## Result and Discussion

**Information's from the questionnaires are presented in Table 1 to 4 below. Table 1, above summarizes the water sample source locations, 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 abbreviation.**

**Table 1. Water Sample Collection**

| Sample No | Water Source location | Water Source | Height (m) | Northing (N) | Easting (E) |
|---|---|---|---|---|---|
| A | Mojoda Town | BH, PU | 30 | 0640655 | 0359014 |
| B | Oke-Balogun | BH, PU | 57 | 0635222 | 0359020 |
| C | Mobowode Street, Odomola | BH, PU | 36 | 0636313 | 0359088 |
| D | Oke-Oyinbo Road | BH, PU | 30 | 0635218 | 0358772 |
| E | Itun Olamiji, Odomola | BH, PU | 36 | 0636304 | 0359030 |
| F | Governor Street, Agric, | BH, PU | 33 | 0728306 | 0606283 |
| G | Ashabi Ewenla Street, Agric | BH, PU | 22 | 0727450 | 0606603 |
| H | Shade Street, Agric | BH, PU | 45 | 0727969 | 0607638 |
| I | Ayetoro Market | W, PU | 31 | 0727164 | 0607979 |
| J | Ijako Village, Poka | BH, PW | 31 | 0730953 | 0604552 |
| K | Near Atlantic Hall, Poka | BH, PW | 29 | 0637127 | 0357396 |

**Legend: BH = Borehole, W = Well, PU = Public Use, PW = Packaged Water**

Questionnaire from respondents in the residential and business area in Epe community was analysed for personal data of gender, age, employment, education and years of stay in the area as shown in Table 2 below. Female represents 62.8% of respondents and 37.2% for Male. Age class (18 – 30years) has the highest frequency of 58.3% in that category, 59.5% having Primary and Secondary School educational backgrounds.

| Table 2: Respondent Data | | | |
|---|---|---|---|
| **Parameters** | **Category** | **Frequency** | **Percentages** |
| Gender | Male | 124 | 37.2 |
| | Female | 176 | 62.8 |
| Age Class | 18 - 30yrs | 161 | 58.3 |
| | 31 - 45yrs | 70 | 21.0 |
| | 46 - 60yrs | 67 | 20.1 |
| | 60 above | 2 | 0.6 |
| Employment Status | Student | 78 | 23.4 |
| | Civil Servant | 45 | 13.5 |
| | Businessman/woman | 177 | 63.1 |
| Education | Primary & Secondary | 165 | 59.5 |
| | Graduate | 105 | 31.5 |
| | Post-Graduate | 30 | 9.0 |
| Years lived in Epe | 1 - 10yrs | 149 | 54.7 |
| | 11 - 20yrs | 95 | 28.5 |
| | 21 - 30yrs | 36 | 10.8 |
| | 31yrs above | 20 | 6.0 |



Table 3, below shows the percentages of the level of water supply availability and regularity, 60 per cent of respondents never had water supply from the municipal source connection to their residence, and has always relied on alternate sources, majorly from the borehole water source sale.

This was displayed in the percentage of how irregular the water supply was with a high value of 70.8 per cent irregularity, and at present over 76.5 per cent, not have access to the municipal. Up to 70.2 percent of the respondents have stopped getting water supply in the last 1 to 10years. Only 14.8 per cent, consumes water due to non-availability.

| Table 3: Water Source Adequacy and Accessibility | | | |
|---|---|---|---|
| **Parameters** | **Category** | **Frequency** | **Percentages** |
| Ever had water supply from LSWC | Yes | 100 | 40.0 |
| | No | 200 | 60.0 |
| Regularity of supply from LSWC | Very Regular | 15 | 8.5 |
| | Regular | 49 | 20.7 |
| | Not Regular | 236 | 70.8 |
| Do you still get supply from LSWC | Yes | 45 | 23.5 |
| | No | 255 | 76.5 |
| Year of water supply stop-page from LSWC | Less than 1 year | 84 | 25.2 |
| | 1 – 5 years | 96 | 28.8 |

| | | | |
|---|---|---|---|
| | 6 - 10 years | 54 | 16.2 |
| | 11 – 15 years | 35 | 15.4 |
| | 16 years & above | 31 | 14.4 |
| Source of drinking water | Borehole | 182 | 54.6 |
| | Packed water | 102 | 30.6 |
| | Water works | 16 | 14.8 |
| Reasons of non-supply | Infrastructure issue | 244 | 78.7 |
| | Non-payment of bills | 40 | 12.0 |
| | Others | 16 | 9.3 |

The reason for the non and poor supply is infrastructure based as over 60% never had water supply due the limitation of the pipe network reticulation, with breakdown maintenance, non-supply of electricity, vandals action unattended and the recent road construction work in the last four years by Governor Akinwumi Ambode has further increased the number of residents without the municipal water supply pipe network.

**Table 4a: Physical / Chemical Parameters of Water Sample**

| Sample | pH | Color (TCU) | Odor | Turbidity (NTU) | Conductivity (S/cm) | TDS mg/l | Total Hardness | Calcium (mg/l) | Zinc (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| A | 6.10 | Clear | Un-obj | 0.00 | 167..6 | 144.1 | 18.0 | 6.0 | 0.121 |
| B | 4.10 | Clear | Un-obj | 0.00 | 158.9 | 104.0 | 24.0 | 20.0 | 0.126 |
| C | 4.96 | Clear | Un-obj | 0.00 | 170.6 | 146.0 | 18.0 | 6.0 | 0.241 |
| D | 6.32 | Clear | Un-obj | 0.00 | 167..8 | 143.9 | 24.0 | 14.0 | 0.068 |
| E | 5.20 | Clear | Un-obj | 0.00 | 282.0 | 186.0 | 68.0 | 48.0 | 0.028 |
| F | 4.82 | Clear | Un-obj | 0.00 | 150.0 | 134.0 | 38.0 | 22.0 | 0.091 |
| G | 5.12 | Clear | Un-obj | 0.00 | 159.5 | 105.0 | 66.0 | 24.0 | 0.052 |
| H | 4.80 | Clear | Un-obj | 0.00 | 112.6 | 73.8 | 52.0 | 12.0 | 0.216 |
| I | 5.81 | Clear | Un-obj | 0.00 | 458.0 | 671.0 | 188.0 | 120.0 | 0.146 |
| J | 7.10 | Clear | Un-obj | 0.00 | 60.1 | 32.4 | 12.0 | 4.0 | 0.012 |
| K | 7.20 | Clear | Un-obj | 0.00 | 187.9 | 124.2 | 46.0 | 38.0 | 0.062 |
| **STANDARDS** | | | | | | | | | |
| **WHO** | 6.5 – 8.5 | Clear | Un-obj | 5 | 1,200 | 500 | 200 | 75 | 0.3 |
| **NIG-SON** | 6.5 – 8.5 | 15* | Un-obj | 5 | 1.000 | 500 | 150 | 75 | 3 |

The physical, chemical and microbiological test results are shown in Table 4a and 4b above and below. The overall evaluation shows that the ground water supply sources are not fairly safe for consumption, based on the general low pH of all ground water source, except the treated samples J and K. The test result of the water from the open well at the Marina market (Ayetoro) has a high total dissolved solid and hardness, this may be due to its nearness to the lagoon with values of the total dissolved solids 671mg/l above

500mg/l and the calcium hardness of 120mg/l above 75mg/l. The two packaged water confirms it has been fairly treated and satisfy all conditions including the microbiological criteria of total bacteria count below 1.0x102 cfu/ml, while samples G and H from bore-holes (Agric area) and sample I (Ayetoro) from the open well has total bacteria count in excess of the limit. (WHO, 2010; SON, 2007).

**Table 4b: Physical, Chemical and Microbiological Parameters of Water Sample**

| Sample | Chloride (mg/l) | Nitrate, N03 (mg/l) | Copper, Cu (mg/l) | Manganese (mg/l) | Iron, Fe (mg/l) | Lead, Pb (mg/l) | Total Bacterial Count (cfu/ml) |
|---|---|---|---|---|---|---|---|
| A | 28.0 | 0.18 | 0.00 | 0.00 | 0.0412 | 0.00 | 1.0x101 |
| B | 50.0 | 1.12 | 0.00 | 0.00 | 0.041 | 0.00 | 2.0x101 |
| C | 28.0 | 1.12 | 0.00 | 0.00 | 0.068 | 0.00 | 4.0x101 |
| D | 28.0 | 0.08 | 0.00 | 0.00 | 0.02 | 0.00 | 2.0x101 |
| E | 58.0 | 0.62 | 0.00 | 0.00 | 0.058 | 0.00 | 4.0x101 |
| F | 34.0 | 0.04 | 0.00 | 0.00 | 0.084 | 0.00 | 2.0x101 |
| G | 56.0 | 0.06 | 0.00 | 0.00 | 0.072 | 0.00 | 2.1x102 |
| H | 60.0 | 1.12 | 0.426 | 0.00 | 0.021 | 0.00 | 1.2x102 |
| I | 204.0 | 4.12 | 0.621 | 0.00 | 0.052 | 0.00 | 1.6x102 |
| J | 16.0 | 0.08 | 0.00 | 0.00 | 0.048 | 0.00 | 0.2x101 |
| K | 32.0 | 0.21 | 0.00 | 0.00 | 0.011 | 0.00 | 0.00 |
| **STANDARDS** | | | | | | | |
| **WHO** | 250 | 30 | 1.5 | 0.5 | 0.3 | 0.01 | 1.0x102 |
| **NIG-SON** | 250 | 50 | 1.0 | 0.2 | 0.3 | 0.01 | 1.0x102 |

**Plate 1: Water Source from Borehole at Epe (Public Use)**

**Plate 2: Abandoned Public Stand pipe**

**Plate :3 Federal Govt Ogun-Osun River Basin Project**

## Conclusion

It is clear here that part of the 54.6 per cent who drinks from borehole water source drinks unsafe water, due the unavailability of the trusted source of the Lagos State Water Corporation owing to the poor state of infrastructural development of the water supply scheme.

The infrastructure that has been either neglected, destroyed or not replaced over the years includes the increase of the water source, old storage tanks, dilapidated pipe network system, poor electricity supply, and damaged public water dispensing points. The implementation of the Odomola water supply scheme is in the new Lagos water master plan, is a must if the town is get a source that will be adequate for water supply to satisfy the water consumption need of the community. This scenario is a replica to most towns un-

der the Epe local government area in the area of water. The Ota-Ikosi water scheme has been poorly managed, and presently does not any one in Ota-Ikosi, Agbowa-Ikosi, Owu-Ikosi and Odo, due to non-connection of residence to the mains.

Funding options for water infrastructure challenge should include foreign-local counterpart funding, public-private partnership for expansion and repairs of facilities to cover a reasonable percentage of the residents.

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