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# A TECHNICAL ASSESSMENT OF WATER SUPPLY QUALITY AND DISTRIBUTION IN THREE LOCAL GOVERNMENT AREAS OF LAGOS STATE, NIGERIA

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**Abstract**

The study was carried out to assess the technical problems associated with the sources, quality and quantity of drinking water supplies in Agege, Ifako/Ijaiye and Alimosho Local Government Areas (LGAs) of Lagos State, Nigeria. It was also conducted to find out the extent of water contaminations, from various sources, being consumed by residents of the LGAs studied and also to proffer solutions to reduce their effects. Households participation was involved it was revealed that about 35% of respondents use borehole, 25% obtained water from communal taps and 16% from well water. Individual house tap accounted for 11%, 9% from water vendors and 4% of the respondents employed water tankers. Chlorination was the most employed treatment technique while few others boil water before drinking. An average of 50 litres was the water use per capita. 50-100 meters was obtained as the average distance between respondents' residence and water sources. The survey showed that some of these sources were sited near soakaways, some co-existing with tombs, dirty drains and water logged environment. Twelve water samples were examined for analysis on chemical and biological properties. Results obtained however showed that all chemical properties analyzed are within recommended standards for drinking water. *Salmonella spp*. was also not detected in any of the samples.

## 1. Introduction

Despite huge amount of money that was invested in water supply during the United Nations International Drinking Water Supply and Sanitation Decade (IDWSSD, 1981-1990), over 2.4 billion people still do not have access to good quality water. It is also estimated that over 3 million children die each year of dehydration from diarrhoea caused mostly by unhygienic environmental conditions (UNICEF, 2000).

Governments of most developing countries try to provide conventional water supply system for both rural and urban dwellers. However, there are traces of evidence that most rural dwellers still lack good quality and adequate supply of this infrastructure, which result in out-break of water borne diseases (Mnase *et al*., 2001). Some urban centres in Nigeria are also without regular supply of pipe-borne water in which case alternative sources are sought to alleviate poor water supply condition. Boreholes, roof catchment system, shallow dug-wells, springs, streams and water vendors are some of other sources of water enjoyed by those dwellers. To meet required water demand in homes, storage is used to ensure continuous supply at all times (Mnase *et al*., 2001).

Despite all efforts by governmental and non-governmental organizations in Nigeria to make life worth living, some areas still lack major amenities for proper daily activities' needs. These areas are tagged poor urban, rural urban or sub-urban (Mnase *et al*., 2001).

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A study was carried out in Agege, Ifako/Ijaiye and Alimosho LGAs to assess the drinking water quality. The three LGAs where this study was carried out exhibit two characteristics, namely:-

(i) Sub-urban features such as high population density, poor housing, inadequate water supply, poor sewage and drainage facility and irregular clearance of garbage. Some houses are temporary structures, often built from range of materials such as iron sheet, mud blocks, woods and sometimes cement blocks. Their living pattern is surely different from those in the urban areas who are characterized with a concentration of people who depend totally on incomes derived from non-agricultural pursuits.

(ii) Poor urban features that is exposed to a lot of social dangers emanating from poor environment and inadequate supply of good water. These dangers include poor health, bad roads which are as a result of continuous erosion since most areas do not have proper drainage plan execution. Others include drudgery due to long period of fetching water and probably inappropriate means of transportation (Mnase *et al*., 2001).

A pre-study survey was conducted on selected few Health Centres and Medical homes in the three LGAs. The record for the year 2001 revealed that there were about 500 reported cases of water related diseases. Typhoid was found to be so common among the reported cases. The objectives of this study were:

(1) to investigate the sources and uses of water supply and the distribution network in the selected Local government Areas (LGAs);
(2) to investigate technical problems associated with supply in the three LGAs;
(3) to recommend appropriate solutions based on the investigations.

## 2. Materials and method

Agege, Alimosho and Ifako/Ijaiye were chosen for the study; out of which Orile-Agege, Oko-Oba, Agbado-Casso, Abule-Egba, Alakuko, Akowonjo, Iju-Ishaga, Ekoro, and Idimu were chosen to carry our household investigations. The study was conducted from three different perspectives: The first was an investigation on several sources of water available in the study areas including the three water works that were supposed to be supplying water to these areas which were visited. They were:

(1) Iju major water works (IJW), situated at Ifako-Ijaiye LGA.
(2) Agege Mini Water Works (AMW), in Agege LGA,
(3) Idimu Micro Water Works (IW), in Alimosho LGA.

Investigations carried out on them include; the sources of water, water treatment procedure, quality of water pumped out to dwellers, quantity produced by each water works and finally problems associated with distribution of treated water. Other sources of water supply studies were selected boreholes and wells, streams and Rivers within the areas.

The second perspective was administering questionnaires. In this, about 300 copies of the questionnaires were distributed throughout the study areas. It was distributed at 100 copies per LGA. To achieve this, houses were sampled within location for data collection. In

addition informal interviews, personal observations were also used to determine hygienic behaviour and to assess general environmental sanitation conditions.
The last perspective of the study was conducted as a laboratory analysis on some water samples collected from the three major sources in all the locations. Samples were randomly taken from communal taps, boreholes and wells. These wells are those highly fetched by dwellers. Four water samples were taken in each LGA and compared with the existing standards. The samples were collected in very clean plastic bottles which were thoroughly washed and rinsed with distilled water. Each bottle measured approximately 100ml. The pH values were measured the day the samples were collected so as to ensure accurate results. Parameters sought from water analysis included, pH, Total Dissolved Solids (TDS), hardness, Sodium (Na), potassium (K), Calcium (Ca), lead (Pb), Cadmium (Cd), Iron (Fe), Chloride ($Cl^-$), Manganese (Mn), Total Count plate, Coliform total and *Salmonella* spp.

## 3. Results and discussion

### *3.1 Public water supply*

The results of investigation in water treatment plants which supply water to the study areas revealed that three water works are situated in these areas which supply water to various parts of the state. They are: (i) Iju Water Works (IJW) which is also the main treatment plant that supplies water to all areas of Lagos State and it is the second largest throughout the State after Adiyan major Water Works which is not part of the study in this paper. IJW supplies about 160.325 million litres/day. (ii) Agege Mini Water Works (AMW) and, (iii) Adimu Micro Water Works (IM). The sources of water for the water works and their capacities are found in Table 1.

**Table 1: Sources and quantity of water supplied by each water scheme**

| PLANT | SOURCES OF WATER | CAPACITY |
|---|---|---|
| IJW | Iju/Ogun river | 160.325 million litres/day |
| AMW | Underground | 9.4625 million litres/day |
| IMW | Underground | 3.785 million litres/day |

Iju Water Scheme has two intake channels; Ogun Intake 1 and Ogun Intake 2. Intake 1 pumps from five outlets: three at 1105 $m^3$/h each and the other two at 1130 $m^3$/h. Intake 2 has 3 outlets each at 2240 $m^3$/h. Water treatment techniques for the water works are as shown in Table 2.

**Table 2: Treatment techniques employed in each water scheme**

| PLANT | TREATMENT TECHNIQUE |
|---|---|
| IJW | Sedimentation, filtration, liming, chlorination |
| AMW | Aeration, filtration, disinfection (Chlorination) |
| IMW | Aeration, filtration, disinfection (Chlorination) |

From Table 1, IJW produces 160 million litres of water per day, out of which about 20% is supplied to the study areas per day. Total supply of water to study areas is then; 20% of IJW + AMW daily production + IMW daily production. This is about 42.3125 million litres/day. From 1991 census by the National Population Commission and from Wendell Cox Consultant (2001), the population figures obtained for Agege, Alimosho and Ifako/Ijaiye were 417,966, 430,890 and 328,397 respectively. With a projected increase of 20% for every five years (NPC, 1996), the projected population of the three LGA combined was 1,733,342. This gives a per capita consumption of 26.14 litres/head/day. The recommended per capita consumption for developing countries is 100 litres/head/day (Umoh, 1984). Therefore, the quantity of water supplied to these LGA (26.14litres/head/day) is very small. This is responsible for the inhabitants seeking other sources of water supply.

As a result of high turbidity level in water from Ogun river, it was discovered from treatment laboratory at Iju Water Works that it required a lot of treatment input and techniques. Clarification was done to remove colour. This was achieved by addition of alum as water passes through the plant flash mixer. Water with high turbidity easily coagulates small flux to bigger flux that settle down easily. Filtration came next as water passed through sets of graded sand, then liming, to reduce acidity and aggressiveness that could result from addition of alum. At this stage a pH level of 6.8 to 8.2 was achieved as recommended by WHO (1984). Finally, chlorination was introduced to remove contaminations in the water. A Chlorine residual content of about 0.4mg/l was allowed to maintain a good level of disinfection as water passed through pipes to various consumers.

AMW and IMW have a number of tube wells popularly called boreholes. Information pertaining to this showed that the two plants were initiated to boost water produced by Adiyan and Iju Water Works which are the major water schemes in the state. It was expressed that supply from the two stations was erratic since water comes from a constant aquifer and continuous tapping of underground water from the source were suspected to have led to reduction in the water level. The underground water which characteristics depended on soil properties was observed to be cleaner than surface water. With information given at both schemes, the major treatments carried out were aeration and disinfection. Water was pumped from wells into reservoirs, where it was oxidized. Oxidized Fe was then filtered out by compartmentalized filters. The water was then chlorinated and supplied to the mains from IJW.

### *3.2 Questionnaire and interview*

Seven sources of water supply to households in the study areas were considered for this survey work. These are given in Table 3. Out of all sources studied, borehole was the most employed, followed by communal tap, then well. Rainwater was generally accepted and used but it did not form a regular source because of its seasonality. About 66.7% of the respondents were female, meaning that women are more involved in water supply activities than men irrespective of age. This same trend was reported by Sangodoyin (1993). However, a number of respondents that used a particular source could not be ascertained because a single person or household was engaged in two or more sources of water for different purposes. There were cases of individuals who used tap water for drinking and well water for other domestic purposes.

**Table 3: Number of respondents using different sources of water in the three LGAs**

| SOURCES | LGAs | | |
|---|---|---|---|
| | AGEGE | IFAKO/IJAIYE | ALIMOSHO |
| Borehole | 31 | 41 | 32 |
| Communal tap | 26 | 22 | 27 |
| Well | 18 | 12 | 18 |
| Individual tap | 11 | 13 | 9 |
| Vendor | 9 | 8 | 10 |
| Tanker | 5 | 4 | 4 |
| Rain Water | - | - | - |

Result of water used per head showed that about 90% of the respondents used less than 100 litres of watrer. About 11.7% use between 10-20 litres, 34.3% use between 20-50 litres of water (Table 4). This did not meet up with WHO standard. The average per capita consumption of water per day for unsophisticated society is 100 litres and up to 500 litres for industrialized society or where irrigated agriculture is practiced (Umoh, 1984).

**Table 4: Quantity of water used per person per day**

| QUANTITY (Litres) | SAMPLE POPULATION | PERCENTAGE ( %) |
|---|---|---|
| <10 | 9 | 3 |
| 10-20 | 35 | 11.7 |
| 20-50 | 103 | 34.3 |
| 50-100 | 123 | 41 |
| >100 | 30 | 10 |

Data pertaining to distance from source of water to respondents houses revealed 53% of respondents live between 50-500 metres from their major sources of water (Table 5), though about 35% live within a radius of 50 metres from the source of water but the erratic nature of supplies led to less consumption per day due to multiple and costly attempts of fetching water (i.e by families, and water vendors).

**Table 5: Distance from Water Sources**

| DISTANCE (Metres) | NO. OF RESPONDENTS | PERCENTAGE (%) |
|---|---|---|
| 0-50 | 106 | 35.3 |
| 50-100 | 147 | 49 |
| 100-500 | 43 | 14.3 |
| >500 | 4 | 1.4 |

Respondents showed a low treatment attitude to procured water. Only two treatment techniques out of five studied were recorded. Boiling was carried out by 12 respondents while chlorination was practiced by 21, most of which have residential or personal wells. This is shown in Table 6. The table also shows that 33 respondents out of a sample population of 300 do treat water before consumption. The use of buckets and drums was

found to be moderately high and common among respondents as shown in Table 7. Storage facilities and water use could be linked with economic or financial status of respondents. Storage and overhead tanks were used by respondents who use motorized boreholes or wells and sometimes individual taps.

**Table 6: Treatment Techniques Practiced**

| TREATMENT METHOD | NO. OF RESPONDENTS |
|---|---|
| Heating | 12 |
| Adding of Alum | - |
| Settling | - |
| Chlorination | 21 |
| Filtration | - |

**Table 7: Storage Facilities being used by Respondents**

| STORAGE ITEM | NO. OF RESPONDENTS |
|---|---|
| Storage Tanks | 22 |
| Drums | 105 |
| Kegs | 78 |
| Buckets | 121 |
| Overhead Tanks | 18 |

***3.3 Water quality tests***

The chemical and biological properties of the water samples collected from the three LGAs are shown in Tables 8, 9 and 10. It was found that they were within the 1984 recommended WHO standards. All the samples did not contain cadmium. The average value of the pH was 6.8 in Ifako/Ijaiye and 6.9 in Agege and Alimosho.

Except for potassium, the contents of all the parameters measured were higher in the borehole water samples than in the tap water samples. For the potassium, the mean value was 4mg/l as against 6mg/l in the tap water samples as shown in Tables 8 to 10. Boreholes in Agege and Alimosho had the highest pH values. Borehole water in Ifako was the only sample that indicated presence of cadmium (0.01/mg/l) which lies within safe recommended standard for drinking.

Well samples indicated highest content of tested parameters out of all sources surveyed. It has a reasonably high concentration of calcium, manganese, lead and hardness. The result in the tables indicate that it is the most unsafe of all the analyzed samples though the values obtained still lie within recommended drinking water standards.

**Table 8: Result of Water Test in Agege LGA**

| Parameter | TAP | AGG1 | AGG2 | WELL |
|---|---|---|---|---|
| Sodium (mg/l) | 82 | 105 | 110 | 102 |
| Pastassium (mg/l) | 6 | 4 | 4.0 | 4 |
| Calcium (mg/l) | 3 | 10 | 9.0 | 18 |
| Lead (mg/l) | 01 | 0.03 | 0.03 | 0.03 |
| Cadmium (mg/l) | ND | ND | ND | 0.01 |
| Hardness (mg.l) | 200 | 350 | 360 | 380 |
| PH | 6.9 | 7.5 | 7.8 | 7.4 |
| Iron (mg/l) | 0.10 | 0.19 | 0.21 | 0.18 |
| Chloride (mg/) | 260 | 320 | 320 | 480 |
| Total Dissolved Solids (TDS) | 26 | 28 | 30 | 31 |
| Manganese (mg/l) | 0.48 | 0.52 | 0.61 | 0.72 |
| Total Plate Count (100 cfu/ml) | 5.00 | 8.00 | 8.00 | 10.00 |
| Coliform Total | Nil | Nil | 0.02 | 0.03 |
| Salmonella spp. | Nil | Nil | Nil | Nil |

AGG1 and AGG2 are the two borehole water samples taken in Agege LGA.
ND = Not Detected.

**Table 9: Result of Water Test in Ifako/Ijaiye LGA**

| Parameters | TAP | IFJ1 | IFJ2 | WELL |
|---|---|---|---|---|
| Sodium (mg/l) | 80 | 96 | 104 | 110 |
| Potassium (mg/l) | 6 | 3 | 4 | 5 |
| Calcium (mg/l) | 3 | 16 | 16 | 22 |
| Lead (mg/l) | 0.01 | 0.01 | 0.02 | 0.03 |
| Cadmium (mg/l) | ND | 0.01 | 0.01 | ND |
| Hardness (mg/l) | 205 | 300 | 360 | 390 |
| PH | 6.8 | 7.2 | 7.4 | 7.5 |
| Iron (mg/l) | 0.1 | 0.15 | 0.18 | 0.19 |
| Chloride (mg/l) | 264 | 450 | 420 | 430 |
| Total Dissolved Solids (TDS) | 25 | 30 | 29 | 28 |
| Manganese (mg/l) | 0.47 | 25 | 0.27 | 0.4 |
| Total Plate Count (100 cfu/ml) | 5.0 | 10 | 7 | 30 |
| Coliform Total | NIL | NIL | NIL | NIL |
| Salmonella spp. | NIL | NIL | NIL | NIL |

IFJI and IFJ2 are the two borehole water samples taken in Ifako/Ijaiye LGA
ND = Not Detected.

**Table 10: Result of Water Test in Alimosho LGA**

| Parameters | TAP | IFJ1 | IFJ2 | WELL |
|---|---|---|---|---|
| Sodium (mg/l) | 82 | 93 | 92 | 90 |
| Potassium (mg/l) | 6 | 4 | 4 | 5 |
| Calcium (mg/l) | 4 | 12 | 18 | 16 |
| Lead (mg/l) | 0.01 | 0.02 | 0.01 | 0.02 |
| Cadmium (mg/l) | ND | ND | ND | ND |
| Hardness (mg/l) | 198 | 240 | 260 | 300 |
| PH | 6.9 | 7.9 | 7.8 | 7.8 |
| Iron (mg/l) | 0.1 | 0.15 | 0.12 | 0.19 |
| Chloride (mg/l) | 264 | 450 | 470 | 470 |
| Total Dissolved Solids (TDS) | 26 | 27 | 28 | 32 |
| Manganese (mg/l) | 0.48 | 0.55 | 0.58 | 0.6 |
| Total Plate Count (100 cfu/ml) | 5 | 20 | 10 | 28 |
| Coliform Total | NIL | NIL | NIL | 0.05 |
| Salmonella spp. | NIL | NIL | NIL | NIL |

AKM1 and AKM2 are the two borehole water samples in Alimosho LGA
ND = Not Detected.

Results in the tables further reveal that there were lower pH values in the tap water compared to wells. This was traced to their sodium content where it was discovered that there was a direct variation between the two parameters. An increase in the quantity of sodium in each sample directly indicates an increase in pH. A progressive rise in calcium from tap water to boreholes and well water was also traced to treatment of public water. Calcium content in tap water was 3mg/l in Agege and Ifako/Ijaiye and 4mg/l in Alimosho samples. It was 9mg/l and 22mg/l in boreholes and wells respectively. This was also due to the presence of manganese in the samples.

As reported by NYC DEP (2002), presence of iron in water does not necessarily mean that it is unfit for drinking; it is also present in various foods and drinks. Though a small rise in iron content was noticed in untreated water samples, the level of iron concentration obtained does not pose a threat to humans if used for consumption. Total coliform counts show presence of coliform in borehole 2 and well samples in Alimosho as shown in Table 10, while total plate content were higher in well water than in other sources.

*Possible sources of infections*

The results of the assessment show that all samples of water from the various sources in the study area did not signify any harmful level of contaminations. The question is how do people contract some of the water borne infections noticed in the pre-study survey? Interactions with respondents show that water is sometimes drawn from wells with dirty containers, sometimes the containers are tied with muddy ropes. Some individuals were also seen collecting water from burst pipes. They arranged this by digging under burst pipes for easy access to collect the water. These methods of obtaining water rather than the qualities of the water may be responsible for the contamination of the water leading to infection.

## 4. Conclusions

Facilities available to Lagos State Water Corporation (LSWC) can produce higher quantity of water than provided during the study period if all water plants work. This will reduce the hectic effort of getting safe water. At least Agege and Alimosho LGAs services would improve if Idimu plant and Agege mini plant work at their maximum capacities. From the results of tested samples, it was observed that all the samples that represent major sources of water for consumption are fit for human consumption. Water from LSWC has the least chemical and bacteriological contents which means it is the safest source among the samples tested. Results from the household interviews indicate that majority of the respondents do not treat the water from other sources adequately before use and therefore, mass education in this regard is necessary for the people in the three LGAs studied.

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