

Public feedback on State of domestic water supply in Lagos: Implications for public health

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Received 10 August 2015, revised 2 September 2015

Traditional beliefs and public perceptions have direct impact on water use in any community. Furthermore, public feedback has been recognized as a necessary input for integrated water resources management. Thus, public feedback regarding the state of water supply in Lagos state was harvested using stratified sampling technique, while data was analyzed using descriptive statistics. Lagos is a mega-city with annual growth rate of 5% and 21 million residents. Results show that majority of the residents believe water services should be free, and behave as such. Lagos Water Corporation (LWC) supplies 210 million gallons of water/day to the city but loses 60-83% of its production to vandalism, illegal connections and ageing infrastructure. The resultant effect is that 34% of the residents are reached with water, while 64 % use groundwater as an alternative. In Lagos Island, where water table ranges from 3-7 m, septic tanks are sited indiscriminately and saltwater intrusion is frequently reported. Thus, groundwater pollution is rife and public health is constantly at risk. Using proven examples, the paper demonstrated how repositioning LWC for sustainable production and distribution of water in Lagos could provide the cheapest, cleanest, and quickest alternative for making water available to all residents.

Keywords: Water supply, Urban, Developing country, Water costs, Public perception, Sanitation, Water rights

IPC Int. Cl.⁸: E03B, C02F, H04R 27/00, A47K

An estimated 2.8 billion people in the world were without access to clean drinking water and sanitation when the millennium development goals (MDG) were formulated in 1990^{1,2}. Twenty two years later (3 yrs to the deadline), 2 billion people had been reached with access to clean drinking water but only 200 million people gained access to improved sanitation¹. It is expected that by the deadline of 2015, people without access to clean water all over the world would be about 547 million and those without access to sanitation would be 2.4 billion. Presently, 2/3 of the remaining people without access to water and sanitation come from sub-Saharan Africa and parts of South-east Asia also being affected¹. Nigeria is listed among the sub-Saharan African countries which are not likely to meet the MDG by 2015^{1,2}. The impact of lack of access to water and sanitation is debilitating. People die from the effect of polluted water than from any form of violence such as wars and automobile accidents while

approximately 90 % of the casualties occur among children younger than 5 yrs³. Little wonder the United Nations (UN) in its resolution A/RES/64/292 of July 2010 proclaimed safe, clean drinking water and sanitation as human rights⁴. The UN further consolidated this right through resolution 16/2 of April 2011 by declaring that safe water and sanitation is not the only right; having access to them is also a right⁴. Gleick⁵ described this right as legally binding under international law; that is, States are bound to protect and promote individual human right to accessing safe water. UN⁴ also explained that this right involves allowing affected communities and vulnerable groups to partake in decision making processes. This places the greater responsibility of providing safe water to citizens on national governments, with some input from end users and other stake holders. Lagos state, Nigeria, is the largest city-state in Africa and the seventh fastest growing city in the world⁶. With a high growth rate of 5 % and over 20 million residents^{6,7}, the provision of water for Lagos residents has been very

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daunting⁸. Lagos Water Corporation (LWC), the state agency responsible for public water services, currently produces 210 Million gallons per day (MGD) and has a deficit 330 MGD⁷. Previous reports stated that public piped water effectively reached just 30 % of the residents as 60 – 83 % of the produced water is lost in transit due to burst pipes, illegal connections, vandalism, and broken down infrastructure^{2,7}. Aside water losses and water shortage in the state, water quality has also been a problem. A study by Ohwo⁸ showed that water supplied to Ojota area was of good quality when it left the water works but was highly contaminated at the user end. This was attributed to inadequate maintenance of infrastructure by the water agency and acts of sabotage by some users, respectively (Fig. 1). With respect to production and reticulation of potable water supply therefore, reticulation appears to be the greater problem confronting millions of people in Lagos state. Since public input in decision making regarding water supply is an integral part of human right to water, this study sought Lagos public feedback regarding their experience in respect of sustainable production and distribution of water. This was done in the hope that indigenous and innovative solutions could be introduced to solve the water and sanitation problems of Lagos State, with examples that could be extended to solving water and sanitation problems of communities in other developing countries where similar problems exist.

Methodology

Study area

This study was carried out in Lagos State which is one of the 36 states of Nigeria (Fig. 2) between February and April 2013. Lagos state is a coastal environment that borders the Atlantic Ocean. With a landmass of 3, 577km² and 787 km² of inland water, Lagos is the smallest state in Nigeria in terms of landmass, but also the most populated^{7,9,10}.

Lagos state has 20 Local Government Areas (LGA). In 2006, the official census figures placed Lagos State population at 9, 013, 534⁹. Recent estimates by the state government, however, places population figures at 20.19 million^{6,7}. Lagos is a predominantly metropolitan area with a high population density of 2,520 persons per square km (total land and water mass) or 20,000 persons/square kilometer of built up areas¹⁰. Built area in the state is subdivided into island and mainland. Some of the islands communities are remotely situated in areas

such as Badagary, Epe and Ikorodu which are rural in outlook⁷. Lagos state is reputedly the commercial and industrial headquarters of Nigeria, having more than 60 % of all industries in Nigeria within its borders¹⁰.

Data gathering and handling

Questionnaires were served to the sampled population using stratified random sampling method. This method was employed because each member of the total population had an equal and known chance of being selected within a specific sample area. The stratification was aimed at receiving feedback from both high and low income earners of the state. Also, both males and females were targeted for their input. The questionnaires were distributed in four of the 20 LGAs. The LGAs include Ikeja, Lagos Island, Oshodi/Isolo and Mushin. Ikeja and Lagos Island LGAs were selected because they accommodate a higher concentration of corporate firms and by extension, the medium to high income earners while Oshodi/Isolo and Mushin LGAs were selected because of their relatively high population density, slums and concentration of low income earners. From the official population figures, the low income areas



Fig. 1—Leaking water supply pipes lying in sewer⁷

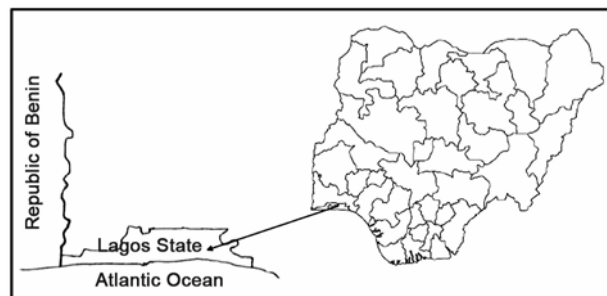


Fig. 2—Map of Nigeria showing Lagos State

had approximately twice the number of residents than the high income areas⁹. Thus, twice the number of questionnaires were distributed in such areas. This stratification approach agrees with the fact the worst cases of water-related problems are often found in densely populated areas¹¹. Three thousand (3000) questionnaires were served to the same number of households. Of this number, 2315 was retrieved for analysis, giving a return rate of 77%. Information sought through the questionnaires included size of the household, age grades within the household, sources of water to the household, reliability and convenience of obtaining water from the water source; average time taken to collect water from the water source, perception of water quality, adequacy of water supply, costs of securing water and level of satisfaction with water source. All data were entered into Microsoft Excel spreadsheet for storage, handling and analysis. General descriptive statistics was conducted on the retrieved data. Additionally, the confidence interval of the data was determined at 95% using the scheme of Montgomery & Runger¹².

Results and discussion

General description of the respondents

The distribution of the respondents indicated that 54 % were males while 46 % were females. Also, most of the respondents were young people aged between 18-25 yrs (Fig. 3). Culturally, children, adolescents and females are the class of people saddled with the responsibility of fetching water for the family when water is not flowing from piped sources within the house.

Sources of water

Approximately 63 % of the respondents obtain domestic water supply from ground water sources such as boreholes and hand dug wells (Fig. 4). About 34 % of the respondents claim to receive water from public utilities and about 2.72 % of the respondents say they visit nearby surface

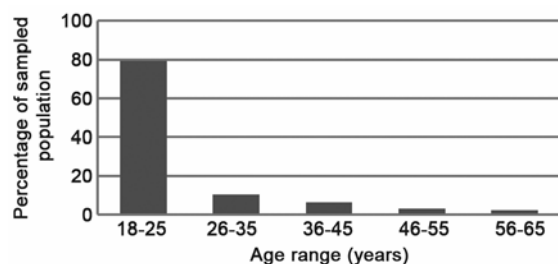


Fig. 3—Age distribution of respondents

water bodies for water supply. At 95 % confidence interval, however, the true range of persons with piped water services from LWC is between 32 - 36%.

Boreholes, covered hand dug wells, and tap water (which is used by 91.57 % of the respondents) are the only sources that could be considered as improved or sanitary sources of water. Other sources such as streams and exposed hand dug wells (accounting for 8.13 % of the respondents’ sources of water) are considered ‘un-improved water sources’ due to the fact contaminants can easily be washed into them¹³. However, even the ‘safe’ sources of water should be approached with care because parts of Lagos such as Lekki, Badagary, Epe, and Ikorodu have typically loose and highly permeable soil, with average water table being as high as 3 m⁷. This makes ground water highly susceptible to pollution. Moreover, the high dependency on groundwater and the attendant withdrawal by millions of people make salt water intrusion a possible risk in the state. Furthermore, Jideonwo⁷ asserted 65 % of persons who have access to piped water sources do not use it for drinking purposes because of prevalent public distrust for quality. Rather, they drink what is known in local parlance as ‘pure water’, which is water packaged in 50 centiliter high density polyethylene sachets¹⁴. Judging by the report of a former director general of the national agency for food and drug administration control (NAFDAC), however, the so-called ‘pure water’ is not so pure as several samples tested for quality were found to contain faecal coliform and other forms of pollutants¹⁴. Evidence suggests that manufacturers of packaged water often source water from piped sources while marketing it as water which had been passed through other forms of filtration and treatment¹⁴.

Service provider

Fig.5 shows the distribution of the respondents according to water service providers. Some 60 % of

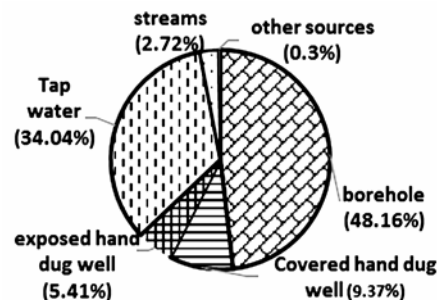


Fig. 4—Distribution of household by source of water

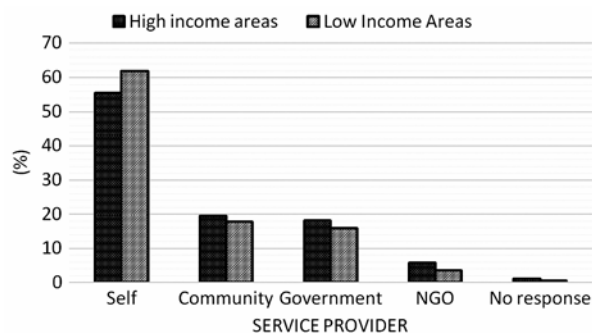


Fig. 5—Distribution of water service provider

the respondents said they were responsible for the provision of their domestic water. Using 95 % confidence interval, the true proportion of those who are responsible for supplying their own water in Lagos state will lie between 58 and 62 %. Similar trends were displayed in both high and low income neighborhoods.

Another identified water service provider was the community. That is, persons residing on the same street or a cluster of households sometimes collaborate to sink a borehole or hand dug well. This type of water service provision is patronized by 18.36 % of the respondents while those who rely on government utilities are just 16.63 % of the respondents. It could be noted that the proportion of respondents who rely on government utilities are those who have it as their sole source of water. Non-governmental organizations, which consist of religious organizations, social groups, corporate bodies and private individuals also provided 4.28 % of the respondents with water supply. The remaining 0.73 % of the respondents did not indicate any water service provider. In particular, it was observed that more than 82 % of the respondents in Mushin (a densely populated mainland LGA with predominant slum conditions) stated that they are responsible for the provision of their household water. The authors noted it will be difficult to extend public water or sanitation services to Mushin and similar peri-urban districts in Lagos due to the proliferation and indiscriminate erection of non-approved buildings. This may be the reason for the relatively high number of homes without access to public utilities. In Nigeria, 80 % of persons who live in urban centers live in un-planned settings¹¹. Applying this percentage to Lagos state could mean that over 16 million people live in places where it would be near impossible to provide appropriate water facilities for them, just by reason of unplanned settlements.

Lagos state has about 200 slums cities with some of them such as Ajegunle and Mushin having as many as 1 million residents^{7,9}. Connecting these areas to public water and sanitation infrastructure would be extremely difficult and expensive as some shelter and homesteads would need to give way in order to have a proper water and sanitation infrastructural network. In the same vein, results show that higher percentages of persons living in high income areas benefited more from public utilities and from collaborative efforts for water provision than persons living in low income areas (Fig. 5). Persons in the lower income group tended to depend more on self-service than people in the higher income brackets. This observed trend may equally be related to the level of compliance with city master plans in the peri-urban and highbrow neighborhoods.

At best, private investment in water services should be regulated. As an example, private property owners in Nigeria are known to site water sources and septic tanks and close proximity and indiscriminately¹⁵. Also, many self-water-service providers lose a lot of capital to quacks who sink failed wells. Research finding from Sokoto and Chad basins of northern Nigeria indicated that at least half of wells sunk in the area for agricultural and domestic uses failed². Also, similar incidences of failed wells were reported in south-western states of Nigeria².

Access to water source

A major source of sanitation problem arises when people find it difficult to access water. Studies have shown that an individual requires a minimum of 50-100 L of water per day⁴. Difficulties in accessing clean drinking water may place water stress on the affected people. Issues that may create water stress include distance to water source and costs related to procuring water.

Distance

Ideally, water sources should be found on the household premises. In the absence of this, however, the maximum specification to any source of domestic water supply was recommended to be 1 km or total travel time of 30 minutes^{4,16}. The distribution of the respondents show that more than 97 % of the respondents have water sources within the specified maximum distance of 1 km distance from their homesteads (Fig. 6). Using 95 % confidence interval, the true proportion of Lagos residents having water within 1 km distance of their homesteads will lie

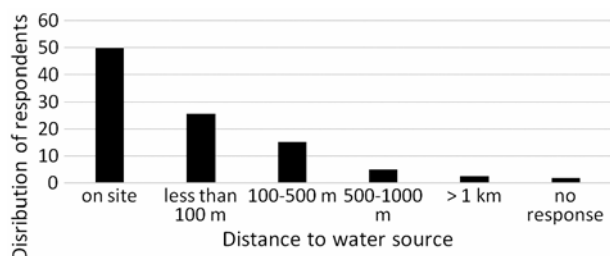


Fig. 6—Distance to water source

between 96 and 98 %. However, less than half of the residents have water on site. This gap necessitates many residents to search for water in other places such as community or NGO sponsored stand pipes, surface water bodies and other sources.

A further analysis of the data showed that 82.4 % of respondents in the low income LGAs had water sources within 100 m of their homesteads while only 57.4 of respondents in high income areas had water sources in their homes. This result is antithesis considering that high income earners would be expected to pay for convenience thereby securing water on-site. The poorest record of 53 % came from Lagos Island. A possible explanation for this could be the fact the elevation of Lagos Island area range between 2-7 m above sea level¹⁷. This is an indication of the susceptibility of the area to saltwater intrusion. In such cases, residents may resort to procuring freshwater from the mainland.

Costs

Like any other utility, accessing water has attendant costs. When this cost is exorbitant, persons may become impoverished. About 65 % of the respondents indicated that they paid to secure water while 35 % indicated that they paid nothing whatsoever to secure water. Similar to this, 68 % indicated that they incurred energy costs in the process of procuring water. Such costs are incurred through payments to public water services, fuels costs, payments to water tanker vendors, commercial borehole operators and packaged water vendors. The human right to water resolution⁴ specifies that household water expenses should not exceed 5 % of the household’s income. While the average household income may be difficult to determine, the poverty level in Nigeria is known. UN¹⁸ stated that 54.1 % of Nigerians can be classified as poor while USAID¹⁵ stated that more than half the population of Nigerians lives on less than US\$ 1 per day (or 200 Naira). Using this guidance, it means the average Nigerian is not expected to spend more than

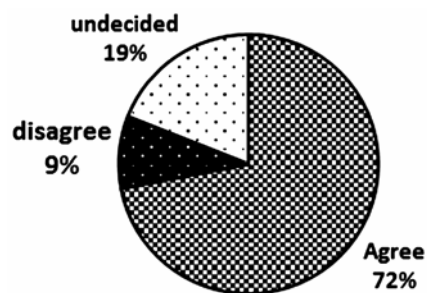


Fig. 7—Notion that government should be solely responsible for providing water for domestic use

US\$ 0.05 per day or US\$ 1.5 per month on water. However, Jideonwo⁷ reported that 80 % of the LWC customers receive flat rate bills regardless of quantity of water utilized. The flat rate bill as at 2014 was N5000 (or US\$ 25) per month. The same report also added that the informal sector charged at least 500 % the rate of LWC per month. Jideonwo⁷ estimated (data from metered LWC customers) that water is supplied at the rate of ₦0.05 /L (or US\$ 0.00025). ‘Pure water’, which is the alternative drinking water source patronized by most Nigerians cost an average of ₦20 /L (or US\$ 0.1) which is 40,000 % the cost of LWC supplied water, although many of the sachet water companies simply bag water coming from LWC. Research suggests that 60 million units of ‘pure water’ is consumed in Nigeria per day¹⁴. This translates to ₦ 600 million/day (or US\$ 3 million/day) being expended on ‘pure water’ only in Nigeria. The high patronage of ‘pure water’ is driven, however, by the inaccurate but pervasive perception of the wholesomeness of the product¹⁴.

Public perception

Who should be responsible for water services?

Public perception can be a very useful tool for receiving feedback regarding the attitude of users to the provided water services. When asked if they think government should be responsible for providing water to people, the true range of people who agreed was 70 – 74 % (at 95 % confidence interval). Also, 19 % were unsure while 9 % of the respondents disagreed that government ought to be responsible for providing them with water (Fig. 7). Although the United Nations human right resolution stated that states must make water available to users and that users should not be billed beyond 5 % of the household GDP, the high costs of making such services available cannot be ignored.

Therefore, the question of who funds the margin for water services is a vital one. In Lagos state, for instance, revenues recovered for water services covered just 2 % of the costs of making the service available⁷. The LWC^{7,19} reported widespread apathy towards payment of water bills by users. Many assume that since they pay taxes, they should be entitled to free water services while others simply make illegal connections to the utilities¹⁹. Thus, reasons why it is difficult to get revenue from water services provided by the LWC may range from relative poverty to the widespread belief that Government should solely fund water services. However, apathy towards payment for water services is an unrealistic notion as alternative funding has not been forthcoming from other sources. Available data shows that the Nigerian federal government expended an average of US\$0.30 per capita per annum on water resources between 2002 and 2011, while foreign aids over a period of 1996-2001 was US\$1.1 per capita². Additionally, data on the global funding of water projects reveal that more than half of all the funds were channeled to just 10 countries (mostly in Asia) while countries having more than 60 % of their residents without access to water got just 12 % of the funds^{2,20}. Needless to say, at the unsustainable rate of US\$ 0.00025/L (₦ 0.05/L), LWC currently provides the cheapest services for water supplied.

Should users pay for water services?

In the face of high costs of alternative water providers who charged between 500–40, 000 % of the rate by LWC, respondents were asked if they would be willing to pay for the marginal costs of public piped water services should the government be able to make water regularly available to residents. Slight more than half of the respondents agreed to pay for such services while, 40 % disagreed and 6 % were undecided (Fig. 8). This suggests that if the decision were left to the general population alone, water service projects may never succeed.

Can you rate the performance of government with respect to provision of water services?

When asked if they think the government has failed in its duty of providing water to the populace, nearly two-thirds of the respondents agreed, while 27 % either disagreed or were undecided (Fig. 9).

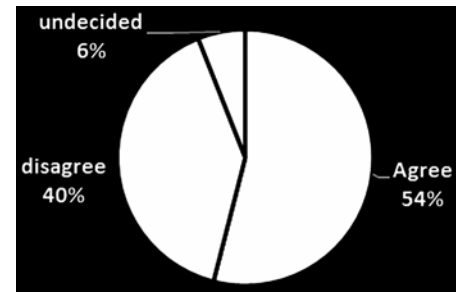


Fig.8—Willingness to pay for services rendered should government provide water for domestic use

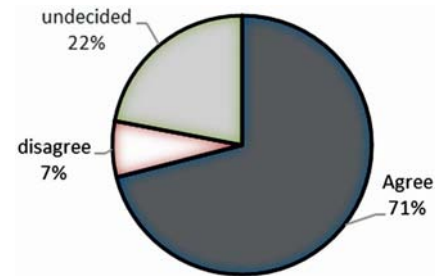


Fig. 9—Notion that government has failed to perform its responsibility in the provision of water

Conclusion

Way forward

From the foregoing, it is evident that urgent action needs to be taken to arrest the current trend in Lagos state whereby millions of people are without access to water. Even when the fund for water production is available, connecting households to water utilities are difficult, given the disregard for city master plans and the indiscriminate erection of buildings across the state. Lagos residents are paying a steep price for this impasse as many have had to travel varying distances to obtain water which may not be potable enough for drinking purposes. Also, it is obvious that LWC is not being operated sustainably. If this situation is left unchecked, future generations will be compelled to pay a much steeper price because of the rate of population growth in the state. Thus, the best solution for the state may be a painful one. The authors believe that the urgent solution to the water supply impasse in Lagos state is not necessarily the injection of huge sums of funds but the adoption of a drastic approach to enforcing a change of attitude among the residents and among water agency personnel through a cocktail of advocacy programs, regulations enforcement, incentives for compliance with set rules, and source protection of water resources. For instance, the production rate of 210 MGD of LWC which currently reaches an average 34 % of the state residents can be extended to reach more than 50 % of

the residents if the 60 - 83 % water losses currently being incurred by the corporation is saved and appropriately channeled through the execution of well-informed action plans.

Lessons from case studies

Like Lagos state, New York City is a fast growing city with a high influx of migrants and a high population density. When it was discovered that sophisticated water treatment was needed, the initial reaction was to inject US\$ 6 billion into the construction of a treatment plant which would further cost US\$ 150 million in annual maintenance costs³. However, the city's water planners opted for the alternative whereby the city's natural source of water was protected from upstream pollution, especially the kind arising from septic system siting, through enactment and enforcement of appropriate regulations. They also monitored and regulated adjacent farms effluents discharge as well as took steps to acquire lands where activities on them can disrupt water quality. Further, best practices were encouraged among water agency personnel by developing capacity and funding their activities. As a result, the New York reputedly has the largest unfiltered and quality surface water resource in the world. Treatment costs account for as much as half the costs of daily water supply costs¹⁹. Thus, this innovative action saved New York City billions of US\$ in current and recurrent costs.

Again, South Africa's *Phiri* community in Soweto, one of the biggest slums in the world, was awarded 42 L/capita/day supply of water by an action of the court⁴. The mandatory supply of water was determined based on the poverty level in the community, the prevalence of HIV/AIDS and the attendant need for sanitation. Also, consideration of the financial capacity of the agency responsible for the provision of water (city of Johannesburg municipal authority) was factored into the decision of the court. The mandatory 42 L was however enforced through an automatic shut-off meter system. Anything in excess of this amount had to be paid for by the users.

In Belgian Flemish region, residents are also guaranteed a minimum amount of free water supply per day⁴. This service is however available only to those who had paid the connection fee. They were also required to make additional payments for any volume of water in excess of the free allocation.

Recommendations

1. Lagos state Government needs to acquire some properties that are sitting on water utilities and along future expansion pathways. The illegal acts of constructions outside of the city's master-plan should not be condoned²¹. Although as many as 80 % of Lagos residents may be living in unapproved settlements and relocation of all defaulters may be impossible, sections of these areas would still need to be acquired to make room for the installation of water and sanitary infrastructures.
2. It must be mandatory and legally binding for all homes to have appropriate sanitary systems whereby household wastes are channeled to clusters of septic systems designed to protect piped water utilities. Also, the city planners must be proactive and ensure future constructions projects are not allowed to take off without proper and prior approval. It is clear that funds may not be forthcoming from either international donor agencies or the federal government. Therefore, the LWC remains the best option for water supply to Lagos residents. Rather than funding more expansion projects, priority must be placed on creating order in the metropolis.
3. Capacity must be developed among water agency personnel. Efforts should be directed at ensuring that an efficient metering system backed by a sound database is developed and made to apply to all users for proper records and planning purposes. Just like it is practiced in South Africa's *Phiri* community and Belgian Flemish region, certain quantity of water may be made available free of charge to residents. However, any amount over and above the stipulated minimum must be metered and paid for by the users⁴. This minimum amount of water may be the lower limit of 50 L / capita per day as specified by WHO¹⁶. Modern water reticulations systems can detect when there is a leakage in the system through pressure changes. Alternatively, geographic information systems (GIS) may also be deployed to detect areas of faulty connection. The LWC must invest in this sort of technologies as it is practically impossible to visually monitor every meter length of the pipe systems in the state.
4. Offenders such as vandals and illegal connectors must be regarded as economic saboteurs and treated as such. Nigeria has several legal

provisions that address this problem however, implementation has been lax¹³. Investments in law enforcement agencies for the proper implementation of applicable laws will prove to be a cheaper option in the long run than continued loss of valuable water resources to wastages and theft occasioned by unscrupulous persons.

5. The state Government must summon sufficient political will to tackle graft among its political elite as well as the public officials. When all fiscal wastages are plugged, more funds will be available for serving the needs of people.
6. The state Government should equally realize that leaving residents with unchecked power to withdraw water from groundwater sources without any form of regulation is risky to public health and the environment in general. At the same time, completely taking away the groundwater option from the people will be disastrous at the moment considering it is the most subscribed alternative water source for millions of people. A form of compromise has to be reached in determining how groundwater resources are used. Licenses for groundwater exploitation must be given in consideration alongside sanitary matters to prevent groundwater pollution. The Government also has the responsibility of identifying source surface and groundwater water and the protection of the same. All the rivers that feed the LWC come from adjacent state of Ogun⁷. The Lagos state government should be proactive in tracking and protecting all the feeder watersheds.
7. Advocacy programs are needed to enlighten the public toward the health risks and economic losses associated with vandalization of public utilities, patronization of packaged water as an alternative source as well as indiscriminate constructions and discharge of domestic wastes into the environment.

When the people are brought in as partners in progress, the current situation in Lagos would improve. Likewise, when the sources of wastages and losses are brought to the barest minimum, expansion projects would become easier to implement and sustain.

Acknowledgement

The authors recognize Covenant University for the use of space and resources. The anonymous reviewer

is also commended for the thorough and detailed contributions that made this work richer.

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